



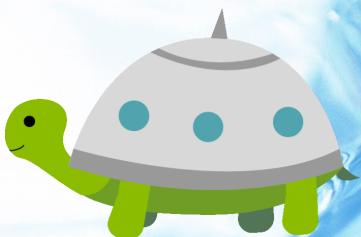
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## GATE Overflow for GATECSE

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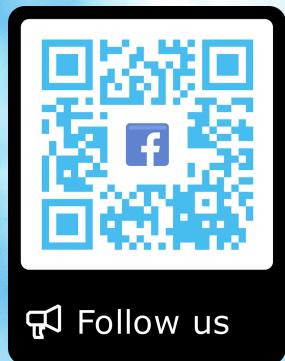


GATE Overflow Team  
led by

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*Computer Science & IT*





Start Date - 6th June 2021



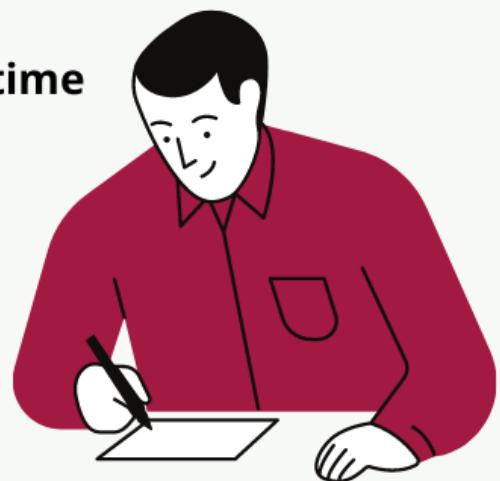
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## 1

## Discrete Mathematics: Combinatory (44)



**Syllabus:** Combinatorics: Counting, Recurrence relations, Generating functions.

Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
1 Mark Count	1	0	0	2	1	0	0	1	0	0	0.55	2
2 Marks Count	0	1	1	0	1	0	1	2	1	0	0.77	2
Total Marks	1	2	2	2	3	0	2	5	2	0	2.11	5

## 1.1

Balls In Bins (3) top ↗1.1.1 Balls In Bins: GATE CSE 2002 | Question: 13 top ↗<https://gateoverflow.in/866>

- a. In how many ways can a given positive integer  $n \geq 2$  be expressed as the sum of 2 positive integers (which are not necessarily distinct). For example, for  $n = 3$ , the number of ways is 2, i.e.,  $1 + 2, 2 + 1$ . Give only the answer without any explanation.
- b. In how many ways can a given positive integer  $n \geq 3$  be expressed as the sum of 3 positive integers (which are not necessarily distinct). For example, for  $n = 4$ , the number of ways is 3, i.e.,  $1 + 2 + 1, 2 + 1 + 1$  and  $1 + 1 + 2$ . Give only the answer without explanation.
- c. In how many ways can a given positive integer  $n \geq k$  be expressed as the sum of  $k$  positive integers (which are not necessarily distinct). Give only the answer without explanation.

gate2002-cse combinatorial normal descriptive balls-in-bins

Answer

1.1.2 Balls In Bins: GATE CSE 2003 | Question: 34 top ↗<https://gateoverflow.in/924>

$m$  identical balls are to be placed in  $n$  distinct bags. You are given that  $m \geq kn$ , where  $k$  is a natural number  $\geq 1$ . In how many ways can the balls be placed in the bags if each bag must contain at least  $k$  balls?

- A.  $\binom{m-k}{n-1}$
- B.  $\binom{m-kn+n-1}{n-1}$
- C.  $\binom{m-1}{n-k}$
- D.  $\binom{m-kn+n+k-2}{n-k}$

gate2003-cse combinatorial balls-in-bins normal

Answer

1.1.3 Balls In Bins: GATE IT 2004 | Question: 35 top ↗<https://gateoverflow.in/3678>

In how many ways can we distribute 5 distinct balls,  $B_1, B_2, \dots, B_5$  in 5 distinct cells,  $C_1, C_2, \dots, C_5$  such that Ball  $B_i$  is not in cell  $C_i$ ,  $\forall i = 1, 2, \dots, 5$  and each cell contains exactly one ball?

- A. 44
- B. 96
- C. 120
- D. 3125

gate2004-it combinatorial normal balls-in-bins

Answer

## Answers: Balls In Bins

**1.1.1 Balls In Bins: GATE CSE 2002 | Question: 13** [top](#)<https://gateoverflow.in/866>

a.  $n = 2(1+1), n = 3(1+2, 2+1), n = 4(1+3, 3+1, 2+2), n = 5(1+4, 4+1, 2+3, 3+2)$

so  $x_1 + x_2 = n$  and  $x_1, x_2 > 0$  (no.of integral sol)

This is same as number of ways of putting  $(n-2)$  (as we can't have 0 for either  $x_1$  or  $x_2$ ) identical balls into two distinct bins, which is obtained by putting a divider across  $(n-2)$  balls and taking all possible permutations with  $(n-2)$  being identical. i.e.,  $\frac{(n-2+1)!}{(n-2)!} = (n-1)$ .

We can also use the following formula ,

$$(n-2+2-1)C_{(2-1)} = {}^{n-1}C_1.$$

b.

$n = 3(1+1+1), n = 4(1+1+2, 1+2+1, 2+1+1), n = 5(1+1+3, 1+3+1, 3+1+1, 2+2+1, 2+1)$   
so  $x_1 + x_2 + x_3 = n$  and  $x_1, x_2, x_3 > 0$  (no.of integral sol)

Here, we can permute  $(n-3)$  items with 2 dividers which will give  $\frac{(n-3+2)!}{(n-3)!2!}$

$$= \frac{(n-1)!}{(n-1-2)!2!}$$

$$= {}^{n-1}C_2$$

c.  $(n-k+k-1)C_{k-1} = {}^{n-1}C_{k-1}.$

43 votes

-- Supromit Roy (633 points)

**1.1.2 Balls In Bins: GATE CSE 2003 | Question: 34** [top](#)<https://gateoverflow.in/924>

✓ As there have to be at least  $k$  balls in each bag, so firstly put  $k$  balls in each bag i.e.,  $(k * n)$  balls.

Now, we have total  $(m - k * n)$  balls remaining.

We can use balls & sticks method now !

$n$  bags =  $n$  variables, they need to be equal to  $(m - k * n)$ , no restrictions on how many balls in each bag !

$$x_1 + x_2 + \dots + x_n = (m - k * n), x_1, x_2, \dots, x_n \geq 0.$$

On solving, we get

$$C(m - k * n + n - 1, n - 1) = C(m - k * n + n - 1, m - k * n)$$

Correct Answer: B

41 votes

-- Akash Kanase (36k points)

**1.1.3 Balls In Bins: GATE IT 2004 | Question: 35** [top](#)<https://gateoverflow.in/3678>

Derangement : arrangement where no element is in its designated position

Number of derangement can be calculated easily using the principle of mutual exclusion and inclusion (<http://math.mit.edu/~fox/MAT307-lecture04.pdf>)

In this question, we take the designated position of ball  $B_i$  as  $C_i$ .

We need to find all possible arrangements where **no**  $B_i$  is in its designated cell  $C_i$ .

Lets take 5 arrangements for positions 1, 2, 3, 4 and 5 where, in each of them, one element is in its designated position and denote them as  $S_i$ .

1	x	x	x	x
$\rightarrow S_1$				

$|S_1| = 4!$  as the other 4 balls can be arranged in  $4!$  ways inside  $S_1$

Similarly, we have  $S_2$  which is the arrangement of all balls with  $B_2$  in its designated position.

x	2	x	x	x
$\rightarrow S_2$				

We have  $|S_2| = 4!$  similar to  $|S_1|$  and likewise  $|S_i| = 4!$ .

We have total number of non-derangement =  $|S_1 \cup S_2 \cup S_3 \cup S_4 \cup S_5|$

According to the principle of [Mutual Inclusion and Exclusion](#),

$$|S_1 \cup S_2 \cup S_3 \cup S_4 \cup S_5| = \Sigma |S_i| - \Sigma |S_i \cap S_j| + \Sigma |S_i \cap S_j \cap S_k| - \dots \rightarrow (A)$$

$|S_1 \cap S_2|$  = number of arrangements where  $B_1$  and  $B_2$  are in their designated positions.

1	2	x	x	x
---	---	---	---	---

This can be done in  $3!$  ways.

Similarly all the other two intersections,  $|S_i \cap S_j| = 3!$  and three intersections,  $|S_i \cap S_j \cap S_k| = 2!$  and similarly all.

Substituting in equation (A),

$$|S_1 \cup S_2 \cup S_3 \cup S_4 \cup S_5| = 5 \times 4! - \binom{5}{2} \times 3! + \binom{5}{3} \times 2! - \binom{5}{4} \times 1! + \binom{5}{5} \times 0! = 76 \quad (\text{equals number of non derangements})$$

Derangements = all arrangements - non derangements

$$= 5! - 76 = 44$$

Correct Answer: A

References



43 votes

-- junk\_mayavi (3k points)

## 1.2

### Combinatory (21) top ↗

#### 1.2.1 Combinatory: GATE CSE 1989 | Question: 4-i top ↗

→ <https://gateoverflow.in/87874>



How many substrings (of all lengths inclusive) can be formed from a character string of length  $n$ ? Assume all characters to be distinct, prove your answer.

gate1989 descriptive combinatory normal proof

Answer ↗

#### 1.2.2 Combinatory: GATE CSE 1990 | Question: 3-iii top ↗

→ <https://gateoverflow.in/84060>



The number of rooted binary trees with  $n$  nodes is,

- A. Equal to the number of ways of multiplying  $(n+1)$  matrices.
- B. Equal to the number of ways of arranging  $n$  out of  $2n$  distinct elements.
- C. Equal to  $\frac{1}{(n+1)} \binom{2n}{n}$ .
- D. Equal to  $n!$ .

gate1990 normal combinatory catalan-number multiple-selects

Answer ↗

#### 1.2.3 Combinatory: GATE CSE 1990 | Question: 3-ix top ↗

→ <https://gateoverflow.in/84841>



The number of ways in which 5  $A'$ s, 5  $B'$ s and 5  $C'$ s can be arranged in a row is:

- A.  $15!/(5!)^3$
- B.  $15!$
- C.  $\binom{15}{5}$
- D.  $15!(5!3!)$ .

gate1990 | normal | combinatoric | multiple-selects

Answer 

#### 1.2.4 Combinatory: GATE CSE 1991 | Question: 02-iv

<https://gateoverflow.in/514>



Match the pairs in the following questions by writing the corresponding letters only.

A.	The number of distinct binary tree with n nodes.	P.	$\frac{n!}{2}$
B.	The number of binary strings of the length of $2n$ with an equal number of 0's and 1's	Q.	$\binom{3n}{n}$
C.	The number of even permutation of n objects.	R.	$\binom{2n}{n}$
D.	The number of binary strings of length $6n$ which are palindromes with $2n$ 0's.	S.	$\frac{1}{1+n} \binom{2n}{n}$

gate1991 | combinatoric | normal | match-the-following

Answer 

#### 1.2.5 Combinatory: GATE CSE 1991 | Question: 16,a

<https://gateoverflow.in/543>



Find the number of binary strings  $w$  of length  $2n$  with an equal number of 1's and 0's and the property that every prefix of  $w$  has at least as many 0's as 1's.

gate1991 | combinatoric | normal | descriptive | catalan-number

Answer 

#### 1.2.6 Combinatory: GATE CSE 1998 | Question: 1.23

<https://gateoverflow.in/1660>



How many sub strings of different lengths (non-zero) can be formed from a character string of length  $n$ ?

- A.  $n$
- B.  $n^2$
- C.  $2^n$
- D.  $\frac{n(n+1)}{2}$

gate1998 | combinatoric | normal

Answer 

#### 1.2.7 Combinatory: GATE CSE 1999 | Question: 1.3

<https://gateoverflow.in/1457>



The number of binary strings of  $n$  zeros and  $k$  ones in which no two ones are adjacent is

- A.  ${}^{n-1}C_k$
- B.  ${}^nC_k$
- C.  ${}^nC_{k+1}$
- D. None of the above

gate1999 | combinatoric | normal

Answer 

#### 1.2.8 Combinatory: GATE CSE 1999 | Question: 2.2

<https://gateoverflow.in/1480>



Two girls have picked 10 roses, 15 sunflowers and 15 daffodils. What is the number of ways they can divide the flowers among themselves?

- A. 1638
- B. 2100
- C. 2640

- D. None of the above

gate1999 | combinatorial | normal

Answer 

### 1.2.9 Combinatory: GATE CSE 2000 | Question: 5 top ↴

<https://gateoverflow.in/676>



A multiset is an unordered collection of elements where elements may repeat any number of times. The size of a multiset is the number of elements in it, counting repetitions.

- What is the number of multisets of size 4 that can be constructed from n distinct elements so that at least one element occurs exactly twice?
- How many multisets can be constructed from n distinct elements?

gate2000-cse | combinatorial | normal | descriptive

Answer 

### 1.2.10 Combinatory: GATE CSE 2001 | Question: 2.1 top ↴

<https://gateoverflow.in/719>



How many 4-digit even numbers have all 4 digits distinct?

- A. 2240
- B. 2296
- C. 2620
- D. 4536

gate2001-cse | combinatorial | normal

Answer 

### 1.2.11 Combinatory: GATE CSE 2003 | Question: 4 top ↴

<https://gateoverflow.in/895>



Let  $A$  be a sequence of 8 distinct integers sorted in ascending order. How many distinct pairs of sequences,  $B$  and  $C$  are there such that

- each is sorted in ascending order,
- $B$  has 5 and  $C$  has 3 elements, and
- the result of merging  $B$  and  $C$  gives  $A$

- A. 2
- B. 30
- C. 56
- D. 256

gate2003-cse | combinatorial | normal

Answer 

### 1.2.12 Combinatory: GATE CSE 2003 | Question: 5 top ↴

<https://gateoverflow.in/896>



$n$  couples are invited to a party with the condition that every husband should be accompanied by his wife. However, a wife need not be accompanied by her husband. The number of different gatherings possible at the party is

- A.  ${}^{2n}C_n \times 2^n$
- B.  $3^n$
- C.  $\frac{(2n)!}{2^n}$
- D.  ${}^{2n}C_n$

gate2003-cse | combinatorial | normal

Answer 

1.2.13 Combinatory: GATE CSE 2004 | Question: 75 [top](#)<https://gateoverflow.in/1069>

Mala has the colouring book in which each English letter is drawn two times. She wants to paint each of these 52 prints with one of  $k$  colours, such that the colour pairs used to colour any two letters are different. Both prints of a letter can also be coloured with the same colour. What is the minimum value of  $k$  that satisfies this requirement?

- A. 9
- B. 8
- C. 7
- D. 6

[gate2004-cse](#) [combinatory](#)

Answer

1.2.14 Combinatory: GATE CSE 2007 | Question: 84 [top](#)<https://gateoverflow.in/1275>

Suppose that a robot is placed on the Cartesian plane. At each step it is allowed to move either one unit up or one unit right, i.e., if it is at  $(i, j)$  then it can move to either  $(i + 1, j)$  or  $(i, j + 1)$ .

How many distinct paths are there for the robot to reach the point  $(10, 10)$  starting from the initial position  $(0, 0)$ ?

- A.  ${}^{20}C_{10}$
- B.  $2^{20}$
- C.  $2^{10}$
- D. None of the above

[gate2007-cse](#) [combinatory](#)

Answer

1.2.15 Combinatory: GATE CSE 2007 | Question: 85 [top](#)<https://gateoverflow.in/43509>

Suppose that a robot is placed on the Cartesian plane. At each step it is allowed to move either one unit up or one unit right, i.e., if it is at  $(i, j)$  then it can move to either  $(i + 1, j)$  or  $(i, j + 1)$ .

Suppose that the robot is not allowed to traverse the line segment from  $(4, 4)$  to  $(5, 4)$ . With this constraint, how many distinct paths are there for the robot to reach  $(10, 10)$  starting from  $(0, 0)$ ?

- A.  $2^9$
- B.  $2^{19}$
- C.  ${}^8C_4 \times {}^{11}C_5$
- D.  ${}^{20}C_{10} - {}^8C_4 \times {}^{11}C_5$

[gate2007-cse](#) [combinatory](#) [normal](#) [discrete-mathematics](#)

Answer

1.2.16 Combinatory: GATE CSE 2014 Set 1 | Question: 49 [top](#)<https://gateoverflow.in/1929>

A pennant is a sequence of numbers, each number being 1 or 2. An  $n$ -pennant is a sequence of numbers with sum equal to  $n$ . For example,  $(1, 1, 2)$  is a 4-pennant. The set of all possible 1-pennants is  $(1)$ , the set of all possible 2-pennants is  $(2)$ ,  $(1, 1)$  and the set of all 3-pennants is  $(2, 1)$ ,  $(1, 1, 1)$ ,  $(1, 2)$ . Note that the pennant  $(1, 2)$  is not the same as the pennant  $(2, 1)$ . The number of 10-pennants is \_\_\_\_\_.

[gate2014-cse-set1](#) [combinatory](#) [numerical-answers](#) [normal](#)

Answer

1.2.17 Combinatory: GATE CSE 2015 Set 3 | Question: 5 [top](#)<https://gateoverflow.in/8399>

The number of 4 digit numbers having their digits in non-decreasing order (from left to right) constructed by using the digits belonging to the set  $\{1, 2, 3\}$  is \_\_\_\_\_.

[gate2015-cse-set3](#) [combinatory](#) [normal](#) [numerical-answers](#)

Answer

**1.2.18 Combinatory: GATE CSE 2019 | Question: 5** [top](#)<https://gateoverflow.in/302843>

Let  $U = \{1, 2, \dots, n\}$ . Let  $A = \{(x, X) \mid x \in X, X \subseteq U\}$ . Consider the following two statements on  $|A|$ .

- I.  $|A| = n2^{n-1}$
- II.  $|A| = \sum_{k=1}^n k \binom{n}{k}$

Which of the above statements is/are TRUE?

- A. Only I
- B. Only II
- C. Both I and II
- D. Neither I nor II

[gate2019-cse](#) [engineering-mathematics](#) [discrete-mathematics](#) [combinatory](#)

Answer

**1.2.19 Combinatory: GATE CSE 2020 | Question: 42** [top](#)<https://gateoverflow.in/333189>

The number of permutations of the characters in LILAC so that no character appears in its original position, if the two L's are indistinguishable, is \_\_\_\_\_.

[gate2020-cse](#) [numerical-answers](#) [combinatory](#)

Answer

**1.2.20 Combinatory: GATE IT 2005 | Question: 46** [top](#)<https://gateoverflow.in/3807>

A line  $L$  in a circuit is said to have a *stuck-at-0* fault if the line permanently has a logic value 0. Similarly a line  $L$  in a circuit is said to have a *stuck-at-1* fault if the line permanently has a logic value 1. A circuit is said to have a multiple *stuck-at* fault if one or more lines have stuck at faults. The total number of distinct multiple *stuck-at* faults possible in a circuit with  $N$  lines is

- A.  $3^N$
- B.  $3^N - 1$
- C.  $2^N - 1$
- D. 2

[gate2005-it](#) [combinatory](#) [normal](#)

Answer

**1.2.21 Combinatory: GATE IT 2008 | Question: 25** [top](#)<https://gateoverflow.in/3286>

In how many ways can  $b$  blue balls and  $r$  red balls be distributed in  $n$  distinct boxes?

- A.  $\frac{(n+b-1)! (n+r-1)!}{(n-1)! b! (n-1)! r!}$
- B.  $\frac{(n+(b+r)-1)!}{(n-1)! (n-1)! (b+r)!}$
- C.  $\frac{n!}{b! r!}$
- D.  $\frac{(n+(b+r)-1)!}{n! (b+r-1)!}$

[gate2008-it](#) [combinatory](#) [normal](#)

Answer

**Answers: Combinatory****1.2.1 Combinatory: GATE CSE 1989 | Question: 4-i** [top](#)<https://gateoverflow.in/87874>

✓ Lets take an example . lets consider the given string is {GATE}.

- So, set of string of length 1 = {G, A, T, E} ; cardinality of set = 4.
- Set of strings of length 2 = {GA, AT, TE}.

- Set of strings of length 3 = {GAT, ATE}.
- Set of strings of length 4 = {GATE}.
- Set of strings of length 0 = {}.

We cannot have any substring of length 5 as the given string has only 4 length.

So total no of substrings possible,

$$= 0 \text{ length substring} + 1 \text{ length substrings} + 2 \text{ length substrings} + 3 \text{ length substrings} + 4 \text{ length substrings.}$$

$$= (1 + 4 + 3 + 2 + 1).$$

This means for 1 length substring to  $n$  length substrings, count will sum of the  $n$  natural numbers from 1 to  $n$ .

$$= 1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}.$$

$$\text{So total no. of substrings possible} = 0 \text{ length strings} + \frac{n(n+1)}{2} = 1 + \left[ \frac{n(n+1)}{2} \right].$$

39 votes

-- Amit Pal (3k points)

### 1.2.2 Combinatory: GATE CSE 1990 | Question: 3-iii top ↴

► <https://gateoverflow.in/84060>



- ✓ Number of rooted binary trees (unlabeled) with  $n$  nodes is given by  $n^{\text{th}}$  Catalan number which equals  $\frac{2nC_n}{n+1}$ .

Here, both options  $A$  and  $C$  are true as option  $A$  corresponds to  $n$  multiply operations of  $n+1$  matrices, the number of ways for this is again given by the  $n^{\text{th}}$  Catalan number.

Ref: <https://math.stackexchange.com/questions/1630457/how-many-ways-to-multiply-n-matrices>

#### References



16 votes

-- Arjun Suresh (328k points)

### 1.2.3 Combinatory: GATE CSE 1990 | Question: 3-ix top ↴

► <https://gateoverflow.in/84841>



- ✓ (A) Use permutation with repetitions formula as we have to arrange 15 elements where 5 each are identical.

9 votes

-- NRN (293 points)

### 1.2.4 Combinatory: GATE CSE 1991 | Question: 02-iv top ↴

► <https://gateoverflow.in/514>



- A.  $-S$  Catalan number <https://gatecse.in/number-of-binary-trees-possible-with-n-nodes/>
- B.  $-R$  Choosing  $n$  locations for 0's out of  $2n$  locations. The remaining  $n$  locations are filled with 1's (no selection required).
- C.  $-P$  An even permutation is a [permutation](#) obtainable from an [even number](#) of two-element swaps, For a set of  $n$  elements and  $n > 2$ , there are  $n!/2$  even permutations.  
Ref - <http://mathworld.wolfram.com/EvenPermutation.html>

- D.  $-Q$

Length =  $6n$ , as it is palindrome, we need to select only the first half part of the string.

Total length to consider is  $3n$  (Remaining  $3n$  will be reverse of this  $3n$ )

Now, choose  $n$  0's out of  $3n$ . So **Q** is correct for **D**.

#### References



36 votes

-- Akash Kanase (36k points)

**1.2.5 Combinatory: GATE CSE 1991 | Question: 16,a** top [www.gateoverflow.in/543](https://gateoverflow.in/543)

- ✓ Answer to a is  $\frac{2nC_n}{(n+1)}$  which is the Catalan number.

This is also equal to the number of possible combinations of balanced parentheses.

See the 5<sup>th</sup> proof here [http://en.wikipedia.org/wiki/Catalan\\_number](http://en.wikipedia.org/wiki/Catalan_number)

**References**

32 votes

-- Arjun Suresh (328k points)

**1.2.6 Combinatory: GATE CSE 1998 | Question: 1.23** top [www.gateoverflow.in/1660](https://gateoverflow.in/1660)

- ✓ Assuming in the string of length  $n$  provided, all alphabets are distinct.

No. of strings of length 1 =  $n$

No. of strings of length 2 =  $(n - 1)$

No. of strings of length 3 =  $(n - 2)$

⋮

No. of strings of length  $n$  = 1

Hence, total no. of strings =  $n + (n - 1) + (n - 2) + (n - 3) + \dots + 1$

$$= \frac{n(n+1)}{2}$$

Correct Answer: D

37 votes

-- Digvijay (44.9k points)

**1.2.7 Combinatory: GATE CSE 1999 | Question: 1.3** top [www.gateoverflow.in/1457](https://gateoverflow.in/1457)

- ✓ Answer is (D)

First place  $n$  zeroes side by side \_ 0 \_ 0 \_ 0 ... 0 \_

$k$  1's can be placed in any of the  $(n + 1)$  available gaps.

Hence, number of ways =  ${}^{n+1}C_k$

53 votes

-- Ankit Rokde (6.9k points)

**1.2.8 Combinatory: GATE CSE 1999 | Question: 2.2** top [www.gateoverflow.in/1480](https://gateoverflow.in/1480)

- ✓ For each flower type, say there are  $n$  number of flowers. We apply star and bars method for each flower type.  $n$  flowers of a type will generate  $(n + 1)$  spaces we just need to place one bar which will separate them into 2 for the two girls. To do that we need to select a position:

For roses:  ${}^{10+1}C_1$

For sunflowers:  ${}^{15+1}C_1$

For daffodils:  ${}^{15+1}C_1$

Total number of ways distribution can take place =  $11 \times 16 \times 16 = 2816$ .

Correct Answer: D

39 votes

-- Amar Vashishth (25.2k points)

Answer - D

Number of ways roses can be distributed =  $\{(0, 10), (1, 9), (2, 8), \dots, (10, 0)\}$  - 11 ways

Similarly, sunflowers and daffodils can be distributed in 16 ways each

So, total number of ways =  $11 \times 16 \times 16 = 2816$ .

39 votes

-- Ankit Rokde (6.9k points)

**1.2.9 Combinatorics: GATE CSE 2000 | Question: 5** <https://gateoverflow.in/676>

- ✓ A. There are four places to be filled in the multiset using the  $n$  distinct elements. At least one element has to occur exactly twice. That would leave 2 more places in the multiset. This means, at most two elements can occur exactly twice. We can thus divide this into 2 mutually exclusive cases as follows:

1. Exactly one element occurs exactly twice:
2. Select this element in  $n$  ways.

Fill up the remaining two spots using 2 distinct elements from the remaining  $n - 1$  elements in  $^{(n-1)}C_2$  ways.

Exactly two elements that occur twice each: These two will fill up the multiset.

So, we only have to select two elements out of  $n$  in  $^nC_2$  ways.

Since, these are mutually exclusive, the total number of ways to form the multiset is:  $^nC_2 + n \cdot {}^{(n-1)}C_2$ .

B. There are infinite number of sets as  $n$  is unbounded. ( $\because$  size of multiset is not given)

ref: <http://cs.stackexchange.com/questions/7578/multisets-of-a-given-set>

**References**

24 votes

-- Pranay Datta (7.8k points)

**1.2.10 Combinatorics: GATE CSE 2001 | Question: 2.1** <https://gateoverflow.in/719>

- If the number ends with a 0 then there are 9 choices for the first digit, 8 for the second and 7 for the third, which makes  $1 \times 9 \times 8 \times 7 = 504$  possibilities.
- If the number is even ending with something else than 0 then there are 4 choices for the last digit, 8 choices for the first digit (no 0 nor the last digit), 8 for the second digit and 7 for the third digit, which makes  $4 \times 8 \times 8 \times 7 = 1792$

Together, this gives 2296 numbers with 4 distinct digits that are even. Note that this does not allow leading 0, as you see to want it based from the question.

Correct Answer: **B**

58 votes

-- yallasrikanthreddy (257 points)

**1.2.11 Combinatorics: GATE CSE 2003 | Question: 4** <https://gateoverflow.in/895>

- ✓ If you pick any 3 numbers in the given order from the array(sorted) remaining 5 elements are already sorted. You can not change the relative position of those 5 elements because they are distinct and already sorted. So no of ways  $= {}^8C_3$ .

Same argument holds for picking up 5 elements initially. No of ways  $= {}^8C_5$ .

Correct Answer: **C**

44 votes

-- Debashish Deka (40.7k points)

**1.2.12 Combinatorics: GATE CSE 2003 | Question: 5** <https://gateoverflow.in/896>

- ✓ Possible outcome for a couple:

1. only wife comes
2. both husband and wife come
3. neither husband nor wife comes

Thus 3 possibilities for each couple, so  $\underbrace{3 \times 3 \times 3 \times \dots \times 3}_{n \text{ times}} = 3^n$

Correct Answer: **B**

70 votes

-- Palash Nandi (1.2k points)

**1.2.13 Combinatory: GATE CSE 2004 | Question: 75** [→ https://gateoverflow.in/1069](https://gateoverflow.in/1069)

- ✓ This question is slightly ambiguous. So, first, let us understand what the question is asking. So in a book, we have letters A to Z and each letter is printed twice, so there are 52 letters. Now we have to color each letter, so we need a pair of colors for that because each letter is printed twice. Also in a pair, both colors can be the same. Now the condition is that a pair of colors can't be used more than once.

So, suppose Mala has 3 colors : Red, Blue, Green.

She can color as follows :

1. (Red, Red)
2. (Blue, Blue)
3. (Green, Green)
4. (Red, Blue)
5. (Red, Green)
6. (Blue, Green)

Now we don't have more pairs of colors left, we have used all pairs, but could color only 6 letters out of 26. So, question is to find minimum no. of colors, so that we could color all 26 letters.

So, if Mala has  $k$  colors, she can have  $k$  pairs of the same colors, thus coloring  $k$  letters, then  ${}^k C_2$  other pairs of colors, thus coloring  ${}^k C_2$  more letters.

$$\text{So, total no. of letters colored} = k + \binom{k}{2} = k + k \left( \frac{k-1}{2} \right) = k \left( \frac{k+1}{2} \right).$$

$$\text{So, we want } k \left( \frac{k+1}{2} \right) \geq 26 \text{ i.e. } k(k+1) \geq 52 \implies k \geq 7.$$

So, option (C) is correct.

Ref: [http://www.cse.iitd.ac.in/~mittal/gate/gate\\_math\\_2004.html](http://www.cse.iitd.ac.in/~mittal/gate/gate_math_2004.html)

#### References



73 votes

-- Anu (4.7k points)

**1.2.14 Combinatory: GATE CSE 2007 | Question: 84** [→ https://gateoverflow.in/1275](https://gateoverflow.in/1275)

In ques given,  $r$  = Move Right and  $u$  = Move Up  
so using 10 combination of  $r$  and 10 combinations of  $u$  moves we get a solution.

Convert the graphical moves to text and one such solution we get,

$$= \{u, u, u, u, u, u, u, u, r, r, r, r, r, r, r, r\}$$

$$\text{now all possible arrangements of them is given by } = \frac{20!}{10! \times 10!} = \binom{20}{10}.$$

Hence, option A is true.

76 votes

-- Amar Vashishth (25.2k points)

**1.2.15 Combinatory: GATE CSE 2007 | Question: 85** [→ https://gateoverflow.in/43509](https://gateoverflow.in/43509)

- ✓ Say,  $r$  = Move Right and  $u$  = Move Up  
so using 10 combination of  $r$  and 10 combinations of  $u$  moves we get a solution.

Convert the graphical moves to text and one such solution we get,

$$= \{u, u, u, u, u, u, u, u, r, r, r, r, r, r, r, r\}$$

$$\text{now all possible arrangements of them is given by } = \frac{20!}{10! \times 10!} = \binom{20}{10}$$

now we need to discard the segment move from (4, 4) to (5, 4):

to do that we first calculate how many solutions to our problem to reach (10, 10) involves that segment.

We'll then subtract those solutions from the total number of solutions.

Number of solutions to reach from  $(0, 0)$  to  $(4, 4)$ ,  
 = all possible arrangements of  $\{r, r, r, r, u, u, u, u\}$   
 $= \frac{(4+4)!}{4! \times 4!} = \binom{8}{4}$

definitely we take the segment  $(4, 4)$  to  $(5, 4) = 1$ .

now, Number of solutions to reach from  $(5, 4)$  to  $(10, 10)$ ,  
 = all possible arrangements of  $\{r, r, r, r, r, u, u, u, u, u\}$   
 $= \frac{(6+5)!}{6! \times 5!} = \binom{11}{5}$

so required number of solutions for Q.85 is given by **option D**  
 i.e.  $= \binom{20}{10} - \binom{8}{4} \times 1 \times \binom{11}{5}$

68 votes

-- Amar Vashishth (25.2k points)

### 1.2.16 Combinatory: GATE CSE 2014 Set 1 | Question: 49 [top](#)



- ✓ Let us denote number of  $n$ -pennants by  $f(n)$ , so  $f(10)$  is number of 10-pennants.

A 10-pennant means sum of numbers in sequence is 10. If we look at any 9-pennant, we can make it a 10-pennant by adding 1 into that sequence. Similarly, we can make any 8-pennant a 10-pennant by adding 2 into that sequence.

So all 10-pennants can be formed by 8-pennants and 9-pennants, and no other pennant (since we can add only 1 or 2 into a sequence)

So  $f(10) = f(9) + f(8)$

This is in fact a Fibonacci sequence, in which  $f(1) = 1, f(2) = 2$ , so this sequence becomes

1, 2, 3, 5, 8, 13, 21, 34, 55, 89...

So  $f(10) = 89$ .

102 votes

-- Happy Mittal (8.2k points)

Numbers could be any one of

$\{(1, 1, 1, 1, 1, 1, 1, 1, 1, 1), (1, 1, 1, 1, 1, 1, 1, 1, 2), (1, 1, 1, 1, 1, 1, 2, 2), (1, 1, 1, 1, 2, 2, 2), (1, 1, 2, 2, 2, 2), (2, 2, 2, 2, 2)\}$

So, the number of 10 pennants  $= 1 + \frac{9!}{8!} + \frac{8!}{6!2!} + \frac{7!}{4!3!} + \frac{6!}{2!4!} + 1 = 89$ .

129 votes

-- srestha (85k points)

### 1.2.17 Combinatory: GATE CSE 2015 Set 3 | Question: 5 [top](#)



- ✓ We can arrive at a solution by constructing a graph for each starting digit. For example root 3 means - starting with 3 it can have 3 children 1, 2, 3 and the construction goes.

3 can have three children 1, 2, 3

2 can have two children 1, 2

1 can have only 1 as child.

Graph need to be done till four levels as we need 4 digits and we have 3 such graphs starting with 3, 2 and 1. And finally count the total number of leaves of all the graphs gives our answer as 15.

77 votes

-- Sankaranarayanan P.N (8.6k points)

## Dynamic Programming Approach

	1 digit	2 digits	3 digits	4 digits
Starting 3	1	1	1	1
Starting 2	1	2	3	4
Starting 1	1	3	6	10

Here Starting 1 means numbers starting with 1. And cell  $(i, j)$  is for number of numbers starting with  $i$  and having  $j$  digits.  
We can have the relation

$$c(i, j) = \sum_{k=1}^i c(k, j-1)$$

as per the non-decreasing condition given in the question. So, our answer will be

$$c(1, 4) + c(2, 4) + c(3, 4) = 1 + 4 + 10 = 15$$

### Brute force

- 3 3 3 3
- 2 2 2 2
- 2 2 2 3
- 2 2 3 3
- 2 3 3 3
- 1 1 1 1
- 1 1 1 2
- 1 1 1 3
- 1 1 2 2
- 1 1 2 3
- 1 1 3 3
- 1 2 2 2
- 1 2 2 3
- 1 2 3 3
- 1 3 3 3

60 votes

-- Arjun Suresh (328k points)

### 1.2.18 Combinatory: GATE CSE 2019 | Question: 5

<https://gateoverflow.in/302843>



✓ Option C: Both are correct.

$$|\{X \mid X \subset U\}| = \binom{n}{0} + \binom{n}{1} + \binom{n}{2} + \cdots + \binom{n}{n} = 2^n$$

Now  $x$  can be any element of the individual subset  $X$ .

$$\text{So } |A| = \binom{n}{0} \times 0 + \binom{n}{1} \times 1 + \binom{n}{2} \times 2 + \cdots + \binom{n}{n} \times n = n \cdot 2^{n-1}$$

Note here that for the case when our chosen subset is empty ( $X = \emptyset$ ), we don't have any member  $x \in X$ , and hence the term  $\binom{n}{0} \times 0$  is correct.

**Proof that**  $\sum_{k=1}^n k \times \binom{n}{k} = n \cdot 2^{n-1}$

We have the Binomial Expansion:

$$(1+x)^n = \binom{n}{0} x^0 + \binom{n}{1} x^1 + \binom{n}{2} x^2 + \cdots + \binom{n}{n} x^n$$

Differentiating both sides w.r.t  $x$ , we get,

$$n(1+x)^{n-1} = \binom{n}{1} + 2 \times \binom{n}{2} x + \cdots + n \times \binom{n}{n} x^{n-1}$$

Put  $x = 1$  to get

$$n \times 2^{n-1} = \binom{n}{1} + 2 \times \binom{n}{2} + \cdots + n \times \binom{n}{n}$$

Q.E.D.

23 votes

-- Ruturaj Mohanty (3.2k points)

**1.2.19 Combinatory: GATE CSE 2020 | Question: 42** <https://gateoverflow.in/333189>

✓ We have LILAC.

Lets number the positions as 1, 2, 3, 4, 5. Now the two *L*s cannot be placed at position 1 and 3 but they can be positioned at 2, 4, 5 in  ${}^3C_2 = 3$  ways. (since the *L*s are indistinguishable)

Now one of 2, 4, 5 is vacant. Without loss of generality lets say 2 is vacant.

Now, if 2 is vacant we can't place *I* there but we can place any of *A*, or *C*, so we have 2 choices for the position which is left after filling the two *L*s. Now all of 2, 4, 5 are filled.

For the remaining two places 1, 3 we have two characters left and none of them is *L* so we can place them in  $2! = 2$  ways.

Multiply them all  $= {}^3C_2 * 2 * 2! = 3 * 2 * 2 = 12$  (ans).

32 votes

-- mkagenius (915 points)

**1.2.20 Combinatory: GATE IT 2005 | Question: 46** <https://gateoverflow.in/3807>

✓ Answer should be  $3^N - 1$ .

**Explanation:**

The total possible combinations (i.e., a line may either be at fault (in 2 ways i.e stuck at fault 0 or 1) or it may not be, so there are only 3 possibilities for a line ) is  $3^N$ .

In only one combination the circuit will have all lines to be correct (i.e not at fault.)

Hence  $3^N - 1$  (as it has been said that circuit is said to have multiple stuck up fault if one or more line is at fault)

96 votes

-- Afaque Ahmad (727 points)

**1.2.21 Combinatory: GATE IT 2008 | Question: 25** <https://gateoverflow.in/3286>

✓  $r$  red balls can be distributed into  $n$ -distinct boxes in  $C(n + r - 1, r) = \frac{(n+r-1)!}{(n-1)!r!}$

$b$  blue balls can be distributed in  $C(n + b - 1, b) = \frac{(n+b-1)!}{(n-1)!b!}$

By product rule total ways are  $\frac{(n+b-1)!(n+r-1)!}{(n-1)!b!(n-1)!r!}$

SO THE ANSWER IS (A).

51 votes

-- Madhu Veluguri (219 points)

**1.3****Counting (3)** **1.3.1 Counting: GATE CSE 1994 | Question: 1.15** <https://gateoverflow.in/2458>

The number of substrings (of all lengths inclusive) that can be formed from a character string of length  $n$  is

- A.  $n$
- B.  $n^2$
- C.  $\frac{n(n-1)}{2}$
- D.  $\frac{n(n+1)}{2}$

[gate1994](#) [combinatory](#) [counting](#) [normal](#)

Answer

**1.3.2 Counting: GATE CSE 2021 Set 1 | Question: 19** <https://gateoverflow.in/357432>

There are 6 jobs with distinct difficulty levels, and 3 computers with distinct processing speeds. Each job is assigned to a computer such that:

- The fastest computer gets the toughest job and the slowest computer gets the easiest job.
- Every computer gets at least one job.

The number of ways in which this can be done is \_\_\_\_\_.

[gate2021-cse-set1](#) [combinatory](#) [counting](#) [numerical-answers](#)

Answer 

### 1.3.3 Counting: GATE CSE 2021 Set 2 | Question: 50 [top](#)

<https://gateoverflow.in/357487>



Let  $S$  be a set of consisting of 10 elements. The number of tuples of the form  $(A, B)$  such that  $A$  and  $B$  are subsets of  $S$ , and  $A \subseteq B$  is \_\_\_\_\_

[gate2021-cse-set2](#) [combinatory](#) [counting](#) [numerical-answers](#)

Answer 

## Answers: Counting

### 1.3.1 Counting: GATE CSE 1994 | Question: 1.15 [top](#)

<https://gateoverflow.in/2458>



- Number of substrings of length  $n$  is 1.
- Number of substrings of length  $(n - 1)$  is 2.
- Number of substrings of length  $(n - 2)$  is 3.

So, total number of substrings =  $\frac{n(n+1)}{2}$ .

Correct Answer: D.

 27 votes

-- Bhagirathi Nayak (11.7k points)

### 1.3.2 Counting: GATE CSE 2021 Set 1 | Question: 19 [top](#)

<https://gateoverflow.in/357432>



- ✓ Let  $C_1$  be the fastest and  $C_3$  be the slowest computers.

These two are assigned two jobs. Now out of the remaining 4 jobs we need to ensure  $C_2$  gets at least 1. Without this constraint we can assign 4 jobs to 3 computers in  $3^4 = 81$  ways. Out of these 81 ways  $2^4 = 16$  will be having no jobs for  $C_2$ .

So, number of possible ways so that  $C_2$  gets at least one job =  $81 - 16 = 65$ .

 15 votes

-- Arjun Suresh (32.8k points)

### 1.3.3 Counting: GATE CSE 2021 Set 2 | Question: 50 [top](#)

<https://gateoverflow.in/357487>



- ✓ Let's find general solution i.e. when  $|S| = n$

#### Method 1 :

We want the ordered pairs  $(A, B)$  where  $(A \subseteq S, B \subseteq S; A \subseteq B;)$

For every element  $x$  of set  $S$ , we have three choices :

- Choice 1 :  $x \notin A$  and  $x \notin B$
- Choice 2 :  $x \notin A$  and  $x \in B$
- Choice 3 :  $x \in A$  and  $x \in B$

So, for each element we have 3 choices, and we have  $n$  elements. So, answer will be  $3^n$ .

So, for the given question, answer will be  $3^{10} = 59049$

NOTE : This method is nice and can be used to solve a wide variety of problems/variations very easily and in less time.

For example, Try the following variations :

**Variation 1 :** Find the number of ordered triples  $(A, B, C)$  where  $(A, B, C \subseteq S; A \subseteq B \subseteq C;)$

Answer : For every element  $x$  of set  $S$ , we have 4 choices. So,  $4^n$

**Variation 2 :** Find the number of ordered triples  $(A, B, C)$  where  $(A, B, C \subseteq S; A \subseteq B \supseteq C;)$

Answer : For every element  $x$  of set  $S$ , we have 5 choices. So,  $5^n$

**Variation 3 :** Find the number of ordered triples  $(A, B, C)$  where  $(A, B, C \subseteq S; A \subseteq B; A \subseteq C;)$

Answer : For every element  $x$  of set  $S$ , we have 5 choices. So,  $5^n$

**Variation 4 :** Find the number of ordered triples  $(A, B)$  where  $(A, B \subseteq S; A \cap B = \emptyset)$

Answer : For every element  $x$  of set  $S$ , we have 3 choices. So,  $3^n$

Many more questions can be easily solved by this method, so it is good to practice it.

### Method 2 :

If we make ordered pairs  $(A, B)$  where  $(A \subseteq S, B \subseteq S; A \subseteq B;)$  such that  $A$  has  $k$  elements in it then for  $B$  we have  $2^{(n-k)}$  possible choices. (Because those  $k$  elements of  $A$  must be present in  $B$  so there is no choice for them But for each of the remaining  $n - k$  elements of  $S$ , we have 2 choices for each element)

For example, if  $A = \{a_1, a_2\}$  then how many supersets are possible for  $A$ ?

There will be  $2^{n-2}$  supersets of  $A$ .

So the number of ordered pairs  $(A, B)$  where  $(A \subseteq S, B \subseteq S; A \subseteq B;)$  that we have :

We can divide it into cases :

When  $|A| = 0$  OR  $|A| = 1$  OR  $|A| = 2$  OR ...  $|A| = n$

When  $|A| = 0$ , there is only one such  $A$  is possible, that is  $A = \emptyset$ , So, number of possible  $B$ 's =  $2^n$ ; So total  $(A, B)$  pairs in this case will be  $1 \times 2^n$

When  $|A| = 1$ , there are  ${}^nC_1$  such  $A$  possible, So, for each possible  $A$ , the number of possible  $B$ 's =  $2^{n-1}$ ; So total  $(A, B)$  pairs in this case will be  ${}^nC_1 \times 2^{n-1}$

When  $|A| = 2$ , there are  ${}^nC_2$  such  $A$  possible, So, for each possible  $A$ , the number of possible  $B$ 's =  $2^{n-2}$ ; So total  $(A, B)$  pairs in this case will be  ${}^nC_2 \times 2^{n-2}$

and so on,

When  $|A| = n$ , there are  ${}^nC_n = 1$  such  $A$  possible, So, for each possible  $A$ , the number of possible  $B$ 's =  $2^{n-n} = 2^0$ ; So, total  $(A, B)$  pairs in this case will be  ${}^nC_n \times 2^0$

We want total possible pairs  $(A, B)$  so we can add all the above cases :

$${}^nC_0 \times 2^n + {}^nC_1 \times 2^{n-1} + {}^nC_2 \times 2^{n-2} + \dots + {}^nC_n \times 2^0$$

This is binomial expansion of  $(1 + 2)^n = 3^n$

So, for the given question, answer will be  $3^{10} = 59049$

3 votes

-- Deepak Poonia (23k points)

## 1.4

### Generating Functions (5) top

#### 1.4.1 Generating Functions: GATE CSE 1987 | Question: 10b top

<https://gateoverflow.in/82451>



What is the generating function  $G(z)$  for the sequence of Fibonacci numbers?

gate1987 | combinatorics | generating-functions | descriptive

Answer

#### 1.4.2 Generating Functions: GATE CSE 2005 | Question: 50 top

<https://gateoverflow.in/1175>



Let  $G(x) = \frac{1}{(1-x)^2} = \sum_{i=0}^{\infty} g(i)x^i$ , where  $|x| < 1$ . What is  $g(i)$ ?

- A.  $i$
- B.  $i + 1$
- C.  $2i$
- D.  $2^i$

gate2005-cse | normal | generating-functions

Answer

#### 1.4.3 Generating Functions: GATE CSE 2016 Set 1 | Question: 26 top

<https://gateoverflow.in/39693>



The coefficient of  $x^{12}$  in  $(x^3 + x^4 + x^5 + x^6 + \dots)^3$  is \_\_\_\_\_.

[gate2016-cse-set1](#) [combinatory](#) [generating-functions](#) [normal](#) [numerical-answers](#)

Answer 

#### 1.4.4 Generating Functions: GATE CSE 2017 Set 2 | Question: 47 [top](#)

▪ <https://gateoverflow.in/118392>



If the ordinary generating function of a sequence  $\{a_n\}_{n=0}^{\infty}$  is  $\frac{1+z}{(1-z)^3}$ , then  $a_3 - a_0$  is equal to \_\_\_\_\_.

[gate2017-cse-set2](#) [combinatory](#) [generating-functions](#) [numerical-answers](#) [normal](#)

Answer 

#### 1.4.5 Generating Functions: GATE CSE 2018 | Question: 1 [top](#)

▪ <https://gateoverflow.in/204075>



Which one of the following is a closed form expression for the generating function of the sequence  $\{a_n\}$ , where  $a_n = 2n + 3$  for all  $n = 0, 1, 2, \dots$ ?

- A.  $\frac{3}{(1-x)^2}$
- B.  $\frac{3x}{(1-x)^2}$
- C.  $\frac{2-x}{(1-x)^2}$
- D.  $\frac{3-x}{(1-x)^2}$

[gate2018-cse](#) [generating-functions](#) [normal](#) [combinatory](#)

Answer 

### Answers: Generating Functions

#### 1.4.1 Generating Functions: GATE CSE 1987 | Question: 10b [top](#)

▪ <https://gateoverflow.in/82451>



✓ Assuming Fibonacci Sequence as:-

1, 1, 2, 3, 5, 8, 13, ...

So, sequence  $a_n = 1, 1, 2, 3, 5, 8, 13, \dots$  where,  $n = 0, 1, 2, 3, \dots$

Now, The Generating Function for the sequence  $a_n$  of real numbers is defined as:

$$G(z) = \sum_{n=0}^{\infty} a_n z^n$$

So, For the given Fibonacci Series :-

$$\Rightarrow G(z) = 1 + z + 2z^2 + 3z^3 + 5z^4 + 8z^5 + 13z^6 + \dots + f_n z^n + \dots \rightarrow (1)$$

Now , Shift one position right and multiply by 'z' :-

$$\Rightarrow zG(z) = z + z^2 + 2z^3 + 3z^4 + 5z^5 + 8z^6 + \dots \rightarrow (2)$$

Now, Shift one more position right and multiply by 'z' :-

$$\Rightarrow z^2 G(z) = z^2 + z^3 + 2z^4 + 3z^5 + 5z^6 + 8z^7 + \dots \rightarrow (3)$$

Now, Add Equation (2) and Equation (3):-

$$\Rightarrow zG(z) + z^2 G(z) = z + 2z^2 + 3z^3 + 5z^4 + 8z^5 + 13z^6 + \dots$$

$$\Rightarrow zG(z) + z^2 G(z) = G(z) - 1 \quad [:\text{From equation (1)}]$$

$$\Rightarrow G(z) - zG(z) - z^2 G(z) = 1$$

$$\Rightarrow G(z) = \frac{1}{1-z-z^2}$$

So, Generating Function for the given Fibonacci Series is :-

$$G(z) = \frac{1}{1-z-z^2} = 1 + z + 2z^2 + 3z^3 + 5z^4 + 8z^5 + 13z^6 + \dots + f_n z^n$$

Now , To get the Closed-Form Expression, We have to find the coefficient of  $z^n$  i.e.  $f_n$  in the given Generating Function for the given Fibonacci Sequence.

$$\text{Let, } \frac{1}{1-z-z^2} = \frac{-1}{z^2+z-1} = \frac{-1}{(z-\alpha)(z-\beta)}$$

$$\Rightarrow z^2 + z - 1 = (z - \alpha)(z - \beta)$$

$$\implies z^2 + z - 1 = z^2 - (\alpha + \beta)z + \alpha\beta$$

On Comparing Coefficients :  $-\alpha + \beta = -1$  and  $\alpha\beta = -1$

$$\text{Since , } (\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta = (-1)^2 + 4 = 5$$

$$\text{So, } \alpha + \beta = -1 \text{ and } \alpha - \beta = \pm\sqrt{5}$$

On Solving these 2 equations , We get :-

$$\alpha = \frac{-1 \pm \sqrt{5}}{2} \text{ and } \beta = \frac{-1 \mp \sqrt{5}}{2}$$

Let's take only one solution for the further calculations :-

$$\text{So, Consider , } \alpha = \frac{-1 + \sqrt{5}}{2} \text{ and } \beta = \frac{-1 - \sqrt{5}}{2}$$

Now, By Using Partial Fractions,

$$\frac{-1}{(z-\alpha)(z-\beta)} = \frac{A}{(z-\alpha)} + \frac{B}{(z-\beta)}$$

$$\implies -1 = A(z - \beta) + B(z - \alpha)$$

$$\implies -1 = (A + B)z - (A\beta + B\alpha)$$

$$\text{So, } A = -B \text{ and } A\beta = 1 - B\alpha$$

On solving these 2 equations , We get ,

$$A = \frac{1}{\beta - \alpha} \text{ and } B = \frac{-1}{\beta - \alpha}$$

Now , after putting the values of  $\alpha$  and  $\beta$  , We get

$$A = \frac{-1}{\sqrt{5}} \text{ and } B = \frac{+1}{\sqrt{5}}$$

Now, on putting all these values in the original equation, we get ,

$$\frac{1}{1-z-z^2} = \frac{-1}{z^2+z-1} = \frac{-1}{(z-\alpha)(z-\beta)} = \frac{A}{(z-\alpha)} + \frac{B}{(z-\beta)} = \frac{-1}{\sqrt{5}} \frac{1}{(z-\alpha)} + \frac{1}{\sqrt{5}} \frac{1}{(z-\beta)}$$

$$\implies \frac{1}{1-z-z^2} = \frac{-1}{\sqrt{5}} \frac{1}{(z-\alpha)} + \frac{1}{\sqrt{5}} \frac{1}{(z-\beta)} = \frac{1}{\sqrt{5}} \frac{1}{(\alpha-z)} - \frac{1}{\sqrt{5}} \frac{1}{(\beta-z)}$$

$$\text{So, } G(z) = \frac{1}{1-z-z^2} = \frac{1}{\sqrt{5}\alpha} \frac{1}{(1-(\frac{1}{\alpha})z)} - \frac{1}{\sqrt{5}\beta} \frac{1}{(1-(\frac{1}{\beta})z)}$$

Now,

If  $G(z) = \frac{1}{1-az}$  , Then Coefficient of  $z^n = a^n$

So, here , Coefficient of  $z^n = f_n$  is :-

$$f_n = \frac{1}{\sqrt{5}} \frac{1}{\alpha} \left(\frac{1}{\alpha}\right)^n - \frac{1}{\sqrt{5}} \frac{1}{\beta} \left(\frac{1}{\beta}\right)^n$$

$$f_n = \frac{1}{\sqrt{5}} \left(\frac{1}{\alpha}\right)^{n+1} - \frac{1}{\sqrt{5}} \left(\frac{1}{\beta}\right)^{n+1}$$

$$\text{Since , } \alpha = \frac{-1 + \sqrt{5}}{2} \text{ and } \beta = \frac{-1 - \sqrt{5}}{2}$$

$$\text{So, } \frac{1}{\alpha} = \frac{2}{\sqrt{5}-1} = \frac{2}{(\sqrt{5}-1)(\sqrt{5}+1)} = \frac{(1+\sqrt{5})}{2}$$

$$\text{Similarly , } \frac{1}{\beta} = \frac{(1-\sqrt{5})}{2}$$

Now, On putting these values in  $f_n$  , We get,

$$f_n = \frac{1}{\sqrt{5}} \left(\frac{1+\sqrt{5}}{2}\right)^{n+1} - \frac{1}{\sqrt{5}} \left(\frac{1-\sqrt{5}}{2}\right)^{n+1}$$

So, Closed-Form Expression for the given Fibonacci Sequence is :-

$$f_n = \frac{1}{\sqrt{5}} \left[ \left(\frac{1+\sqrt{5}}{2}\right)^{n+1} - \left(\frac{1-\sqrt{5}}{2}\right)^{n+1} \right]$$

**Note :-**

1. Here, Irrational Number  $\frac{1+\sqrt{5}}{2} = 1.618\dots$  represents the [golden ratio](#)  $\Phi$ .

2. If we take Fibonacci Sequence as  $0, 1, 1, 2, 3, 5, 8, \dots$ , then the Generating Function  $G(z)$  will be  $\frac{z}{1-z-z^2}$  and Closed-Form expression will be different .  $G(z)$  and Closed-Form expression for this Fibonacci Sequence can be obtained by the above procedure.

## References



42 votes

-- ankitgupta.1729 (14.9k points)

#### 1.4.2 Generating Functions: GATE CSE 2005 | Question: 50 [top](#)

<https://gateoverflow.in/1175>



✓  $\frac{1}{1-x} = 1 + x + x^2 + x^3 + x^4 + x^5 + \dots + \infty$

Differentiating it w.r.to  $x$

$$\frac{1}{(1-x)^2} = 1 + 2x + 3x^2 + 4x^3 + 5x^4 + \dots + \infty$$

$$\sum_{i=0}^{\infty} g(i)x^i = g(0) + g(1)x + g(2)x^2 + g(3)x^3 + \dots + \infty$$

Comparing above two, we get  $g(1) = 2, g(2) = 3 \Rightarrow g(i) = i + 1$

Correct Answer: B

68 votes

-- Manish Joshi (20.5k points)

#### 1.4.3 Generating Functions: GATE CSE 2016 Set 1 | Question: 26 [top](#)

<https://gateoverflow.in/39693>



✓ we will get  $x^{12}$  as

1.  $(x^4)^3$  having coefficient  ${}^3C_0 = 1$
2.  $(x^3)^2(x^6)$  having coefficient  ${}^3C_1 = 3$
3.  $(x^3)(x^4)(x^5)$  having coefficient  ${}^3C_2 \times {}^2C_1 = 6$

So it is 10

Second Method:

$$\begin{aligned} & [\mathbf{x}^{12}] (x^3 + x^4 + x^5 + x^6 + \dots)^3 \\ & [\mathbf{x}^{12}] [x^3 (1 + x^1 + x^2 + x^3 + \dots)]^3 \\ & [\mathbf{x}^{12}] [x^9 (1 + x^1 + x^2 + x^3 + \dots)^3] \\ & [\mathbf{x}^3] [(1 + x^1 + x^2 + x^3 + \dots)^3] \\ & [\mathbf{x}^3] \left[ \left( \frac{1}{1-x} \right)^3 \right] \\ & [\mathbf{x}^3] \left[ \sum_{k=0}^{\infty} {}^{3+k-1}C_k x^k \right] \end{aligned}$$

Now, put  $k = 3$

Coefficient of  $[\mathbf{x}^3] = {}^{2+3}C_3 = 5C3 = 5C2 = 10$

$$[\mathbf{x}^{12}] (x^3 + x^4 + x^5 + x^6 + \dots)^3 \Rightarrow 10$$

62 votes

-- Praveen Saini (41.9k points)

#### 1.4.4 Generating Functions: GATE CSE 2017 Set 2 | Question: 47 [top](#)

<https://gateoverflow.in/118392>



✓  $\frac{1+z}{(1-z)^3} = (1+z)(1-z)^{-3}$

$$(1-z)^{-3} = 1 + {}^3C_1 z + {}^4C_2 z^2 + {}^5C_3 z^3 + \dots \infty$$

$$(1+z)(1-z)^{-3} = (1+z) * (1 + {}^3C_1 z + {}^4C_2 z^2 + {}^5C_3 z^3 + \dots \infty)$$

$a_0$  is the first term in the expansion of above series and  $a_3$  is the fourth term (or) coefficient of  $z^3$

$a_0$  = coefficient of  $z^0 = 1$

$a_3$  = coefficient of  $z^3 = \binom{5}{3} + \binom{4}{2} = 10 + 6$

$$\Rightarrow a_3 - a_0 = 16 - 1 = 15$$

82 votes

-- Manish Joshi (20.5k points)



#### 1.4.5 Generating Functions: GATE CSE 2018 | Question: 1 [top](#)

<https://gateoverflow.in/204075>

- Given that  $a_n = 2n + 3$

Let  $G(x)$  be the generating function for the sequence  $\{a_n\}$ .

$$\begin{aligned} \text{So, } G(x) &= \sum_{n=0}^{\infty} a_n x^n \\ &= \sum_{n=0}^{\infty} (2n+3)x^n \\ &= \sum_{n=0}^{\infty} (2n)x^n + \sum_{n=0}^{\infty} (3)x^n \\ &= 2 \sum_{n=0}^{\infty} nx^n + 3 \sum_{n=0}^{\infty} x^n \\ &= 2A + 3B \end{aligned}$$

Now,  $A = \sum_{n=0}^{\infty} nx^n$ . By expanding, it will look like:  $0 + 1x + 2x^2 + 3x^3 + \dots$  which is an AGP series with first term,  $(a) = 0$ , common difference,  $(d) = 1$ , ratio,  $(r) = x$ .

$$\text{Sum of infinite AGP series} = \frac{a}{1-r} + \frac{dr}{(1-r)^2}.$$

$$\text{So, } A = \frac{0}{1-x} + \frac{x}{(1-x)^2} = \frac{x}{(1-x)^2}$$

$$\text{and } B = \sum_{n=0}^{\infty} x^n = 1 + x + x^2 + x^3 + \dots = \frac{1}{1-x}$$

$$\text{Therefore, } 2A + 3B = \frac{2x}{(1-x)^2} + \frac{3}{1-x}$$

$$= \frac{2x+3-3x}{(1-x)^2} = \frac{3-x}{(1-x)^2}$$

Option (D) is correct.

54 votes

-- Pinaki Dash (1.5k points)

#### 1.5

#### Modular Arithmetic (2) [top](#)

##### 1.5.1 Modular Arithmetic: GATE CSE 2016 Set 2 | Question: 29 [top](#)

<https://gateoverflow.in/39588>



The value of the expression  $13^{99} \pmod{17}$  in the range 0 to 16, is \_\_\_\_\_.

gate2016-cse-set2 modular-arithmetic normal numerical-answers

Answer

##### 1.5.2 Modular Arithmetic: GATE CSE 2019 | Question: 21 [top](#)

<https://gateoverflow.in/302827>



The value of  $3^{51} \pmod{5}$  is \_\_\_\_\_

gate2019-cse numerical-answers combinatory modular-arithmetic

Answer

#### Answers: Modular Arithmetic

##### 1.5.1 Modular Arithmetic: GATE CSE 2016 Set 2 | Question: 29 [top](#)

<https://gateoverflow.in/39588>



- By Fermat's Little Theorem, if  $p$  is prime, then

$$a^{p-1} \equiv 1 \pmod{p}$$

$$\text{So, } 13^{16} \equiv 1 \pmod{17}.$$

$$\text{And, } 13^{96} = 13^{16 \times 6} \equiv 1 \pmod{17}.$$

We are left with  $13^{99} = 13^{96} \times 13^3 \equiv 13^3 \pmod{17} \equiv 2197 \pmod{17}$  which is 4.

## References



96 votes

-- Gaurav Sharma (1.8k points)

### 1.5.2 Modular Arithmetic: GATE CSE 2019 | Question: 21

<https://gateoverflow.in/302827>



$$3^{51} \bmod 5 = (3^3)^{17} \bmod 5 = (27)^{17} \bmod 5 = (27 \bmod 5)^{17} \bmod 5 = 2^{17} \bmod 5 = 131072 \bmod 5 = 2$$

20 votes

-- Rituraj Mohanty (3.2k points)

By using [Fermat's Little Theorem](#), if  $p$  is a prime number, then

$$a^{p-1} \equiv 1 \pmod{p}$$

$$a^{p-1} \bmod p = 1$$

So,  $3^4 \bmod 5 = 1$ .

$$3^{48} \bmod 5 = 3^{12 \times 4} \bmod 5 = 1.$$

$$\text{Now } 3^{51} \bmod 5 = (3^{48} \bmod 5) \times (3^3 \bmod 5) = 3^3 \bmod 5 = 27 \bmod 5 = 2$$

## References



48 votes

-- Rajesh Pradhan (18.9k points)

## 1.6

### Pigeonhole Principle (2)

#### 1.6.1 Pigeonhole Principle: GATE CSE 2000 | Question: 1.1

<https://gateoverflow.in/624>



The minimum number of cards to be dealt from an arbitrarily shuffled deck of 52 cards to guarantee that three cards are from same suit is

- A. 3
- B. 8
- C. 9
- D. 12

[gate2000-cse](#) [easy](#) [pigeonhole-principle](#) [combinatory](#)

Answer

#### 1.6.2 Pigeonhole Principle: GATE CSE 2005 | Question: 44

<https://gateoverflow.in/1170>



What is the minimum number of ordered pairs of non-negative numbers that should be chosen to ensure that there are two pairs  $(a, b)$  and  $(c, d)$  in the chosen set such that,  $a \equiv c \pmod{3}$  and  $b \equiv d \pmod{5}$

- A. 4
- B. 6
- C. 16
- D. 24

[gate2005-cse](#) [set-theory&algebra](#) [normal](#) [pigeonhole-principle](#)

Answer

## Answers: Pigeonhole Principle

#### 1.6.1 Pigeonhole Principle: GATE CSE 2000 | Question: 1.1

<https://gateoverflow.in/624>



- ✓ There are 4 sets of cards. So, up till 8 cards there is a chance that no more than 2 cards are from a given set. But, once we pick the 9<sup>th</sup> one, it should make 3 cards from any one of the sets. So, (C) is the answer.

36 votes

-- gatecse (60k points)

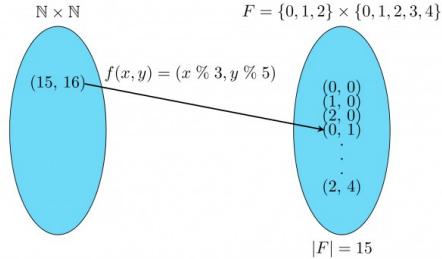
<https://gateoverflow.in/1170>**1.6.2 Pigeonhole Principle: GATE CSE 2005 | Question: 44** [top](#)

- ✓ Let us pick any tuple  $(p, q)$  from  $\mathbb{N}^2$

What can happen?

Well,  $p \bmod 3$  can be 0, 1 or 2. And  $q \bmod 5$  can be 0, 1, 2, 3 or 4. So, there are 15 possibilities.

Now if we have 16 of these tuples, surely two of these will map to same combination. Hence, answer is 16.



Correct Answer: C

41 votes

-- Dhruv Patel (1.6k points)

Order pairs for  $(a, b)$  are $(0, 0), (0, 1), (0, 2), (0, 3), (0, 4), (1, 0), (1, 1), (1, 2), (1, 3), (1, 4), (2, 0), (2, 1), (2, 2), (2, 3), (2, 4)$ Take any other combination for  $(c, d)$  that will surely match with one of the above 15 combinations (Pigeon Hole principle)Total  $15 + 1 = 16$  combinations

62 votes

-- Digvijay (44.9k points)

**1.7****Recurrence (5)** [top](#)<https://gateoverflow.in/2761>**1.7.1 Recurrence: GATE CSE 1996 | Question: 9** [top](#)The Fibonacci sequence  $\{f_1, f_2, f_3 \dots f_n\}$  is defined by the following recurrence:

$$f_{n+2} = f_{n+1} + f_n, n \geq 1; f_2 = 1 : f_1 = 1$$

Prove by induction that every third element of the sequence is even.

[gate1996](#) [recurrence](#) [proof](#) [descriptive](#)

Answer

<https://gateoverflow.in/39636>**1.7.2 Recurrence: GATE CSE 2016 Set 1 | Question: 2** [top](#)Let  $a_n$  be the number of  $n$ -bit strings that do NOT contain two consecutive 1's. Which one of the following is the recurrence relation for  $a_n$ ?

- A.  $a_n = a_{n-1} + 2a_{n-2}$
- B.  $a_n = a_{n-1} + a_{n-2}$
- C.  $a_n = 2a_{n-1} + a_{n-2}$
- D.  $a_n = 2a_{n-1} + 2a_{n-2}$

[gate2016-cse-set1](#) [combinatorics](#) [recurrence](#) [easy](#)

Answer

<https://gateoverflow.in/39714>**1.7.3 Recurrence: GATE CSE 2016 Set 1 | Question: 27** [top](#)Consider the recurrence relation  $a_1 = 8, a_n = 6n^2 + 2n + a_{n-1}$ . Let  $a_{99} = K \times 10^4$ . The value of  $K$  is \_\_\_\_\_.[gate2016-cse-set1](#) [combinatorics](#) [recurrence](#) [normal](#) [numerical-answers](#)

Answer

**1.7.4 Recurrence: GATE IT 2004 | Question: 34** top ↴<https://gateoverflow.in/3677>

Let  $H_1, H_2, H_3, \dots$  be harmonic numbers. Then, for  $n \in \mathbb{Z}^+$ ,  $\sum_{j=1}^n H_j$  can be expressed as

- A.  $nH_{n+1} - (n+1)$
- B.  $(n+1)H_n - n$
- C.  $nH_n - n$
- D.  $(n+1)H_{n+1} - (n+1)$

[gate2004-it](#) [recurrence](#) [combinatory](#) [normal](#)

Answer

**1.7.5 Recurrence: GATE IT 2007 | Question: 76** top ↴<https://gateoverflow.in/3528>

Consider the sequence  $\langle x_n \rangle$ ,  $n \geq 0$  defined by the recurrence relation  $x_{n+1} = c \cdot x_n^2 - 2$ , where  $c > 0$ .

Suppose there exists a **non-empty, open** interval  $(a, b)$  such that for all  $x_0$  satisfying  $a < x_0 < b$ , the sequence converges to a limit. The sequence converges to the value?

- A.  $\frac{1+\sqrt{1+8c}}{2c}$
- B.  $\frac{1-\sqrt{1+8c}}{2c}$
- C. 2
- D.  $\frac{2}{2c-1}$

[gate2007-it](#) [combinatory](#) [normal](#) [recurrence](#)

Answer

**Answers: Recurrence****1.7.1 Recurrence: GATE CSE 1996 | Question: 9** top ↴<https://gateoverflow.in/2761>

- ✓ Formal proof,

$$f_{n+2} = f_{n+1} + f_n$$

For  $n = 1$ ,

$f_3 = f_2 + f_1 = 1 + 1 = 2$  is an even number

and  $f_3$ , here  $3 \% 3 = 0$

Hence, the statement is true for  $n = 1$

Now, let this statement is true for  $n = k$

So,  $f_{k+2} = f_{k+1} + f_k$ , where  $f_k$  and  $f_{k+1}$  is ODD and  $f_{k+2}$  is EVEN, and also  $(k+2) \% 3 = 0$

Now, Prove this statement true for  $(k+5)$  which is next to  $3^{rd}$  number after  $(k+2)$

$$f_{k+3} = f_{k+2} + f_{k+1} = \text{ODD}(\text{EVEN} + \text{ODD})$$

$$f_{k+4} = f_{k+3} + f_{k+2} = \text{ODD}(\text{ODD} + \text{EVEN})$$

$$f_{k+5} = f_{k+4} + f_{k+3} = \text{EVEN}(\text{ODD} + \text{ODD})$$

Hence, it is also true for  $(k+5)$ .

So, By the principle of mathematical induction  $f(n)$ , is true for all  $n \% 3 = 0$

4 votes

-- Harsh Mehta (1k points)

**1.7.2 Recurrence: GATE CSE 2016 Set 1 | Question: 2** top ↴<https://gateoverflow.in/39636>

- ✓

$n$	n-bit strings that do NOT contain consecutive 11	$a_n$	those containing 11
1	{0, 1}	$a_1 = 2$	{}
2	{00, 01, 10}	$a_2 = 3$	{11}
3	{000, 001, 010, 100, 101}	$a_3 = 5$	{011, 110, 111}

$$a_n = a_{n-1} + a_{n-2}$$

Rest of the options are already out.

Alternatively, we can get a string in  $a_n$  by appending "0" to any string in  $a_{n-1}$  as well as by appending "01" to any string in  $a_{n-2}$  and the two cases are mutually exclusive (no common strings) as well as exhaustive (covers all cases).

Correct Answer: **B**

72 votes

-- Praveen Saini (41.9k points)

### 1.7.3 Recurrence: GATE CSE 2016 Set 1 | Question: 27 [top](#)

→ <https://gateoverflow.in/39714>



✓ 
$$\begin{aligned} a_n &= 6n^2 + 2n + a_{n-1} \\ &= 6n^2 + 2n + 6(n-1)^2 + 2(n-1) + a_{n-2} \\ &= 6n^2 + 2n + 6(n-1)^2 + 2(n-1) + 6(n-2)^2 + 2(n-2) + \dots + a_1 \\ &= 6n^2 + 2n + 6(n-1)^2 + 2(n-1) + 6(n-2)^2 + 2(n-2) + \dots + 6 \cdot 1^2 + 2 \cdot 1 \\ &= 6(n^2 + (n-1)^2 + \dots + 2^2 + 1^2) + 2(n + (n-1) + \dots + 2 + 1) \\ &= 6 \times \frac{n(n+1)(2n+1)}{6} + 2 \times \frac{n(n+1)}{2} \\ &= n(n+1)(2n+1) \end{aligned}$$

$$a_n = 2n(n+1)^2$$

$$\text{for } n = 99 \quad a_{99} = 2 \times 99 \times (99+1)^2 = 198 \times 10^4$$

166 votes

-- Praveen Saini (41.9k points)

### 1.7.4 Recurrence: GATE IT 2004 | Question: 34 [top](#)

→ <https://gateoverflow.in/3677>



✓ The  $n^{th}$  [Harmonic Number](#) is defined as the summation of the reciprocals of all numbers from 1 to  $n$ .

$$H_n = \sum_{i=1}^n \frac{1}{i} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{n}$$

Lets call the value of  $\sum_{j=1}^n H_j$  as  $S_n$

Then,

$$\begin{aligned}
S_n &= H_1 + H_2 + H_3 + \cdots + H_n \\
&= \underbrace{\left( \frac{1}{1} \right)}_{H_2} + \underbrace{\left( \frac{1}{1} + \frac{1}{2} \right)}_{H_3} + \underbrace{\left( \frac{1}{1} + \frac{1}{2} + \frac{1}{3} \right)}_{H_4} + \cdots + \underbrace{\left( \frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n} \right)}_{H_n} \\
&= \textcolor{red}{n} \times \frac{1}{1} + (\textcolor{blue}{n}-1) \times \frac{1}{2} + (\textcolor{green}{n}-2) \times \frac{1}{3} + \cdots + 1 \times \frac{1}{n} \\
&= \sum_{i=1}^n (n-i+1) \times \frac{1}{i} \\
&= \sum_{i=1}^n \left( \frac{n+1}{i} - 1 \right) \\
&= \left( \sum_{i=1}^n \frac{\textcolor{red}{n}+1}{i} \right) - \left( \sum_{i=1}^n 1 \right) \\
&= \left( \textcolor{red}{n+1} \times \underbrace{\sum_{i=1}^n \frac{1}{i}}_{=H_n} \right) - \textcolor{blue}{n}
\end{aligned}$$

$$S_n = (n+1) \cdot H_n - n$$

Hence, the answer is option (B).

#### References



82 votes

-- Pragy Agarwal (18.3k points)

#### 1.7.5 Recurrence: GATE IT 2007 | Question: 76 top ↴

<https://gateoverflow.in/3528>



- ✓ Lets take a look when  $c = 1$

The value the recurrence converges to must be,  $\frac{1 \pm \sqrt{1+8 \times 1}}{2 \times 1} = 2, -1$

However, when we take the positive square root, i.e. when  $x_i$  supposedly converges to  $\frac{1+\sqrt{1+8c}}{2c}$ ,

the convergence does not hold for the neighborhood.

$$x_i = \lim_{\delta \rightarrow 0} 2 + \delta$$

$$x_{i+1} = 1 \times x_i^2 - 2 = \lim_{\delta \rightarrow 0} (2 + \delta)^2 - 2$$

$$= \lim_{\delta \rightarrow 0} 4 - 2 + \delta^2 + 4\delta$$

$$x_{i+1} = \lim_{\delta \rightarrow 0} 2 + \delta^2 + 4\delta$$

We can see that  $x_{i+1}$  is further than  $x_i$  from the assumed convergence value of  $\lim_{i \rightarrow \infty} x_i = 2$

Similarly, the value does not converge when  $x_i$  approaches 2 from the left side of the number line.

When the negative square root is considered, the convergence does hold for neighbors on either side.

$$x_i = \lim_{\delta \rightarrow 0} (-1) + \delta$$

$$x_{i+1} = 1 \times x_i^2 - 2 = \lim_{\delta \rightarrow 0} ((-1) + \delta)^2 - 2$$

$$= \lim_{\delta \rightarrow 0} 1 - 2 + \delta^2 - 2\delta$$

$$x_{i+1} = \lim_{\delta \rightarrow 0} -1 + \delta^2 - 2\delta$$

Also,

$$x_i = \lim_{\delta \rightarrow 0} (-1) - \delta$$

$$x_{i+1} = 1 \times x_i^2 - 2 = \lim_{\delta \rightarrow 0} ((-1) - \delta)^2 - 2$$

$$= \lim_{\delta \rightarrow 0} 1 - 2 + \delta^2 + 2\delta$$

$$x_{i+1} = \lim_{\delta \rightarrow 0} -1 + \delta^2 + 2\delta$$

Hence, when negative square root is considered, the value oscillates around the convergence point, and actually converges.

Therefore the answer should be only B.

15 votes

-- Pragy Agarwal (18.3k points)

## 1.8

### Summation (3)

#### 1.8.1 Summation: GATE CSE 1994 | Question: 15

<https://gateoverflow.in/2511>



Use the patterns given to prove that

A.  $\sum_{i=0}^{n-1} (2i + 1) = n^2$

(You are not permitted to employ induction)

$$\begin{array}{ccccccc} & & & \bullet & \bullet & \bullet & \\ & & & \bullet & \bullet & \bullet & \\ \bullet & & \bullet & \bullet & \bullet & \bullet & \text{etc} \\ 1 & & 4 & & 9 & & \end{array}$$

B. Use the result obtained in (A) to prove that  $\sum_{i=1}^n i = \frac{n(n+1)}{2}$

[gate1994](#) [combinatorics](#) [proof](#) [summation](#) [descriptive](#)

Answer

#### 1.8.2 Summation: GATE CSE 2008 | Question: 24

<https://gateoverflow.in/422>



Let  $P = \sum_{\substack{1 \leq i \leq 2k \\ i \text{ odd}}} i$  and  $Q = \sum_{\substack{1 \leq i \leq 2k \\ i \text{ even}}} i$ , where  $k$  is a positive integer. Then

- A.  $P = Q - k$
- B.  $P = Q + k$
- C.  $P = Q$

D.  $P = Q + 2k$

gate2008-cse combinatorics easy summation

Answer 

### 1.8.3 Summation: GATE CSE 2015 Set 1 | Question: 26

 <https://gateoverflow.in/8248>



$$\sum_{x=1}^{99} \frac{1}{x(x+1)} = \text{_____}.$$

gate2015-cse-set1 combinatorics normal numerical-answers summation

Answer 

## Answers: Summation

### 1.8.1 Summation: GATE CSE 1994 | Question: 15

 <https://gateoverflow.in/2511>



- A. Using the pattern we can see that  $n^2$  is obtained by summing all the odd numbers from 1 to  $2n - 1$ . For  $i^{th}$  row of the pattern if we sum the dots to the right end and then down we get  $2i - 1$ . Then sum up the values of all rows and we get  $n^2$ .

B.  $\sum_{i=0}^{n-1} (2i + 1) = n^2$

$$\begin{aligned} &\Rightarrow 1 + \sum_{i=1}^n (2i + 1) = (n + 1)^2 \text{(Substituting } n \text{ for } n - 1\text{)} \\ &\Rightarrow 1 + \sum_{i=1}^n (2i + 1) = n^2 + 2n + 1 \\ &\Rightarrow \sum_{i=1}^n 2i + \sum_{i=1}^n 1 = n^2 + 2n \\ &\Rightarrow 2 \cdot \sum_{i=1}^n i + n = n^2 + 2n \\ &\Rightarrow 2 \cdot \sum_{i=1}^n i = n^2 + n \\ &\Rightarrow \sum_{i=1}^n i = \frac{n(n+1)}{2} \end{aligned}$$

 12 votes

-- Arjun Suresh (328k points)

### 1.8.2 Summation: GATE CSE 2008 | Question: 24

 <https://gateoverflow.in/422>



✓  $P = 1 + 3 + 5 + 7 + \dots + (2k - 1)$   
 $= (2 - 1) + (4 - 1) + (6 - 1) + (8 - 1) + \dots + (2k - 1)$   
 $= (2 + 4 + 6 + 8 + \dots + 2k) + (-1 - 1 - 1 - 1 - \dots k \text{ times})$   
 $= \mathbf{Q} + (-k) = \mathbf{Q} - \mathbf{k}$

Correct Answer: A

 26 votes

-- Pranabesh Ghosh (3.3k points)

### 1.8.3 Summation: GATE CSE 2015 Set 1 | Question: 26

 <https://gateoverflow.in/8248>



✓  $\frac{1}{1.2} + \frac{1}{2.3} + \dots + \frac{1}{99.100} = 1 - \frac{1}{2} + \frac{1}{2} - \frac{1}{3} + \frac{1}{3} - \frac{1}{4} + \dots + \frac{1}{99} - \frac{1}{100} = 1 - \frac{1}{100} = 0.99$

 50 votes

-- Arjun Suresh (328k points)

It can be answered by using the concept of partial fraction

$$\frac{1}{x(x+1)} = \frac{A}{x} + \frac{B}{(x+1)}$$

solving this we will get  $A = 1$  and  $B = -1$

So, this will form a sequence in which 2 terms will remain  $\left(1 - \frac{1}{100}\right)$  and we will get  $\frac{99}{100} = 0.99$  as answer.

65 votes

-- Aditi Tiwari (881 points)

## Answer Keys

1.1.1	N/A	1.1.2	B	1.1.3	A	1.2.1	N/A	1.2.2	A;C
1.2.3	A	1.2.4	N/A	1.2.5	N/A	1.2.6	D	1.2.7	D
1.2.8	D	1.2.9	N/A	1.2.10	B	1.2.11	C	1.2.12	B
1.2.13	C	1.2.14	A	1.2.15	D	1.2.16	89	1.2.17	15
1.2.18	C	1.2.19	12	1.2.20	B	1.2.21	A	1.3.1	D
1.3.2	65 : 65	1.3.3	59049 : 59049	1.4.1	N/A	1.4.2	B	1.4.3	10
1.4.4	15	1.4.5	D	1.5.1	4	1.5.2	2	1.6.1	C
1.6.2	C	1.7.1	N/A	1.7.2	B	1.7.3	197.9 : 198.1	1.7.4	B
1.7.5	B	1.8.1	N/A	1.8.2	A	1.8.3	0.99		

## 2

## Discrete Mathematics: Graph Theory (60)



**Syllabus:** Connectivity, Matching, Coloring.

## Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
1 Mark Count	1	0	0	1	1	0	1	0	1	0	0.55	1
2 Marks Count	1	0	1	1	1	0	0	0	0	0	0.44	1
Total Marks	3	0	2	3	3	0	1	0	1	0	1.44	3

## 2.1

Counting (5) top ↗<https://gateoverflow.in/2443>

The number of distinct simple graphs with up to three nodes is

- A. 15
- B. 10
- C. 7
- D. 9

[gate1994](#) [graph-theory](#) [combinatorics](#) [normal](#) [isro2008](#) [counting](#)

Answer

<https://gateoverflow.in/733>2.1.2 Counting: GATE CSE 2001 | Question: 2.15 top ↗

How many undirected graphs (not necessarily connected) can be constructed out of a given set  $V = \{v_1, v_2, \dots, v_n\}$  of  $n$  vertices?

- A.  $\frac{n(n-1)}{2}$
- B.  $2^n$
- C.  $n!$
- D.  $2^{\frac{n(n-1)}{2}}$

[gate2001-cse](#) [graph-theory](#) [normal](#) [counting](#)

Answer

<https://gateoverflow.in/1073>2.1.3 Counting: GATE CSE 2004 | Question: 79 top ↗

How many graphs on  $n$  labeled vertices exist which have at least  $\frac{(n^2-3n)}{2}$  edges?

- A.  $\binom{\frac{n^2-n}{2}}{C_{\binom{\frac{n^2-3n}{2}}{2}}}$
- B.  $\sum_{k=0}^{\frac{n^2-3n}{2}} \cdot (n^2-n) C_k$
- C.  $\binom{n^2-n}{2} C_n$
- D.  $\sum_{k=0}^n \cdot \binom{\frac{n^2-n}{2}}{2} C_k$

[gate2004-cse](#) [graph-theory](#) [combinatorics](#) [normal](#) [counting](#)

Answer

<https://gateoverflow.in/1371>2.1.4 Counting: GATE CSE 2005 | Question: 35 top ↗

How many distinct binary search trees can be created out of 4 distinct keys?

- A. 5
- B. 14
- C. 24
- D. 42

gate2005-cse graph-theory counting normal

Answer 

### 2.1.5 Counting: GATE CSE 2012 | Question: 38

 <https://gateoverflow.in/473>



Let  $G$  be a complete undirected graph on 6 vertices. If vertices of  $G$  are labeled, then the number of distinct cycles of length 4 in  $G$  is equal to

- A. 15
- B. 30
- C. 90
- D. 360

gate2012-cse graph-theory normal marks-to-all counting

Answer 

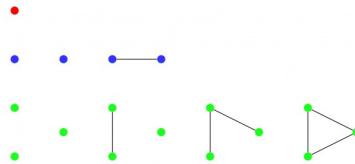
### Answers: Counting

#### 2.1.1 Counting: GATE CSE 1994 | Question: 1.6, ISRO2008-29

 <https://gateoverflow.in/2443>



- ✓ Answer is (C)



 98 votes

-- Amar Vashishth (25.2k points)

Answer: C

The number of max edges a simple graph can have is  $\frac{n \times (n-1)}{2}$ .

So, for a graph with 3 nodes the max number of edges is 3.

Now there can be 0 edges, 1 edge, 2 edges or 3 edges in a 3 node simple graph.

So the total number of unlabeled simple graphs on 3 nodes will be 4.

Similarly for two node graph we have option of 0 or 1 edge and for one node graph we have option of 0 edge.

So the total number of simple graphs upto three nodes =  $4 + 2 + 1 = 7$ .

 42 votes

-- Rajarshi Sarkar (27.8k points)

#### 2.1.2 Counting: GATE CSE 2001 | Question: 2.15

 <https://gateoverflow.in/733>



- ✓ With  $n$  vertices we have max possible  ${}^n C_2$  edges in a simple graph. and each subset of these edges will form a graph, so total number of undirected graph possible =  $2^{\frac{n(n-1)}{2}}$

Correct Answer: D

 58 votes

-- Vikrant Singh (11.2k points)

#### 2.1.3 Counting: GATE CSE 2004 | Question: 79

 <https://gateoverflow.in/1073>



- ✓ Let  $a = \frac{n(n-1)}{2}$ ,  $b = \frac{n^2 - 3n}{2}$

Minimum no of edges has to be  $\frac{n^2 - 3n}{2} = b$ .

Maximum no of edges in simple graph =  $\frac{n(n-1)}{2} = a$ .

So, no of graph with minimum  $b$  edges :

$$= C(a, b) + C(a, b+1) + C(a, b+2) + \dots + C(a, a)$$

$$\begin{aligned}
&= C(a, a - b) + C(a, a - (b + 1)) + C(a, a - (b + 2)) + \dots + C(a, 0) \\
&= C(a, n) + C(a, n - 1) + C(a, n - 2) + \dots + C(a, 0) \quad (\because a - b = n) \\
&= C\left(\frac{n(n-1)}{2}, n\right) + C\left(\frac{n(n-1)}{2}, n - 1\right) + C\left(\frac{n(n-1)}{2}, n - 2\right) + \dots + C\left(\frac{n(n-1)}{2}, 0\right) \\
&= \sum_{k=0}^n \binom{\frac{n^2-n}{2}}{k} C_k
\end{aligned}$$

Option (D).

109 votes

-- Digvijay (44.9k points)

#### 2.1.4 Counting: GATE CSE 2005 | Question: 35 [top](#)



✓ answer - (B)

$$\text{number of distinct BSTs} = \frac{2nC_n}{n+1} \text{ (or)} = \frac{(2n)!}{(n+1)!n!}$$

For a given Binary tree structure, there can be only 1 [BST](#). Hence, no. of different [BSTs](#) with  $n$  nodes will be equal to the no. of different binary tree structures possible for  $n$  nodes.

For derivation:

<http://gatecse.in/number-of-binary-trees-possible-with-n-nodes/>

References



32 votes

-- Ankit Rokde (6.9k points)

#### 2.1.5 Counting: GATE CSE 2012 | Question: 38 [top](#)



✓ From 6 vertices we can select 4 distinct vertices in  ${}^6C_4 = 15$  ways.

Now, with 4 vertices, we can form only 3 distinct cycles. [See below]

So, total no. of distinct cycles of length 4 =  $15 \times 3 = 45$ .

No. of cyclic permutations of  $n$  objects =  $(n - 1)!$  and for  $n = 4$ , we get  $3! = 6$  ways. But number of distinct cycles in a graph is exactly half the number of cyclic permutations as there is no left/right ordering in a graph. For example  $a - b - c - d$  and  $a - d - c - b$  are different permutations but in a graph they form the same cycle.

Since, 45 was not in the choice, marks were given to all in GATE.

161 votes

-- gatecse (60k points)

## 2.2

### Degree Of Graph (12) [top](#)

#### 2.2.1 Degree Of Graph: GATE CSE 1987 | Question: 9c [top](#)



Show that the number of odd-degree vertices in a finite graph is even.

[gate1987](#) [graph-theory](#) [degree-of-graph](#) [descriptive](#) [proof](#)

Answer

#### 2.2.2 Degree Of Graph: GATE CSE 1991 | Question: 16-b [top](#)

[https://gateoverflow.in/82438](#)



Show that all vertices in an undirected finite graph cannot have distinct degrees, if the graph has at least two vertices.

[gate1991](#) [graph-theory](#) [degree-of-graph](#) [descriptive](#) [proof](#)

Answer

#### 2.2.3 Degree Of Graph: GATE CSE 1995 | Question: 24 [top](#)

[https://gateoverflow.in/26647](#)



Prove that in finite graph, the number of vertices of odd degree is always even.



gate1995 graph-theory degree-of-graph proof descriptive

Answer 

#### 2.2.4 Degree Of Graph: GATE CSE 2003 | Question: 40

 <https://gateoverflow.in/931>



A graph  $G = (V, E)$  satisfies  $|E| \leq 3 |V| - 6$ . The min-degree of  $G$  is defined as  $\min_{v \in V} \{\text{degree}(v)\}$ . Therefore, min-degree of  $G$  cannot be

- A. 3
- B. 4
- C. 5
- D. 6

gate2003-cse graph-theory normal degree-of-graph

Answer 

#### 2.2.5 Degree Of Graph: GATE CSE 2006 | Question: 71

 <https://gateoverflow.in/1850>



The  $2^n$  vertices of a graph  $G$  corresponds to all subsets of a set of size  $n$ , for  $n \geq 6$ . Two vertices of  $G$  are adjacent if and only if the corresponding sets intersect in exactly two elements.

The number of vertices of degree zero in  $G$  is:

- A. 1
- B.  $n$
- C.  $n + 1$
- D.  $2^n$

gate2006-cse graph-theory normal degree-of-graph

Answer 

#### 2.2.6 Degree Of Graph: GATE CSE 2006 | Question: 72

 <https://gateoverflow.in/43566>



The  $2^n$  vertices of a graph  $G$  corresponds to all subsets of a set of size  $n$ , for  $n \geq 6$ . Two vertices of  $G$  are adjacent if and only if the corresponding sets intersect in exactly two elements.

The maximum degree of a vertex in  $G$  is:

- A.  $\binom{n}{2} \cdot 2^{\frac{n}{2}}$
- B.  $2^{n-2}$
- C.  $2^{n-3} \times 3$
- D.  $2^{n-1}$

gate2006-cse graph-theory normal degree-of-graph

Answer 

#### 2.2.7 Degree Of Graph: GATE CSE 2009 | Question: 3

 <https://gateoverflow.in/804>



Which one of the following is **TRUE** for any simple connected undirected graph with more than 2 vertices?

- A. No two vertices have the same degree.
- B. At least two vertices have the same degree.
- C. At least three vertices have the same degree.
- D. All vertices have the same degree.

gate2009-cse graph-theory normal degree-of-graph

Answer 

#### 2.2.8 Degree Of Graph: GATE CSE 2010 | Question: 1

 <https://gateoverflow.in/1147>



Let  $G = (V, E)$  be a graph. Define  $\xi(G) = \sum_d i_d * d$ , where  $i_d$  is the number of vertices of degree  $d$  in  $G$ . If  $S$  and  $T$  are two different trees with  $\xi(S) = \xi(T)$ , then

- A.  $|S| = 2|T|$
- B.  $|S| = |T| - 1$
- C.  $|S| = |T|$
- D.  $|S| = |T| + 1$

gate2010-cse graph-theory normal degree-of-graph

Answer 

### 2.2.9 Degree Of Graph: GATE CSE 2010 | Question: 28 top ↗

<https://gateoverflow.in/1154>



The degree sequence of a simple graph is the sequence of the degrees of the nodes in the graph in decreasing order. Which of the following sequences can not be the degree sequence of any graph?

- I. 7, 6, 5, 4, 4, 3, 2, 1
  - II. 6, 6, 6, 6, 3, 3, 2, 2
  - III. 7, 6, 6, 4, 4, 3, 2, 2
  - IV. 8, 7, 7, 6, 4, 2, 1, 1
- 
- A. I and II
  - B. III and IV
  - C. IV only
  - D. II and IV

gate2010-cse graph-theory degree-of-graph

Answer 

### 2.2.10 Degree Of Graph: GATE CSE 2013 | Question: 25 top ↗

<https://gateoverflow.in/1536>



Which of the following statements is/are TRUE for undirected graphs?

P: Number of odd degree vertices is even.  
Q: Sum of degrees of all vertices is even.

- A. P only
- B. Q only
- C. Both P and Q
- D. Neither P nor Q

gate2013-cse graph-theory easy degree-of-graph

Answer 

### 2.2.11 Degree Of Graph: GATE CSE 2014 Set 1 | Question: 52 top ↗

<https://gateoverflow.in/1932>



An ordered  $n$ -tuple  $(d_1, d_2, \dots, d_n)$  with  $d_1 \geq d_2 \geq \dots \geq d_n$  is called *graphic* if there exists a simple undirected graph with  $n$  vertices having degrees  $d_1, d_2, \dots, d_n$  respectively. Which one of the following 6-tuples is NOT graphic?

- A. (1, 1, 1, 1, 1, 1)
- B. (2, 2, 2, 2, 2, 2)
- C. (3, 3, 3, 1, 0, 0)
- D. (3, 2, 1, 1, 1, 0)

gate2014-cse-set1 graph-theory normal degree-of-graph

Answer 

### 2.2.12 Degree Of Graph: GATE CSE 2017 Set 2 | Question: 23 top ↗

<https://gateoverflow.in/118594>



$G$  is an undirected graph with  $n$  vertices and 25 edges such that each vertex of  $G$  has degree at least 3. Then the maximum possible value of  $n$  is \_\_\_\_\_.

gate2017-cse-set2 graph-theory numerical-answers degree-of-graph

Answer 

## Answers: Degree Of Graph

### 2.2.1 Degree Of Graph: GATE CSE 1987 | Question: 9c top ↗

↗ <https://gateoverflow.in/82438>



- ✓ For proving this we should know that

$$\sum_d(V) = 2e \rightarrow (1)$$

Because one edge consist of two vertices and hence contributes two degrees.

For any Graph  $G$

$$\sum_d(V) = \sum_d(V_{odd}) + \sum_d(V_{even}) \rightarrow (2)$$

From (1) we can say that  $\sum_d(V)$  should be **even**.

$\sum_d(V_{even})$  will be always **even** ( $\because$  sum of even numbers is always even)

So, for (2) to be true  $\sum_d(V_{odd})$  should be **even** ( $\because$  even+odd=odd & even+even=even)

In  $\sum_d(V_{odd})$ , every **degree is odd**.

So, for  $\sum_d(V_{odd})$  to be **Even**,

**The number of odd-degree vertices should be even** ( $\because$  only when we add an even number of odd numbers we get an even number).

16 votes

-- saurabh dange (427 points)

### 2.2.2 Degree Of Graph: GATE CSE 1991 | Question: 16-b top ↗

↗ <https://gateoverflow.in/26647>



- ✓ Let  $n > 2$  and all the vertices have distinct degrees. Now, let the degrees be  $0, 1, 2, \dots, (n - 1)$  which are all distinct and possible as a vertex can be connected to  $(n - 1)$  other vertices. But, there is a problem here if a vertex is connected to  $(n - 1)$  other vertices, it means there cannot be a vertex with 0 degree anymore. Thus for  $n$  vertices we now have only  $(n - 1)$  possible degrees meaning at least one must repeat- pigeon comes here :)

71 votes

-- Arjun Suresh (328k points)

### 2.2.3 Degree Of Graph: GATE CSE 1995 | Question: 24 top ↗

↗ <https://gateoverflow.in/2663>



- ✓ In any finite graph,

- Sum of the degree of all the vertices  $= 2 \times$  number of edges
- Sum of the degree of all the vertices with even degree  $+$  sum of the degree of all the vertices with odd degree  $= 2 \times$  number of edges
- Even number  $+$  sum of the degree of all the vertices with odd degree  $=$  an even number.

It is possible only if the number of odd degree vertices is even.

26 votes

-- suraj (4.8k points)

### 2.2.4 Degree Of Graph: GATE CSE 2003 | Question: 40 top ↗

↗ <https://gateoverflow.in/931>



- ✓ Say every vertex has a minimum degree, therefore, least number of edges that will be in the graph is given by the handshaking lemma as  $\frac{\min \times |v|}{2}$

But the maximum number of edges for such a graph is defined in the question as  $3 \times |v| - 6$

Putting the minimum number of edges obtained by handshaking lemma in the given inequality, we get:

$$\frac{\min \times |v|}{2} \leq 3 \times |v| - 6$$

$$\frac{6 \times |v|}{2} \leq 3 \times |v| - 6; \text{ putting min degree as 6}$$

$$3 \times |v| \leq 3 \times |v| - 6$$

$$0 \leq -6$$

which is definitely inconsistent.

Hence, answer = **option (D)**

60 votes

-- Amar Vashishth (25.2k points)

Let the min-degree of  $G$  be  $x$ . Then  $G$  has at least  $\lceil |v| \times \frac{x}{2} \rceil$  edges.

$$\left[ |v| \times \frac{x}{2} \right] \leq [(3 \times |v|) - 6]$$

for  $x = 6$ , we get  $0 \leq -6$ , Therefore, min degree of  $G$  cannot be 6.

Correct answer is (D).

An alternative approach,

Let the min\_degree of a graph be 'x', then

$$x \leq \left( \frac{2e}{n} \right),$$

given,  $e \leq (3n - 6)$  {it will be planner graph}

put the value of  $e$ , then min\_degree will be,

$$x \leq \frac{(2(3n-6))}{n}$$

$$x \leq \frac{(6n-12)}{n}$$

$$x \leq \left( \frac{6n}{n} - \frac{12}{n} \right)$$

$$x \leq \left( 6 - \frac{12}{n} \right),$$

when number of vertices is more, then value of

$\left( \frac{12}{n} \right)$  will be less, ( $\frac{12}{n} = 0.000001$  assume),

then min\_degree will be,

$$x \leq \left( 6 - 0.000001 \right)$$

$$x \leq 5.999999, \text{ max value}$$

$$x \leq \text{floor value } (5.999999\dots)$$

$x = 5$ , maximum value of min\_degree of defined graph (i.e. planner graph)

35 votes

-- suraj (4.8k points)

## 2.2.5 Degree Of Graph: GATE CSE 2006 | Question: 71 top ↴

→ <https://gateoverflow.in/1850>



✓ Ans is (C).

no. of vertices with degree zero = no. of subsets with size ( $\leq 1$ ) =  $n + 1$ .

as edges are there for every vertex with two or more elements as we have a vertex for all subsets of  $n$ .

50 votes

-- Vikrant Singh (11.2k points)

## 2.2.6 Degree Of Graph: GATE CSE 2006 | Question: 72 top ↴

→ <https://gateoverflow.in/43566>



✓ (C)  $\max_k ({}^k C_2 \times 2^{n-k}) = {}^3 C_2 \times 2^{n-3} = 3 \times 2^{n-3}$ .

Let the vertex having the max degree contain  $k$  elements. Now, as per the given condition, it can have edges to all vertices having two common elements (exactly 2 common). So, we can choose the 2 common elements in  ${}^k C_2$  ways. Now, for each of these 2 pair of elements, it can have an edge to a vertex containing  $n - k$  elements + the 2 common elements. This will be equal to  $2^{n-k}$  possible subsets as the 2 common elements must always be present and other  $k$  elements must always be absent. So, we get the degree as  ${}^k C_2 \times 2^{n-k}$ .

Now, our answer will be the maximum value for this. We can differentiate this (w.r.t  $k$ ) and equate to 0. But in other way we can try different values for  $k$  starting with 2. As we see if we increase  $k$  from 2 onwards, the  $2^{n-k}$  term gets divided by 2. The other term is  ${}^k C_2$ , which goes like 1, 3, 6, 10, ... for  $k = 2, 3, 4, 5, \dots$ . So, we get the max. degree for  $k = 3$  or 4 and this will be  $3 \times 2^{n-3}$ .

65 votes

-- Vikrant Singh (11.2k points)

## 2.2.7 Degree Of Graph: GATE CSE 2009 | Question: 3 top ↴

→ <https://gateoverflow.in/804>



✓ answer = option (B)

There are  $n$  vertices and at least  $(n - 1)$  edges. So, for each vertex, degree should range from 1 (since graph is connected) to  $(n - 1)$  (since graph is simple).

But we have  $n$  such vertices- filling  $n$  things with  $(n - 1)$  numbers.

$$\left\lceil \frac{n}{n-1} \right\rceil = \lceil 1. \sim \rceil = 2$$

So, at least 2 of them must be equal (pigeonhole principle).

64 votes

-- gatecse (60k points)



### 2.2.8 Degree Of Graph: GATE CSE 2010 | Question: 1 top ↗

<https://gateoverflow.in/1147>

- ✓ Sum of degrees in a graph =  $2|E|$ , as each edge contributes two to the sum of degrees. So, when sum of degrees are same, number of edges must also be same.

Trees with equal no of edges has to have equal no of vertices as No of Edges = No of vertices - 1, in a tree.

So, should be  $|S| = |T|$

Correct Answer: C

89 votes

-- Digvijay (44.9k points)



### 2.2.9 Degree Of Graph: GATE CSE 2010 | Question: 28 top ↗

<https://gateoverflow.in/1154>

- ✓ A degree sequence  $d_1, d_2, d_3 \dots d_n$  of non negative integer is graphical if it is a degree sequence of a graph. We now introduce a powerful tool to determine whether a particular sequence is graphical due to Havel and Hakimi

Havel–Hakimi Theorem :

- According to this theorem, Let  $D$  be the sequence  $d_1, d_2, d_3 \dots d_n$  with  $d_1 \geq d_2 \geq d_3 \geq \dots d_n$  for  $n \geq 2$  and  $d_i \geq 0$ .
- If each  $d_i = 0$  then  $D$  is graphical
- Then  $D_0$  be the sequence obtained by:
- Discarding  $d_1$ , and
- Subtracting 1 from each of the next  $d_1$  entries of  $D$ .
- That is Degree sequence  $D_0$  would be :  $d_2 - 1, d_3 - 1, \dots, d_{d_1+1} - 1, \dots, d_n$
- Then,  $D$  is graphical if and only if  $D_0$  is graphical.

Now, we apply this theorem to given sequences:

- I. 7, 6, 5, 4, 4, 3, 2, 1 → 5, 4, 3, 3, 2, 1, 0 → 3, 2, 2, 1, 0, 0 → 1, 1, 0, 0, 0 → 0, 0, 0, 0 so it is graphical.
- II. 6, 6, 6, 3, 3, 2, 2 → 5, 5, 5, 2, 2, 1, 2 ( arrange in descending order)  
→ 5, 5, 5, 2, 2, 2, 1 → 4, 4, 1, 1, 1, 1 → 3, 0, 0, 0, 1 we cannot continue to get all 0's, so it is not graphical.
- III. 7, 6, 6, 4, 4, 3, 2, 2 → 5, 5, 3, 3, 2, 1, 1 → 4, 2, 2, 1, 1, 0 → 1, 1, 0, 0, 0 → 0, 0, 0, 0 so it is graphical.
- IV. 8, 7, 7, 6, 4, 2, 1, 1, here degree of a vertex is 8 and total number of vertices are 8, which is impossible, hence it is not graphical.

Hence, only option (I) and (III) are graphic sequence and answer is option-(D)

31 votes

-- Madhab Paul Choudhury (2.7k points)



### 2.2.10 Degree Of Graph: GATE CSE 2013 | Question: 25 top ↗

<https://gateoverflow.in/1536>

- ✓ Both are correct

P: sum of odd degree + sum of even degree =  $2 \times$  no. of edges

sum of odd degree =  $2 \times$  no. of edges - sum of even degree

The right hand side must be even as the difference of 2 even numbers is always even.

Q: each edge is counted twice so sum of degree is always even

38 votes

-- Bhagirathi Nayak (11.7k points)



### 2.2.11 Degree Of Graph: GATE CSE 2014 Set 1 | Question: 52 top ↗

<https://gateoverflow.in/1932>

- ✓ This can be solved using havel-hakimi theorem.

The idea is simple : Remove a vertex, which results into decrease of degree by 1 of each vertex which was connected to it. Keep removing like this, and if we get any negative degree, the degree sequence was not possible.

We need not check (A) and (B) as they are clearly graphs : (A) is 3 disconnected edges and (B) is 2 disconnected triangles.

For (C), we remove first vertex of degree 3, and thus decrease degree by 1 of next 3 vertices, so we get  $(2, 2, 0, 0, 0)$ , then we remove vertex of degree 2, and decrease degree of next 2 vertices to get  $(1, -1, 0, 0)$ . Since we get negative degree, original degree sequence is impossible.

For (D) :  $(3, 2, 1, 1, 1, 0) \Rightarrow (1, 0, 0, 1, 0)$ . Now since this list is not sorted (which is required to apply further steps of algorithm), we sort it to get  $(1, 1, 0, 0, 0)$ . Then we continue our algorithm on this list to get  $(0, 0, 0, 0)$ , which is valid (4 isolated vertices).

**So (C) is answer.**

45 votes

-- Happy Mittal (8.2k points)

### 2.2.12 Degree Of Graph: GATE CSE 2017 Set 2 | Question: 23 top

→ <https://gateoverflow.in/118594>



- Let  $m$  be minimum degree and  $M$  be maximum degree of a graph, then  $m \leq \frac{2E}{V} \leq M$

$$m = 3, E = 25, V = \dots ?$$

$$\text{So, } 3 \leq \frac{2*25}{V}$$

$$V \leq \frac{50}{3}$$

$$V \leq 16.667 \Rightarrow V = 16$$

63 votes

-- Manish Joshi (20.5k points)

## 2.3

### Graph Coloring (8) top

#### 2.3.1 Graph Coloring: GATE CSE 2002 | Question: 1.4 top

→ <https://gateoverflow.in/808>



The minimum number of colours required to colour the vertices of a cycle with  $n$  nodes in such a way that no two adjacent nodes have the same colour is

- A. 2
- B. 3
- C. 4
- D.  $n - 2 \lfloor \frac{n}{2} \rfloor + 2$

gate2002-cse graph-theory graph-coloring normal

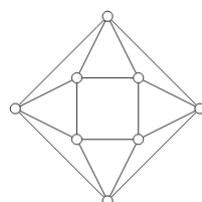
Answer ↗

#### 2.3.2 Graph Coloring: GATE CSE 2004 | Question: 77 top

→ <https://gateoverflow.in/1071>



The minimum number of colours required to colour the following graph, such that no two adjacent vertices are assigned the same color, is



- A. 2
- B. 3
- C. 4
- D. 5

gate2004-cse graph-theory graph-coloring easy

[Answer](#)**2.3.3 Graph Coloring: GATE CSE 2009 | Question: 2** [top](#)<https://gateoverflow.in/796>

What is the chromatic number of an  $n$  vertex simple connected graph which does not contain any odd length cycle? Assume  $n > 2$ .

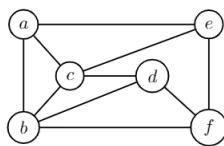
- A. 2
- B. 3
- C.  $n - 1$
- D.  $n$

[gate2009-cse](#) [graph-theory](#) [graph-coloring](#) [normal](#)[Answer](#)**2.3.4 Graph Coloring: GATE CSE 2016 Set 2 | Question: 03** [top](#)<https://gateoverflow.in/39553>

The minimum number of colours that is sufficient to vertex-colour any planar graph is \_\_\_\_\_.

[gate2016-cse-set2](#) [graph-theory](#) [graph-coloring](#) [normal](#) [numerical-answers](#)[Answer](#)**2.3.5 Graph Coloring: GATE CSE 2018 | Question: 18** [top](#)<https://gateoverflow.in/204092>

The chromatic number of the following graph is \_\_\_\_\_

[graph-theory](#) [graph-coloring](#) [numerical-answers](#) [gate2018-cse](#)[Answer](#)**2.3.6 Graph Coloring: GATE CSE 2020 | Question: 52** [top](#)<https://gateoverflow.in/333179>

Graph  $G$  is obtained by adding vertex  $s$  to  $K_{3,4}$  and making  $s$  adjacent to every vertex of  $K_{3,4}$ . The minimum number of colours required to edge-colour  $G$  is \_\_\_\_\_

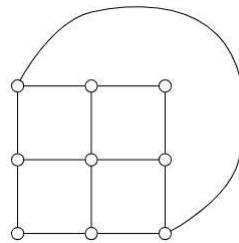
[gate2020-cse](#) [numerical-answers](#) [graph-theory](#) [graph-coloring](#)[Answer](#)**2.3.7 Graph Coloring: GATE IT 2006 | Question: 25** [top](#)<https://gateoverflow.in/3564>

Consider the undirected graph  $G$  defined as follows. The vertices of  $G$  are bit strings of length  $n$ . We have an edge between vertex  $u$  and vertex  $v$  if and only if  $u$  and  $v$  differ in exactly one bit position (in other words,  $v$  can be obtained from  $u$  by flipping a single bit). The ratio of the chromatic number of  $G$  to the diameter of  $G$  is,

- A.  $\frac{1}{(2^{n-1})}$
- B.  $(\frac{1}{n})$
- C.  $(\frac{2}{n})$
- D.  $(\frac{3}{n})$

[gate2006-it](#) [graph-theory](#) [graph-coloring](#) [normal](#)[Answer](#)**2.3.8 Graph Coloring: GATE IT 2008 | Question: 3** [top](#)<https://gateoverflow.in/3263>

What is the chromatic number of the following graph?



- A. 2  
B. 3  
C. 4  
D. 5

gate2008-it graph-theory graph-coloring normal

Answer

### Answers: Graph Coloring

#### 2.3.1 Graph Coloring: GATE CSE 2002 | Question: 1.4

<https://gateoverflow.in/808>



- ✓ Chromatic number will be 3 for when  $n$  is odd and will be 2 when  $n$  is even. Option (D) is a representation for this, hence the correct answer

34 votes

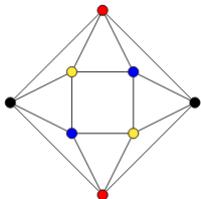
-- Madhur Rawat (2k points)

#### 2.3.2 Graph Coloring: GATE CSE 2004 | Question: 77

<https://gateoverflow.in/1071>



- ✓ 4 colors are required to color the graph in the prescribed way.



answer = option C

31 votes

-- Amar Vashishth (25.2k points)

#### 2.3.3 Graph Coloring: GATE CSE 2009 | Question: 2

<https://gateoverflow.in/796>



- ✓ Lemma 1 :  $G$  is bipartite, if and only if it does not contain any cycle of odd length.

Proof. Suppose  $G$  has an odd cycle. Then obviously it cannot be bipartite, because no odd cycle is 2-colorable. Conversely, suppose  $G$  has no odd cycle. Then we can color the vertices greedily by 2 colors, always choosing a different color for a neighbor of some vertex which has been colored already. Any additional edges are consistent with our coloring, otherwise they would close a cycle of odd length with the edges we considered already. The easiest extremal question is about the maximum possible number of edges in a bipartite graph on  $n$  vertices. 1 ref@ <http://math.mit.edu/~fox/MAT307-lecture07.pdf>

Bipartite Graph: A graph which is 2-colorable is called bipartite. We have already seen several bipartite graphs, including paths, cycles with even length, and the graph of the cube (but not any other regular polyhedra)

ref@ [http://ocw.mit.edu/high-school/mathematics/combinatorics-the-fine-art-of-counting/lecture-notes/MITFH\\_lecturenotes\\_9.pdf](http://ocw.mit.edu/high-school/mathematics/combinatorics-the-fine-art-of-counting/lecture-notes/MITFH_lecturenotes_9.pdf)

3. Bipartite graphs: By definition, every bipartite graph with at least one edge has chromatic number 2. (otherwise 1 if graph is null graph )

ref@ [http://math.ucsb.edu/~padraic/mathcamp\\_2011/introGT/MC2011\\_intro\\_to\\_GT\\_wk1\\_day4.pdf](http://math.ucsb.edu/~padraic/mathcamp_2011/introGT/MC2011_intro_to_GT_wk1_day4.pdf)

Correct Answer: A

### References



48 votes

-- Mithlesh Upadhyay (4.3k points)

### 2.3.4 Graph Coloring: GATE CSE 2016 Set 2 | Question: 03 top ↗

↗ <https://gateoverflow.in/39553>



- ✓ Four color theorem is a famous result and it says that any planar graphs can be colored with only 4 colors.

Ref: [https://en.wikipedia.org/wiki/Four\\_color\\_theorem](https://en.wikipedia.org/wiki/Four_color_theorem)

### Note for confused people 😊

Here ANY is used in sense of FOR ALL  $x$ . i.e., ANY means literally any one of graph can be selected !  
Any man alive is gonna die  $\Rightarrow$  All men are gonna die and not any specific one.

Hope this clears thing a bit !

### References



57 votes

-- Akash Kanase (36k points)

### 2.3.5 Graph Coloring: GATE CSE 2018 | Question: 18 top ↗

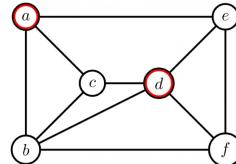
↗ <https://gateoverflow.in/204092>



- ✓ Here, Independent sets,  $S_1 = \{a, d\}$ ,  $S_2 = \{b, e\}$ ,  $S_3 = \{c, f\}$

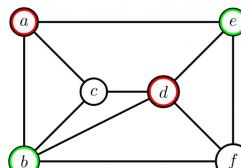
Therefore, vertices of  $S_1$  has no connection between each other [ $\because a$  &  $d$  are not connected by an edge]

$S_1 \Rightarrow$  put RED



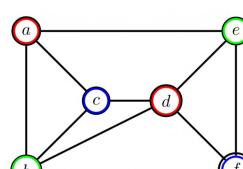
Vertices of  $S_2$  has no connection between each other [ $\because b$  &  $e$  are not connected by an edge]

$S_2 \Rightarrow$  put GREEN



Vertices of  $S_3$  has no connection between each other [ $\because c$  &  $f$  are not connected by an edge]

$S_3 \Rightarrow$  put BLUE



$\therefore$  These graph has chromatic number as 3.

#### Explanation: Why solving by independent sets?

Independent set means a set containing vertices & each & every vertex of this set is independent to each other i.e. if there are 3 vertices in an independent set, then each vertex of this set does not connected to other vertex of this set by an edge.

Suppose, there are two independent sets ( $S_1$  &  $S_2$ ). Then any vertex of  $S_1$  has connection(share an edge) to any vertex of set  $S_2$ .

$\because S_1, S_2, S_3$  are different independent sets & they share some connection between them, we put different colours to different sets.

$S_1$  share connections to  $S_2$  &  $S_3$

$\therefore$  Put **RED** to  $S_1$ , not  $S_2$  &  $S_3$

Similarly,  $S_2$  share connections to  $S_1$  &  $S_3$

$\therefore$  Put **GREEN** to  $S_2$ , not  $S_1$  &  $S_3$

$S_3$  share connections to  $S_1$  &  $S_2$

$\therefore$  Put **BLUE** to  $S_3$ , not  $S_1$  &  $S_2$

**The advantage of following this method is when we have a complicated graph then we do not need to continuously see whether any vertex is adjacent to each other when we colour any vertex.**

55 votes

-- Sukanya Das (9,9k points)



#### 2.3.6 Graph Coloring: GATE CSE 2020 | Question: 52 top

https://gateoverflow.in/333179

- ✓ This question is asking for edge coloring and not vertex coloring.

Had it been asked for vertex coloring, the answer would be 3 (one color each for the two sets of vertices in given bipartite graph and 1 color for vertex 's')

Edge coloring for graph is assignment of colors to the graph edges such that no two incident edges have the same color.

The vertex which is a part of highest number of incident edges is 's' as it has an edge to every other vertex of the graph. So there are 7 incident edges for this vertex and all of them need to be assigned a different/unique color.

So the minimum number of colors needed for edge coloring the given graph is 7.

12 votes

-- NabilSayyad (7.61 points)



#### 2.3.7 Graph Coloring: GATE IT 2006 | Question: 25 top

https://gateoverflow.in/3564

- ✓ Answer is (C)

For the given condition we can simply design a K-MAP and mark an edge between every two adjacent cells in K-Map. (adjacency has to seen just as we do for minimization )

That will give us a Bipartite graph. chromatic number for this = 2.

Also from the same we can conclude that we need ,for a ' $n$ ' bit string, to traverse NO MORE than  $(n - 1)$  edges or ' $n$ ' vertices to get a path b/w two arbitrary points.

So ratio is  $(\frac{2}{n})$ .

The given graph is actually hypercubegraph.

[https://en.wikipedia.org/wiki/Hypercube\\_graph](https://en.wikipedia.org/wiki/Hypercube_graph)

See problem 4 here:

[http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-spring-2005/assignments/pset5\\_soln.pdf](http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-spring-2005/assignments/pset5_soln.pdf)

References

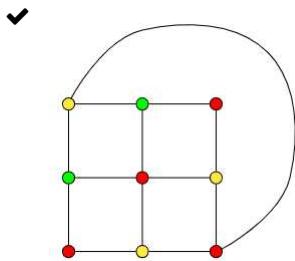


38 votes

-- Sandeep\_Uniyal (6.5k points)

### 2.3.8 Graph Coloring: GATE IT 2008 | Question: 3 top ↗

<https://gateoverflow.in/3263>



The chromatic number of a graph is the smallest number of colors needed to color the vertices so that no two adjacent vertices share the same color.

Hence minimum number of colors needed to color given graph is equal to 3

For odd length cycles we need minimum 3 colors for vertex coloring and for even length cycles we need just 2.

Answer is B

31 votes

-- vinodmmts (363 points)

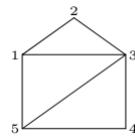
## 2.4

### Graph Connectivity (29) top ↗

<https://gateoverflow.in/82442>



### 2.4.1 Graph Connectivity: GATE CSE 1987 | Question: 9d top ↗



Specify an adjacency-lists representation of the undirected graph given above.

gate1987 graph-theory easy graph-connectivity descriptive

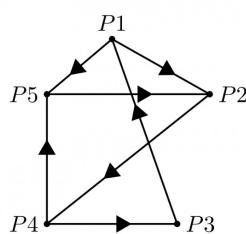
Answer ↗

### 2.4.2 Graph Connectivity: GATE CSE 1988 | Question: 2xvi top ↗

<https://gateoverflow.in/94340>



Write the adjacency matrix representation of the graph given in below figure.



gate1988 descriptive graph-theory graph-connectivity

Answer ↗

### 2.4.3 Graph Connectivity: GATE CSE 1990 | Question: 1-viii top ↗

<https://gateoverflow.in/83854>



A graph which has the same number of edges as its complement must have number of vertices congruent to \_\_\_\_\_ or \_\_\_\_\_ modulo 4.

gate1990 graph-theory graph-connectivity fill-in-the-blanks

Answer 

#### 2.4.4 Graph Connectivity: GATE CSE 1991 | Question: 01,xv [top](#)

<https://gateoverflow.in/510>



The maximum number of possible edges in an undirected graph with  $n$  vertices and  $k$  components is \_\_\_\_\_.

gate1991 graph-theory graph-connectivity normal fill-in-the-blanks

Answer 

#### 2.4.5 Graph Connectivity: GATE CSE 1992 | Question: 03,iii [top](#)

<https://gateoverflow.in/580>



How many edges can there be in a forest with  $p$  components having  $n$  vertices in all?

gate1992 graph-theory graph-connectivity descriptive

Answer 

#### 2.4.6 Graph Connectivity: GATE CSE 1993 | Question: 8.1 [top](#)

<https://gateoverflow.in/2299>



Consider a simple connected graph  $G$  with  $n$  vertices and  $n$  edges ( $n > 2$ ). Then, which of the following statements are true?

- A.  $G$  has no cycles
- B. The graph obtained by removing any edge from  $G$  is not connected
- C.  $G$  has at least one cycle
- D. The graph obtained by removing any two edges from  $G$  is not connected
- E. None of the above

gate1993 graph-theory graph-connectivity easy multiple-selects

Answer 

#### 2.4.7 Graph Connectivity: GATE CSE 1994 | Question: 2.5 [top](#)

<https://gateoverflow.in/2472>



The number of edges in a regular graph of degree  $d$  and  $n$  vertices is \_\_\_\_\_

gate1994 graph-theory easy graph-connectivity fill-in-the-blanks

Answer 

#### 2.4.8 Graph Connectivity: GATE CSE 1995 | Question: 1.25 [top](#)

<https://gateoverflow.in/2612>



The minimum number of edges in a connected cyclic graph on  $n$  vertices is:

- A.  $n - 1$
- B.  $n$
- C.  $n + 1$
- D. None of the above

gate1995 graph-theory graph-connectivity easy

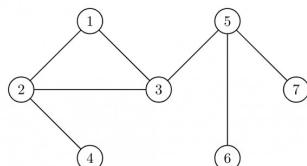
Answer 

#### 2.4.9 Graph Connectivity: GATE CSE 1999 | Question: 1.15 [top](#)

<https://gateoverflow.in/1468>



The number of articulation points of the following graph is



- A. 0
- B. 1

- C. 2  
D. 3

gate1999 graph-theory graph-connectivity normal

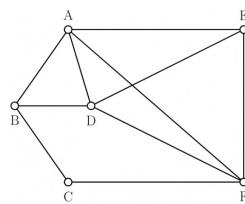
Answer 

#### 2.4.10 Graph Connectivity: GATE CSE 1999 | Question: 5

<https://gateoverflow.in/1504>



Let  $G$  be a connected, undirected graph. A cut in  $G$  is a set of edges whose removal results in  $G$  being broken into two or more components, which are not connected with each other. The size of a cut is called its cardinality. A min-cut of  $G$  is a cut in  $G$  of minimum cardinality. Consider the following graph:



- Which of the following sets of edges is a cut?
  - $\{(A, B), (E, F), (B, D), (A, E), (A, D)\}$
  - $\{(B, D), (C, F), (A, B)\}$
- What is cardinality of min-cut in this graph?
- Prove that if a connected undirected graph  $G$  with  $n$  vertices has a min-cut of cardinality  $k$ , then  $G$  has at least  $(\frac{n \times k}{2})$  edges.

gate1999 graph-theory graph-connectivity normal descriptive proof

Answer 

#### 2.4.11 Graph Connectivity: GATE CSE 2002 | Question: 1.25, ISRO2008-30, ISRO2016-6



The maximum number of edges in a  $n$ -node undirected graph without self loops is

- A.  $n^2$   
 B.  $\frac{n(n-1)}{2}$   
 C.  $n - 1$   
 D.  $\frac{(n+1)(n)}{2}$

gate2002-cse graph-theory easy isro2008 isro2016 graph-connectivity

Answer 

#### 2.4.12 Graph Connectivity: GATE CSE 2003 | Question: 8, ISRO2009-53

<https://gateoverflow.in/899>



Let  $G$  be an arbitrary graph with  $n$  nodes and  $k$  components. If a vertex is removed from  $G$ , the number of components in the resultant graph must necessarily lie down between

- A.  $k$  and  $n$   
 B.  $k - 1$  and  $k + 1$   
 C.  $k - 1$  and  $n - 1$   
 D.  $k + 1$  and  $n - k$

gate2003-cse graph-theory graph-connectivity normal isro2009

Answer 

#### 2.4.13 Graph Connectivity: GATE CSE 2005 | Question: 11

<https://gateoverflow.in/1161>



Let  $G$  be a simple graph with 20 vertices and 100 edges. The size of the minimum vertex cover of  $G$  is 8. Then, the size of the maximum independent set of  $G$  is:

- A. 12

- B. 8  
C. less than 8  
D. more than 12

gate2005-cse graph-theory normal graph-connectivity

Answer 

#### 2.4.14 Graph Connectivity: GATE CSE 2006 | Question: 73

<https://gateoverflow.in/43567>



The  $2^n$  vertices of a graph  $G$  corresponds to all subsets of a set of size  $n$ , for  $n \geq 6$ . Two vertices of  $G$  are adjacent if and only if the corresponding sets intersect in exactly two elements.

The number of connected components in  $G$  is:

- A.  $n$   
B.  $n + 2$   
C.  $2^{\frac{n}{2}}$   
D.  $\frac{2^n}{n}$

gate2006-cse graph-theory normal graph-connectivity

Answer 

#### 2.4.15 Graph Connectivity: GATE CSE 2007 | Question: 23

<https://gateoverflow.in/1211>



Which of the following graphs has an Eulerian circuit?

- A. Any  $k$ -regular graph where  $k$  is an even number.  
B. A complete graph on 90 vertices.  
C. The complement of a cycle on 25 vertices.  
D. None of the above

gate2007-cse graph-theory normal graph-connectivity

Answer 

#### 2.4.16 Graph Connectivity: GATE CSE 2013 | Question: 26

<https://gateoverflow.in/1537>



The line graph  $L(G)$  of a simple graph  $G$  is defined as follows:

- There is exactly one vertex  $v(e)$  in  $L(G)$  for each edge  $e$  in  $G$ .
- For any two edges  $e$  and  $e'$  in  $G$ ,  $L(G)$  has an edge between  $v(e)$  and  $v(e')$ , if and only if  $e$  and  $e'$  are incident with the same vertex in  $G$ .

Which of the following statements is/are TRUE?

- (P) The line graph of a cycle is a cycle.
- (Q) The line graph of a clique is a clique.
- (R) The line graph of a planar graph is planar.
- (S) The line graph of a tree is a tree.

- A.  $P$  only  
B.  $P$  and  $R$  only  
C.  $R$  only  
D.  $P, Q$  and  $S$  only

gate2013-cse graph-theory normal graph-connectivity

Answer 

#### 2.4.17 Graph Connectivity: GATE CSE 2014 Set 1 | Question: 51

<https://gateoverflow.in/1931>



Consider an undirected graph  $G$  where self-loops are not allowed. The vertex set of  $G$  is  $\{(i, j) \mid 1 \leq i \leq 12, 1 \leq j \leq 12\}$ . There is an edge between  $(a, b)$  and  $(c, d)$  if  $|a - c| \leq 1$  and  $|b - d| \leq 1$ . The number of edges in this graph is \_\_\_\_\_.

[gate2014-cse-set1](#) [graph-theory](#) [numerical-answers](#) [normal](#) [graph-connectivity](#)

Answer

**2.4.18 Graph Connectivity: GATE CSE 2014 Set 2 | Question: 3** [top](#)<https://gateoverflow.in/1955>

The maximum number of edges in a bipartite graph on 12 vertices is \_\_\_\_\_

[gate2014-cse-set2](#) [graph-theory](#) [graph-connectivity](#) [numerical-answers](#) [normal](#)

Answer

**2.4.19 Graph Connectivity: GATE CSE 2014 Set 3 | Question: 51** [top](#)<https://gateoverflow.in/2085>If  $G$  is the forest with  $n$  vertices and  $k$  connected components, how many edges does  $G$  have?

- A.  $\left\lfloor \frac{n}{k} \right\rfloor$
- B.  $\left\lceil \frac{n}{k} \right\rceil$
- C.  $n - k$
- D.  $n - k + 1$

[gate2014-cse-set3](#) [graph-theory](#) [graph-connectivity](#) [normal](#)

Answer

**2.4.20 Graph Connectivity: GATE CSE 2015 Set 2 | Question: 50** [top](#)<https://gateoverflow.in/8252>

In a connected graph, a bridge is an edge whose removal disconnects the graph. Which one of the following statements is true?

- A. A tree has no bridges
- B. A bridge cannot be part of a simple cycle
- C. Every edge of a clique with size  $\geq 3$  is a bridge (A clique is any complete subgraph of a graph)
- D. A graph with bridges cannot have cycle

[gate2015-cse-set2](#) [graph-theory](#) [graph-connectivity](#) [easy](#)

Answer

**2.4.21 Graph Connectivity: GATE CSE 2019 | Question: 12** [top](#)<https://gateoverflow.in/302836>Let  $G$  be an undirected complete graph on  $n$  vertices, where  $n > 2$ . Then, the number of different Hamiltonian cycles in  $G$  is equal to

- A.  $n!$
- B.  $(n - 1)!$
- C. 1
- D.  $\frac{(n-1)!}{2}$

[gate2019-cse](#) [engineering-mathematics](#) [discrete-mathematics](#) [graph-theory](#) [graph-connectivity](#)

Answer

**2.4.22 Graph Connectivity: GATE CSE 2019 | Question: 38** [top](#)<https://gateoverflow.in/302810>Let  $G$  be any connected, weighted, undirected graph.

- I.  $G$  has a unique minimum spanning tree, if no two edges of  $G$  have the same weight.
- II.  $G$  has a unique minimum spanning tree, if, for every cut of  $G$ , there is a unique minimum-weight edge crossing the cut.

Which of the following statements is/are TRUE?

- A. I only
- B. II only
- C. Both I and II
- D. Neither I nor II

gate2019-cse engineering-mathematics discrete-mathematics graph-theory graph-connectivity

Answer 

#### 2.4.23 Graph Connectivity: GATE CSE 2021 Set 1 | Question: 36 [top](#)

<https://gateoverflow.in/357415>



Let  $G = (V, E)$  be an undirected unweighted connected graph. The *diameter* of  $G$  is defined as:

$$\text{diam}(G) = \max_{u,v \in V} \{\text{the length of shortest path between } u \text{ and } v\}$$

Let  $M$  be the adjacency matrix of  $G$ .

Define graph  $G_2$  on the same set of vertices with adjacency matrix  $N$ , where

$$N_{ij} = \begin{cases} 1 & \text{if } M_{ij} > 0 \text{ or } P_{ij} > 0, \text{ where } P = M^2 \\ 0 & \text{otherwise} \end{cases}$$

Which one of the following statements is true?

- A.  $\text{diam}(G_2) \leq \lceil \text{diam}(G)/2 \rceil$
- B.  $\lceil \text{diam}(G)/2 \rceil < \text{diam}(G_2) < \text{diam}(G)$
- C.  $\text{diam}(G_2) = \text{diam}(G)$
- D.  $\text{diam}(G) < \text{diam}(G_2) \leq 2 \text{ diam}(G)$

gate2021-cse-set1 graph-theory graph-connectivity

Answer 

#### 2.4.24 Graph Connectivity: GATE IT 2004 | Question: 37 [top](#)

<https://gateoverflow.in/3680>



What is the number of vertices in an undirected connected graph with 27 edges, 6 vertices of degree 2, 3 vertices of degree 4 and remaining of degree 3?

- A. 10
- B. 11
- C. 18
- D. 19

gate2004-it graph-theory graph-connectivity normal

Answer 

#### 2.4.25 Graph Connectivity: GATE IT 2004 | Question: 5 [top](#)

<https://gateoverflow.in/3646>



What is the maximum number of edges in an acyclic undirected graph with  $n$  vertices?

- A.  $n - 1$
- B.  $n$
- C.  $n + 1$
- D.  $2n - 1$

gate2004-it graph-theory graph-connectivity normal

Answer 

#### 2.4.26 Graph Connectivity: GATE IT 2005 | Question: 56 [top](#)

<https://gateoverflow.in/3817>



Let  $G$  be a directed graph whose vertex set is the set of numbers from 1 to 100. There is an edge from a vertex  $i$  to a vertex  $j$  iff either  $j = i + 1$  or  $j = 3i$ . The minimum number of edges in a path in  $G$  from vertex 1 to vertex 100 is

- A. 4
- B. 7
- C. 23
- D. 99

gate2005-it graph-theory graph-connectivity normal

[Answer](#)**2.4.27 Graph Connectivity: GATE IT 2006 | Question: 11** [top](#)<https://gateoverflow.in/3550>

If all the edge weights of an undirected graph are positive, then any subset of edges that connects all the vertices and has minimum total weight is a

- A. Hamiltonian cycle
- B. grid
- C. hypercube
- D. tree

[gate2006-it](#) [graph-theory](#) [graph-connectivity](#) [normal](#)
[Answer](#)**2.4.28 Graph Connectivity: GATE IT 2007 | Question: 25** [top](#)<https://gateoverflow.in/3458>

What is the largest integer  $m$  such that every simple connected graph with  $n$  vertices and  $n$  edges contains at least  $m$  different spanning trees ?

- A. 1
- B. 2
- C. 3
- D.  $n$

[gate2007-it](#) [graph-theory](#) [graph-connectivity](#) [normal](#)
[Answer](#)**2.4.29 Graph Connectivity: GATE IT 2008 | Question: 27** [top](#)<https://gateoverflow.in/3317>

$G$  is a simple undirected graph. Some vertices of  $G$  are of odd degree. Add a node  $v$  to  $G$  and make it adjacent to each odd degree vertex of  $G$ . The resultant graph is sure to be

- A. regular
- B. complete
- C. Hamiltonian
- D. Euler

[gate2008-it](#) [graph-theory](#) [graph-connectivity](#) [normal](#)
[Answer](#)**Answers: Graph Connectivity****2.4.1 Graph Connectivity: GATE CSE 1987 | Question: 9d** [top](#)<https://gateoverflow.in/82442>

- ✓ An adjacency list is an array  $A$  of separate lists.

Each element of the array  $A_i$  is a list, which contains all the vertices that are adjacent to vertex  $i$ .

- $A_1 \rightarrow 2 \rightarrow 3 \rightarrow 5$
- $A_2 \rightarrow 1 \rightarrow 3$
- $A_3 \rightarrow 1 \rightarrow 2 \rightarrow 4 \rightarrow 5$
- $A_4 \rightarrow 3 \rightarrow 5$
- $A_5 \rightarrow 1 \rightarrow 3 \rightarrow 4$

[10 votes](#)

-- Satbir Singh (20.9k points)

**2.4.2 Graph Connectivity: GATE CSE 1988 | Question: 2xvi** [top](#)<https://gateoverflow.in/94340>[✓](#)

	$P_1$	$P_2$	$P_3$	$P_4$	$P_5$
$P_1$	0	1	0	0	1
$P_2$	0	0	0	1	0
$P_3$	1	0	0	0	0
$P_4$	0	0	1	0	1
$P_5$	0	1	0	0	0

8 votes

-- shruti pujar (241 points)

#### 2.4.3 Graph Connectivity: GATE CSE 1990 | Question: 1-viii [top](#)

<https://gateoverflow.in/83854>



It is the definition of self complementary graph..The definition of self complementary graph is :

**It is a graph which is isomorphic to its complement.**

By using invariant of isomorphism and property of edges of graph and its complement , we have :

- a. No of edges of isomorphic graphs must be the same.
- b. no of edge of a graph + no of edges of complementary graph = No of edges in  $K_n$  (complete graph), where n is the no of vertices in each of the 2 graphs which will be the same

So we know no of edges in  $K_n = \frac{n(n-1)}{2}$ .

So no of edges of each of the above 2 graph (a graph and its complement) =  $\frac{n(n-1)}{4}$

So this means the number of vertices in each of the 2 graphs should be of the form “ $4x$ ” or “ $4x + 1$ ” for integral value of no of edges which is necessary.

**Hence, the required answer is  $4x$  or  $4x + 1$ .... So that on doing modulo we get 0 which is the definition of congruence.**

25 votes

-- HABIB MOHAMMAD KHAN (67.5k points)

#### 2.4.4 Graph Connectivity: GATE CSE 1991 | Question: 01,xv [top](#)

<https://gateoverflow.in/510>



✓  $N$  vertices and  $K$  components.

(Component means they are non connected subgraphs)

We want maximum edges in total graph. How to get maximum edges ?

**To get maximum, take one vertex each for each component, except last component.**

Now  $k - 1$  components have 1 vertex each and so no edges.

The last component has  $n - (k - 1)$  vertices.

So make the last component complete.

i.e., It has  $\frac{(n-k)(n-k+1)}{2}$  edges.

Must do a similar model qsn on forest: [https://gateoverflow.in/580/gate1992\\_03-iii](https://gateoverflow.in/580/gate1992_03-iii)

#### References



50 votes

-- Ahwan Mishra (10.1k points)

Hopefully it should be clear that in any such graph all components will be complete, i.e., have all possible edges. Thus the only remaining question is how large each component should be?

If there are two components with  $a$  and  $b$  vertices,  $a > 1, b > 1$ , then together they can have at most

$$\binom{a}{2} + \binom{b}{2} = \frac{1}{2}(a^2 - a + b^2 - b) \text{ edges.}$$

However, if we place all but one of the vertices in a single component, we could have

$$\binom{a+b-1}{2} + \binom{1}{2} = \frac{1}{2}(a+b-1)(a+b-2) \\ = \frac{1}{2}(a^2 + 2ab - 3a + b^2 - 3b + 2) \text{ edges.}$$

Subtracting the first quantity from the second gives

$$\frac{1}{2}((2ab - 3a - 3b + 2) - (-a - b)) = ab - a - b + a = (a - 1)(b - 1) \text{ which is } > 0$$

Hence it is better not to have two components with multiple vertices.

This leaves us with the answer that all components should have one vertex except one, which will have  $n - k + 1$  vertices, for a total of  $\binom{n-k+1}{2}$  edges.

in simple connected graph , number of edges ,

$$(n - 1) \leq e \leq n \cdot \frac{(n-1)}{2}$$

in simple unconnected graph with k component , number of edges ,

$$(n - k) \leq e \leq (n - k) \cdot \frac{(n-k+1)}{2}$$

note :- put  $k = 1$  then it will be connected graph .

reference @ <http://www.quora.com/What-is-the-maximum-number-of-edges-in-graph-with-n-vertices-and-k-components>  
another read @ <http://stackoverflow.com/questions/24003861/maximum-number-of-edges-in-undirected-graph-with-n-vertices-with-k-connected-com>

## References



37 votes

-- Mithlesh Upadhyay (4.3k points)

### 2.4.5 Graph Connectivity: GATE CSE 1992 | Question: 03,iii top ↴

↗ <https://gateoverflow.in/580>



✓ Answer:  $n - p$ .

There are  $p$  components and  $n$  vertices. A component can have any no. of vertices but it must be a tree.

Let the no. of vertices in 1st component be  $x_1$ , in 2nd component  $x_2$ , in 3rd component  $x_3$ , and so on. For the  $p$ th component, there will be  $x_p$  vertices.

- In a tree with  $n$  vertices, there are exactly  $n - 1$  edges.

So, In 1st component  $\Rightarrow (x_1 - 1)$  edges.

2nd component  $\Rightarrow (x_2 - 1)$  edges.

:

In  $p$ th component  $\Rightarrow (x_p - 1)$  edges.

Therefore, total no. of edges  $= [(x_1 + x_2 + x_3 + \dots + x_p) - p]$

$(x_1 + x_2 + x_3 + \dots + x_p) = n$  (total no. of vertices).

So, total no. of edges is  $(n - p)$ .

67 votes

-- Hemant Parihar (11.8k points)

### 2.4.6 Graph Connectivity: GATE CSE 1993 | Question: 8.1 top ↴

↗ <https://gateoverflow.in/2299>



✓ This seems like multiple answer questions.

Here we have  $n$  vertices &  $n$  edges. So we must have cycle.

So (C) has at least one cycle is True & (A) is false.

(D) The graph obtained by removing any two edges from  $G$  is not connected → This is true, for graph of  $n$  vertices to be connected, we need at least  $n - 1$  edges. If we remove 2 out of  $n$ , we get  $n - 2$  edges, which can connect at max  $n - 1$  vertices. 1 Vertex at least will be disconnected. So D is true.

(B) is false as if graph is cyclic graph then removing any edge will not disconnect graph.

Answer → **(C) & (D)**.

22 votes

-- Akash Kanase (36k points)

#### 2.4.7 Graph Connectivity: GATE CSE 1994 | Question: 2.5 [top](#)

<https://gateoverflow.in/2472>



- ✓ Consider the example of complete graph, In a complete graph which is  $(n - 1)$  **regular** (where  $n$  is the no of vertices) has edges  $\frac{n(n-1)}{2}$ .  
 $n$  vertices are adjacent to  $n - 1$  vertices and an edge contributes two degree so dividing by 2.  
 $d * n = 2 * |E|$   
Therefore, in  $d$  regular graph No of edges will be  $\frac{n*d}{2}$ .

24 votes

-- Manu Thakur (34k points)

#### 2.4.8 Graph Connectivity: GATE CSE 1995 | Question: 1.25 [top](#)

<https://gateoverflow.in/2612>



- ✓ For making a cyclic graph, the minimum number of edges has to be equal to the number of vertices.

32 votes

-- Gate Keeda (16k points)

#### 2.4.9 Graph Connectivity: GATE CSE 1999 | Question: 1.15 [top](#)

<https://gateoverflow.in/1468>



- ✓ **ARTICULATION POINT:** are those points whose removal from the graph makes the graph disconnected.  
here if we remove the vertex no. 2 than we get disconnected graph.  
similarly if we remove the vertex no. 3 than we get disconnected graph.  
similarly if we remove the vertex no. 5 than we get disconnected graph.  
So, **(D)** choice.

42 votes

-- kunal chalotra (13.6k points)

#### 2.4.10 Graph Connectivity: GATE CSE 1999 | Question: 5 [top](#)

<https://gateoverflow.in/1504>



- ✓
  - Not a cut. We have spanning tree after removing this edges.  
This is cut.we break graph into two pieces.
  - Min cut size is  $2 \cdot \{BC, CF\}$ . Removal these two edges disconnects  $C$  from the remaining graph.
  - Always cardinality of min-cut will be  $\leq$  min-degree of the graph  
So,  $k \leq$  min-degree of the graph  
min-degree of the graph  $\geq k$   
We know that sum of degrees of all vertices =  $2 \times$  number of edges.  
minimum degree  $\times n \leq 2 \times |E|$ , where  $n$  is number of vertices,  $|E|$  is number of edges.  
 $= k * n \leq 2|E|$   
 $\Rightarrow |E| \geq (n * k / 2)$

34 votes

-- Akash Kanase (36k points)

#### 2.4.11 Graph Connectivity: GATE CSE 2002 | Question: 1.25, ISRO2008-30, ISRO2016-6 [top](#)



- ✓ In a graph of  $n$  vertices you can draw an edge from a vertex to  $(n - 1)$  vertex we will do it for  $n$  vertices so total number of edges is  $n(n - 1)$  now each edge is counted twice so the required maximum number of edges is  $\frac{n(n-1)}{2}$ .

Correct Answer: **B**

40 votes

-- Bhagirathi Nayak (11.7k points)

**2.4.12 Graph Connectivity: GATE CSE 2003 | Question: 8, ISRO2009-53**<https://gateoverflow.in/899>

- ✓ If a vertex is removed from the graph  $G$ ,

Lower Bound: number of components decreased by one =  $k - 1$  (remove an isolated vertex which was a component)

Upper Bound: number of components =  $n - 1$  (consider a vertex connected to all other vertices in a component as in a star and all other vertices outside this component being isolated. Now, removing the considered vertex makes all other  $n - 1$  vertices isolated making  $n - 1$  components)

Therefore (C).

71 votes

-- Danish (3.4k points)

**2.4.13 Graph Connectivity: GATE CSE 2005 | Question: 11**<https://gateoverflow.in/1161>

- ✓ Vertex cover: A set of vertices such that each edge of the graph is incident to at least one vertex of the set.

Therefore, removing all the vertices of the vertex cover from the graph results in an isolated graph and the same set of nodes would be the independent set in the original graph.

Size of minimum vertex cover = 8

Size of maximum independent set =  $20 - 8 = 12$

Therefore, correct answer would be (A).

Reference :- <http://mathworld.wolfram.com/MaximumIndependentVertexSet.html>

**References**

54 votes

-- suraj (4.8k points)

**2.4.14 Graph Connectivity: GATE CSE 2006 | Question: 73**<https://gateoverflow.in/43567>

- ✓ (B)  $n + 1$  (subsets of size  $< 2$  are all disconnected) + 1 (subsets of size  $\geq 2$  are all connected) =  $n + 2$ .

<https://math.stackexchange.com/questions/148305/is-a-single-node-graph-a-strongly-connected-component>

**References**

48 votes

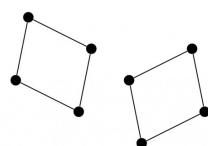
-- Vikrant Singh (11.2k points)

**2.4.15 Graph Connectivity: GATE CSE 2007 | Question: 23**<https://gateoverflow.in/1221>

- ✓ A connected Graph has Euler Circuit  $\iff$  all of its vertices have even degree
- A connected Graph has Euler Path  $\iff$  exactly 2 of its vertices have odd degree

A.  $k$ -regular graph where  $k$  is even number.

A  $k$ -regular graph need not be connected always. Example : The given below graph is a 2 regular graph is not a Euler graph. This is so because there is no single walk which covers all edges.



Graph G with 2 components

B. The complete graph of 90 vertices

In such a graph every vertex will have an odd degree = 89, Hence it cannot have a Euler path/Circuit.

C. To get degree of all vertices of the complement of cycle on 25 vertices we need to subtract the degree of a complete graph of 25 vertices with degree of vertices in the original given graph i.e. cycle on 25 vertices.

Degree of complement =  $24 - 2 = 22$ . Since, every degree is Even, and it is connected also, therefore Graph Might be a Euler Cycle but we need to check graph is connected or not.

Now Question comes it is connected or not :

It is connected because, there is a theorem which says, "Let  $G$  be a graph with  $n$  vertices and if every vertex has a degree of at least  $\frac{n-1}{2}$  then  $G$  is connected." [check this] (Alternate Proof: We can also prove this theorem using contradiction.

Suppose we have two disconnected components, then the least component (component with minimum vertices) has to have  $\leq \frac{n}{2}$  vertices. Now we can try to maximize the degree of any vertices in the least component, which can be at most  $\frac{n}{2} - 1 (= \frac{n-2}{2})$ , but we already know that the minimum degree is  $\frac{n-1}{2}$ , hence contradiction. )

Here degree of each vertex is 22, which is, of course, greater than  $\frac{25-1}{2} = 12$ .

Hence, Graph must be Euler graph.

### Option C

#### References



113 votes

-- Mithlesh Upadhyay (4.3k points)



#### 2.4.16 Graph Connectivity: GATE CSE 2013 | Question: 26 top

<https://gateoverflow.in/1537>

- ✓ P) True. Because every edge in cycle graph will become a vertex in new graph  $L(G)$  and every vertex of cycle graph will become an edge in new graph.

R) False. We can give counter example. Let  $G$  has 5 vertices and 9 edges which is a planar graph. Assume degree of one vertex is 2 and of all others are 4. Now,  $L(G)$  has 9 vertices (because  $G$  has 9 edges) and 25 edges. (See below). But for a graph to be planar  $|E| \leq 3|V| - 6$ .

For 9 vertices  $|E| \leq 3 * 9 - 6$

$$\Rightarrow |E| \leq 27 - 6$$

$\Rightarrow |E| \leq 21$ . But  $L(G)$  has 25 edges and so is not planar.

As R) is False option (B), (C) are eliminated.

<http://www.personal.kent.edu/~rmuhamma/GraphTheory/MyGraphTheory/planarity.htm>

S) False. By counter example. Try drawing a simple tree which has a Root node ,Root node has one child A, node A has two child B and C. Draw its Line graph acc. to given rules in question you will get a cycle graph of 3 vertices.

So (D) also not correct.

$\therefore$  option (A) is correct.

For a graph  $G$  with  $n$  vertices and  $m$  edges, the number of vertices of the line graph  $L(G)$  is  $m$ , and the number of edges of  $L(G)$  is half the sum of the squares of the degrees of the vertices in  $G$ , minus  $m$ .

#### References



51 votes

-- prashant singh (337 points)

**2.4.17 Graph Connectivity: GATE CSE 2014 Set 1 | Question: 51**[top ↴](https://gateoverflow.in/1931)

- ✓ If you think of a  $12 \times 12$  grid (like a chess board of size  $12 \times 12$ ), then each point  $(i, j)$ , which is in  $i^{th}$  row and  $j^{th}$  column, is a vertex  $(i, j)$ .

Now we are allowed to connect only those points which are atmost 1 distance apart (in both horizontal and vertical direction). So we will connect only horizontal neighbours, vertical neighbours, and diagonal neighbours.

So horizontal edges on each row are 11 i.e.  $11 \times 12 = 132$  horizontal edges. Similarly we have 132 vertical edges.

To count diagonal edges, think of  $1 \times 1$  square boxes in which diagonals meet each other. There are  $11 \times 11$  such square boxes, and each box contains 2 diagonals, so total diagonals = 242.

So total edges =  $132 + 132 + 242 = 506$ .

163 votes

-- Happy Mittal (8.2k points)

Total number of vertices =  $12 \times 12 = 144$ .

The graph formed by the description contains 4 (corner) vertices of degree 3 and 40 (external) vertices of degree 5 and 100 (remaining) vertices of degree 8.

According to (handshake theorem's)

$$2|E| = \text{sum of the degrees}$$

$$2|E| = 4 \times 3 + 40 \times 5 + 100 \times 8 = 1012.$$

$$|E| = \frac{1012}{2} = 506 \text{ edges.}$$

135 votes

-- Mithlesh Upadhyay (4.3k points)

**2.4.18 Graph Connectivity: GATE CSE 2014 Set 2 | Question: 3**[top ↴](https://gateoverflow.in/1955)

- ✓ Maximum no. of edges occur in a complete bipartite graph i.e. when every vertex has an edge to every opposite vertex.

Number of edges in a complete bipartite graph is  $mn$ , where  $m$  and  $n$  are no. of vertices on each side. This quantity is maximum when  $m = n$  i.e. when there are 6 vertices on each side, so answer is 36.

43 votes

-- Happy Mittal (8.2k points)

**2.4.19 Graph Connectivity: GATE CSE 2014 Set 3 | Question: 51**[top ↴](https://gateoverflow.in/2085)

- ✓ A forest is a collection of trees. here we are given a forest with  $n$  vertices and  $k$  components. a component is itself a tree.

Since there are  $k$  components means that every component has a root (every tree has one), therefore we have  $k$  roots.

Introduction of each new vertex to the forest introduces a single edge to a forest. so for remaining  $n - k$  vertices when introduced, to make up to  $n$  vertices, contributes to  $n - k$  edges.

Hence, ans = **option (C)** =  $(n - k)$

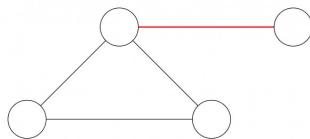
57 votes

-- Amar Vashishth (25.2k points)

**2.4.20 Graph Connectivity: GATE CSE 2015 Set 2 | Question: 50**[top ↴](https://gateoverflow.in/8252)

- ✓ **Bridge / cut edge :** A single edge whose removal will disconnect the graph is known as Bridge or cut edge.

- Every edge of a tree is a bridge.
- A bridge cannot be a part of a single cycle because in a cycle every vertex will be connected with every other vertex in 2 ways. Even if you remove 1 way by deleting an edge still the other way will make sure that the graph is connected.
- A Clique will never have a bridge because though we remove 1 edge between any 2 vertices those 2 vertices will still be connected with the remaining  $(n - 2)$  vertices using an edge each.
- Red edge in the below graph is clearly a bridge as removing that will produce an isolated vertex.



Correct Answer: B

32 votes

-- Vicky rix (7k points)

#### 2.4.21 Graph Connectivity: GATE CSE 2019 | Question: 12 top ↗

<https://gateoverflow.in/302836>



- ✓ The number of different Hamiltonian cycles in a complete undirected **labeled** graph on  $n$  vertices is  $(n - 1)!/2$ .  
Ref : [https://en.wikipedia.org/wiki/Hamiltonian\\_path](https://en.wikipedia.org/wiki/Hamiltonian_path)

If the graph is unlabeled number of different Hamiltonian cycles become 1.

Since the question does not mention whether the graph is labeled or not, answer can be either (C) or (D).

Official answer key is (D) or (C)

#### References



25 votes

-- Digvijay (44.9k points)

#### 2.4.22 Graph Connectivity: GATE CSE 2019 | Question: 38 top ↗

<https://gateoverflow.in/302810>



- ✓ 1. If edge weights are distinct then there exist unique MST.

2. If for every cut of a graph there is a unique light edge crossing the cut then the graph has a unique minimum spanning tree but converse may not be true.

#### Proof by contradiction:

**Lemma:** If an edge  $e$  is contained in some minimum spanning tree, then it is a minimum cost edge crossing some cut of the graph.

Assume MST is not unique and there exist two MST's  $T_1$  and  $T_2$

Suppose  $e_1 \in T_1$  but  $e_1 \notin T_2$ , if we remove  $e_1$  from  $T_1$ , then we will have disconnected graph with two set of vertices  $V_1$  and  $V_2$ . According to lemma  $e_1$  is a minimum cost edge in the cut between  $V_1$  and  $V_2$ .

Suppose  $e_2 \in T_2$  but  $e_2 \notin T_1$ , if we remove  $e_2$  from  $T_2$ , then we will have disconnected graph with two set of vertices  $V_1$  and  $V_2$ . According to lemma  $e_2$  is a minimum cost edge in the cut between  $V_1$  and  $V_2$ .

Because the minimum cost edge is unique implies  $e_1$  and  $e_2$  is the same edge.  $e_1 \in T_2$  and  $e_2 \in T_1$ . We have chosen  $e_1$  at random, of all edges in  $T_1$ , also in  $T_2$  and same for  $e_2$ . As a result, the MST is unique.

Why converse is not true always?

<https://stanford.edu/~rezab/discrete/Midterm/midtermsoln.pdf>

So both statements in the question are TRUE.

Answer is (C).

#### References



16 votes

-- Digvijay (44.9k points)

#### 2.4.23 Graph Connectivity: GATE CSE 2021 Set 1 | Question: 36 top ↗

<https://gateoverflow.in/357415>



From the definition of adjacency matrix of  $G_2$ , it is clear that any two vertices that were adjacent in  $G$  are also adjacent in  $G_2$ . Also, for any two vertices  $m, n$  of  $G$  which were not adjacent in  $G$  will be adjacent in  $G_2$  iff they are adjacent to some other common vertex(just try to find the value of  $N(m, n)$  for some  $m, n$ . You will see why this double implication is true).

Also, take any path between any two vertex, say  $x$  and  $y$  in  $G$ . Let the vertices along this path be  $x, x_1, x_2, \dots, y$ . Now there will be a new path corresponding to this in  $G_2$  which will be  $x, x_2, x_4, \dots, y$  because of the same reason as discussed above(for eg, in  $G_2$   $x$  and  $x_2$  will become adjacent as both were adjacent to  $x_1$  in  $G$ ).

So the length of all paths between any 2 vertex will become almost half.

1 votes

-- ascend (75 points)

#### 2.4.24 Graph Connectivity: GATE IT 2004 | Question: 37 top

<https://gateoverflow.in/3680>



- ✓ sum of degree of all the vertices =  $2 * \text{number of edges}$ .

$$2 \times 6 + 4 \times 3 + 3 \times x = 27 \times 2$$

$$x = 10.$$

$$\text{Number of vertices} = 6 + 3 + x = 19.$$

The correct answer is (D).

34 votes

-- suraj (4.8k points)

#### 2.4.25 Graph Connectivity: GATE IT 2004 | Question: 5 top

<https://gateoverflow.in/3646>



- ✓ This is possible with spanning tree.

A spanning tree with  $n$  nodes has  $n - 1$  edges.

Therefore, Answer is (A)

31 votes

-- Dhananjay (1.1k points)

#### 2.4.26 Graph Connectivity: GATE IT 2005 | Question: 56 top

<https://gateoverflow.in/3817>



- ✓ Edge set consists of edges from  $i$  to  $j$  using either

1.  $j = i + 1$  (or)
2.  $j = 3i$ .

Second option will help us reach from 1 to 100 rapidly. The trick to solve this question is to **think in reverse way**. Instead of finding a path from 1 to 100, try to find a path from 100 to 1.

The edge sequence with minimum number of edges is  $1 \rightarrow 3 \rightarrow 9 \rightarrow 10 \rightarrow 11 \rightarrow 33 \rightarrow 99 \rightarrow 100$  which consists of 7 edges.

The answer is option (B).

74 votes

-- Shridhar (311 points)

#### 2.4.27 Graph Connectivity: GATE IT 2006 | Question: 11 top

<https://gateoverflow.in/3550>



- A. **Hamiltonian cycle**  $\Rightarrow$  This is a cycle. A cycle will not only connect all vertices, it will have 1 extra edge than necessary. So I can just remove that edge & get better cost "subset of edges" which connect all vertices. So, this is FALSE.
- B. **grid**  $\Rightarrow$  A **grid graph** has cycles and so this is FALSE for same reason as option A.
- C. **Hypercube**  $\Rightarrow$  A **hypercube graph** also has cycles. So, this also is FALSE.
- D. **Tree**  $\Rightarrow$  This is answer. We need to have **Minimum spanning tree** to be exact.

"If all the edge weights of an undirected graph are positive, then any subset of edges that connects all the vertices and has minimum total weight is a Minimum Spanning Tree". !

(D) is TRUE.

References



47 votes

-- Akash Kanase (36k points)

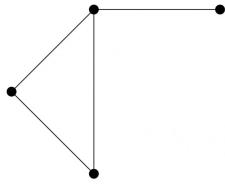
**2.4.28 Graph Connectivity: GATE IT 2007 | Question: 25**<https://gateoverflow.in/3458>

- ✓ **OPTION (C)** is Correct, reason is as follows:

A graph is **connected** and has ' $n$ ' vertices and edges means, **exactly one cycle** is there.

Now we can make a different spanning tree by removing one edge from the cycle, one at a time.

Minimum cycle length can be 3, So, there must be at least 3 spanning trees in any such graph.



Consider the above graph. Here  $n = 4$  and three spanning trees possible at max (removing edges of cycle one at a time, alternatively).

So, any such Graph with minimum cycle length '3' will have at least 3 spanning trees.

73 votes

-- Himanshu Agarwal (12.4k points)

**2.4.29 Graph Connectivity: GATE IT 2008 | Question: 27**<https://gateoverflow.in/3317>

- ✓ In any simple undirected graph, total degree of all vertices is even (since each edge contributes 2 degrees). So number of vertices having odd degrees must be even, otherwise their sum would have been odd, making total degree also odd.

Now Single vertex  $v$  is connected to all these even number of vertices (which have odd degrees). So degree of  $v$  is also even. Moreover, now degree of all vertices which are connected to  $v$  is increased by 1, hence vertices which had odd degree earlier now have even degree.

So now, all vertices in graph have even degree, which is necessary and sufficient condition for euler graph. So **(D)** is correct.

61 votes

-- Happy Mittal (8.2k points)

**2.5****Graph Matching (1)****2.5.1 Graph Matching: GATE CSE 2003 | Question: 36**<https://gateoverflow.in/926>

How many perfect matching are there in a complete graph of 6 vertices?

- A. 15
- B. 24
- C. 30
- D. 60

[gate2003-cse](#) [graph-theory](#) [graph-matching](#) [normal](#)

[Answer](#)

**Answers: Graph Matching****2.5.1 Graph Matching: GATE CSE 2003 | Question: 36**<https://gateoverflow.in/926>

- ✓ Perfect matching is a set of edges such that each vertex appears only once and all vertices appear at least once (EXACTLY one appearance). So for  $n$  vertices perfect matching will have  $n/2$  edges and there won't be any perfect matching if  $n$  is odd.

For  $n = 6$ , we can choose the first edge in  ${}^6C_2 = 15$  ways, second in  ${}^4C_2 = 6$  ways and third in  ${}^2C_2 = 1$  way. So, total number of ways =  $15 \times 6 = 90$ . But perfect matching being a set, order of elements is not important. i.e., the  $3!$  permutations of the 3 edges are same only. So, total number of perfect matching =  $\frac{90}{3!} = \frac{90}{6} = 15$ .

Alternatively we can also say there are 3 identical buckets to be filled from 6 vertices such that 2 should go to each of them. Now the first vertex can combine with any of the other 5 vertices and go to bucket 1 – 5 ways. Now only 4 vertices remain

and 2 buckets. We can take one vertex and it can choose a companion in 3 ways and go to second bucket- 3 ways. Now only a single bucket and 2 vertices remain. so just 1 way to fill the last one. So total ways =  $5 \times 3 = 15$ .

Correct Answer: A

70 votes

-- Arjun Suresh (328k points)

**Note: To understand the solution please go through the definitions of perfect matching**

The complete graph  $k_n$  have a perfect matching only when n is even. So let  $n = 2m$ .

Let the vertices be  $V_1, V_2, \dots, V_{2m}$ .

$v_1$  can be joined to any other  $(2m - 1)$  vertices.

$v_2$  can be joined to any other  $(2m - 3)$  vertices.

Similarly, go till  $V_{2m}$  which will have only one vertex to be joined with.

No. of Perfect matches =  $(2m - 1)(2m - 3)(2m - 5) \dots (3)(1)$

In the above question  $2m = 6$ .

So, No. of perfect matches =  $5 \times 3 \times 1 = 15$ .

41 votes

-- Hunain (575 points)

## 2.6

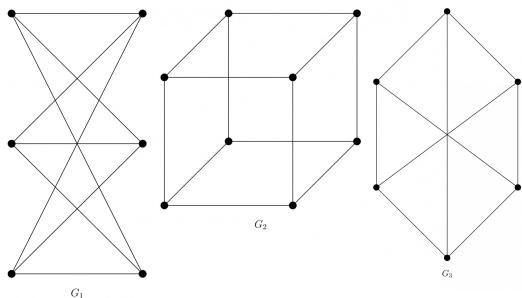
### Graph Planarity (5) top ↗

#### 2.6.1 Graph Planarity: GATE CSE 1989 | Question: 3-vi top ↗

<https://gateoverflow.in/87129>



Which of the following graphs is/are planer?



[gate1989](#) [normal](#) [graph-theory](#) [graph-planarity](#) [descriptive](#)

Answer

<https://gateoverflow.in/85384>



#### 2.6.2 Graph Planarity: GATE CSE 1990 | Question: 3-xi top ↗

A graph is planar if and only if,

- A. It does not contain subgraphs homeomorphic to  $k_5$  and  $k_{3,3}$ .
- B. It does not contain subgraphs isomorphic to  $k_5$  or  $k_{3,3}$ .
- C. It does not contain a subgraph isomorphic to  $k_5$  or  $k_{3,3}$ .
- D. It does not contain a subgraph homeomorphic to  $k_5$  or  $k_{3,3}$ .

[gate1990](#) [normal](#) [graph-theory](#) [graph-planarity](#) [multiple-selects](#)

Answer

<https://gateoverflow.in/1159>



#### 2.6.3 Graph Planarity: GATE CSE 2005 | Question: 10 top ↗

Let  $G$  be a simple connected planar graph with 13 vertices and 19 edges. Then, the number of faces in the planar embedding of the graph is:

- A. 6
- B. 8
- C. 9
- D. 13

[gate2005-cse](#) [graph-theory](#) [graph-planarity](#)

[Answer](#)

#### 2.6.4 Graph Planarity: GATE CSE 2008 | Question: 23 [top](#)

<https://gateoverflow.in/421>



Which of the following statements is true for every planar graph on  $n$  vertices?

- A. The graph is connected
- B. The graph is Eulerian
- C. The graph has a vertex-cover of size at most  $\frac{3n}{4}$
- D. The graph has an independent set of size at least  $\frac{n}{3}$

gate2008-cse graph-theory normal graph-planarity

[Answer](#)

#### 2.6.5 Graph Planarity: GATE CSE 2021 Set 1 | Question: 16 [top](#)

<https://gateoverflow.in/357435>



In an undirected connected planar graph  $G$ , there are eight vertices and five faces. The number of edges in  $G$  is \_\_\_\_\_.

gate2021-cse-set1 graph-theory graph-planarity numerical-answers easy

[Answer](#)

### Answers: Graph Planarity

#### 2.6.1 Graph Planarity: GATE CSE 1989 | Question: 3-vi [top](#)

<https://gateoverflow.in/87129>



- ✓  $G_1$  is  $K_{3,3}$  which is a non-planar graph with the minimum number of edges.

Proof: Let  $K_{3,3}$  is a planar graph.

Therefore it must satisfy this useful corollary. As there is no triangle in  $K_{3,3}$ .

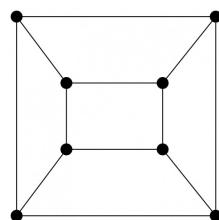
- Let  $G$  be a connected planar simple graph with  $n$  vertices and  $m$  edges, and no triangles. Then  $m \leq 2n - 4$

$$m = 9, n = 6.$$

$$\Rightarrow 9 \leq 12 - 4$$

$$\Rightarrow 9 \leq 8, \text{ which is false. So our assumption that } K_{3,3} \text{ is planar is false.}$$

$G_2$  can be redrawn like this.



Therefore  $G_2$  is a planar graph.

For  $G_3$ , we assume that it is a planar graph. Then it must satisfy the above corollary as it does not have a triangle.

$$m = 9, n = 6.$$

$$\Rightarrow 9 \leq 12 - 4$$

$$\Rightarrow 9 \leq 8, \text{ which is false. So our assumption is wrong and } G_3 \text{ is not a planar graph.}$$

Note:  $G_1$  and  $G_3$  are isomorphic graphs.

**Ans:**  $G_2$  only.

29 votes

-- Hemant Parihar (11.8k points)

#### 2.6.2 Graph Planarity: GATE CSE 1990 | Question: 3-xi [top](#)

<https://gateoverflow.in/85384>



- ✓ A graph is non planar if and only if it contains a sub graph which is homomorphic to  $K_5$  or  $K_{3,3}$ .

**This is KURATOWSKI theorem.**

When a function and its inverse function [are both homomorphic, two graphs are isomorphic](#)

Hence (D) is the answer.

<https://math.stackexchange.com/questions/183133/difference-between-graph-homomorphism-and-graph-isomorphism>

#### References



16 votes

-- vaishalitanna (163 points)

### 2.6.3 Graph Planarity: GATE CSE 2005 | Question: 10 [top](#)

<https://gateoverflow.in/1159>



- ✓  $f = e - n + 2$  where  $f$  denotes number of faces  $E$  the number of edges  $n$  the number of vertices So  $f = 19 - 13 + 2 = 8$  faces

Correct Answer: B

20 votes

-- Bhagirathi Nayak (11.7k points)

### 2.6.4 Graph Planarity: GATE CSE 2008 | Question: 23 [top](#)

<https://gateoverflow.in/421>



- ✓ Independent Set  $\geq \lceil \frac{n}{k} \rceil$  where,

$n$  is the number of vertices and  $k$  is the chromatic number

For any planar graph,  $k \geq 3$  and  $k \leq 4$ , therefore, the Independent set is at least  $\lceil n/4 \rceil$ . Hence (D) is false.

Now we know that size of Vertex Cover + Independent Set Number =  $n$ .

If Independent set number  $\geq \lceil n/4 \rceil$  then,

Vertex cover  $\leq n - \lceil n/4 \rceil$

Vertex Cover  $\leq 3n/4$

Vertex Cover is at most  $3n/4$ . So, (C) is the correct answer.

29 votes

-- nvedansh (269 points)

### 2.6.5 Graph Planarity: GATE CSE 2021 Set 1 | Question: 16 [top](#)

<https://gateoverflow.in/357435>



- ✓ Given: For a planner graph  $G$

- Number of vertices ( $V$ ) = 8
- Number of region/faces ( $R/f$ ) = 5
- Number of edges ( $E$ ) = ?

For any planner graph  $V + F = E + 2$

$$\implies 8 + 5 = E + 2$$

$$\implies E = 13 - 2 = 11$$

∴ Number of edges in given graph  $G$  is 11.

Ref: [Planar\\_graph](#)

#### References



2 votes

-- Hira Thakur (12.3k points)

## Answer Keys

2.1.1	C	2.1.2	D	2.1.3	D	2.1.4	B	2.1.5	X
2.2.1	N/A	2.2.2	N/A	2.2.3	N/A	2.2.4	D	2.2.5	C
2.2.6	C	2.2.7	B	2.2.8	C	2.2.9	D	2.2.10	C

2.2.11	C	2.2.12	16	2.3.1	D	2.3.2	C	2.3.3	A
2.3.4	4	2.3.5	3	2.3.6	7	2.3.7	C	2.3.8	B
2.4.1	N/A	2.4.2	N/A	2.4.3	N/A	2.4.4	N/A	2.4.5	N/A
2.4.6	C;D	2.4.7	N/A	2.4.8	B	2.4.9	D	2.4.10	N/A
2.4.11	B	2.4.12	C	2.4.13	A	2.4.14	B	2.4.15	C
2.4.16	A	2.4.17	506	2.4.18	36	2.4.19	C	2.4.20	B
2.4.21	D	2.4.22	C	2.4.23	A	2.4.24	D	2.4.25	A
2.4.26	B	2.4.27	D	2.4.28	C	2.4.29	D	2.5.1	A
2.6.1	N/A	2.6.2	D	2.6.3	B	2.6.4	C	2.6.5	11 : 11



**Syllabus:** Propositional and first order logic.

### Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
<b>1 Mark Count</b>	1	1	0	0	0	2	1	1	1	0	0.77	2
<b>2 Marks Count</b>	0	0	1	1	1	1	0	0	1	0	0.55	1
<b>Total Marks</b>	1	1	2	2	2	4	1	1	3	1	1.88	4

## 3.1

First Order Logic (31) top ↗3.1.1 First Order Logic: GATE CSE 1989 | Question: 14a top ↗

→ <https://gateoverflow.in/93179>

Symbolize the expression "Every mother loves her children" in predicate logic.

gate1989 descriptive first-order-logic mathematical-logic

Answer ✍

3.1.2 First Order Logic: GATE CSE 1991 | Question: 15,b top ↗

→ <https://gateoverflow.in/26748>



Consider the following first order formula:

$$\left. \begin{array}{c} \forall x \exists y : R(x, y) \\ \wedge \\ \forall x \forall y : (R(x, y) \implies \neg R(y, x)) \\ \wedge \\ \forall x \forall y \forall z : (R(x, y) \wedge R(y, z) \implies R(x, z)) \\ \wedge \\ \forall x : \neg R(x, x) \end{array} \right\}$$

Does it have finite models?

Is it satisfiable? If so, give a countable model for it.

gate1991 mathematical-logic first-order-logic descriptive

Answer ✍

3.1.3 First Order Logic: GATE CSE 1992 | Question: 92,xv top ↗

→ <https://gateoverflow.in/256>



Which of the following predicate calculus statements is/are valid?

- A.  $(\forall(x))P(x) \vee (\forall(x))Q(x) \implies (\forall(x))(P(x) \vee Q(x))$
- B.  $(\exists(x))P(x) \wedge (\exists(x))Q(x) \implies (\exists(x))(P(x) \wedge Q(x))$
- C.  $(\forall(x))(P(x) \vee Q(x)) \implies (\forall(x))P(x) \vee (\forall(x))Q(x)$
- D.  $(\exists(x))(P(x) \vee Q(x)) \implies \sim(\forall(x))P(x) \vee (\exists(x))Q(x)$

gate1992 mathematical-logic normal first-order-logic

Answer ✍

3.1.4 First Order Logic: GATE CSE 2003 | Question: 32 top ↗

→ <https://gateoverflow.in/922>



Which of the following is a valid first order formula? (Here  $\alpha$  and  $\beta$  are first order formulae with  $x$  as their only free variable)

- A.  $((\forall x)[\alpha] \Rightarrow (\forall x)[\beta]) \Rightarrow (\forall x)[\alpha \Rightarrow \beta]$

- B.  $(\forall x)[\alpha] \Rightarrow (\exists x)[\alpha \wedge \beta]$
- C.  $((\forall x)[\alpha \vee \beta] \Rightarrow (\exists x)[\alpha]) \Rightarrow (\forall x)[\alpha]$
- D.  $(\forall x)[\alpha \Rightarrow \beta] \Rightarrow (((\forall x)[\alpha]) \Rightarrow (\forall x)[\beta])$

[gate2003-cse](#) [mathematical-logic](#) [first-order-logic](#) [normal](#)

Answer 

### 3.1.5 First Order Logic: GATE CSE 2003 | Question: 33 [top](#)

<https://gateoverflow.in/923>



Consider the following formula and its two interpretations  $I_1$  and  $I_2$ .

$$\alpha : (\forall x) [P_x \Leftrightarrow (\forall y) [Q_{xy} \Leftrightarrow \neg Q_{yy}]] \Rightarrow (\forall x) [\neg P_x]$$

$I_1$  : Domain: the set of natural numbers

$P_x$  = ' $x$  is a prime number'

$Q_{xy}$  = ' $y$  divides  $x$ '

$I_2$  : same as  $I_1$  except that  $P_x$  = ' $x$  is a composite number'.

Which of the following statements is true?

- A.  $I_1$  satisfies  $\alpha$ ,  $I_2$  does not
- B.  $I_2$  satisfies  $\alpha$ ,  $I_1$  does not
- C. Neither  $I_1$  nor  $I_2$  satisfies  $\alpha$
- D. Both  $I_1$  and  $I_2$  satisfies  $\alpha$

[gate2003-cse](#) [mathematical-logic](#) [difficult](#) [first-order-logic](#)

Answer 

### 3.1.6 First Order Logic: GATE CSE 2004 | Question: 23, ISRO2007-32 [top](#)

<https://gateoverflow.in/1020>



Identify the correct translation into logical notation of the following assertion.

Some boys in the class are taller than all the girls

Note: taller( $x, y$ ) is true if  $x$  is taller than  $y$ .

- A.  $(\exists x)(\text{boy}(x) \rightarrow (\forall y)(\text{girl}(y) \wedge \text{taller}(x, y)))$
- B.  $(\exists x)(\text{boy}(x) \wedge (\forall y)(\text{girl}(y) \wedge \text{taller}(x, y)))$
- C.  $(\exists x)(\text{boy}(x) \rightarrow (\forall y)(\text{girl}(y) \rightarrow \text{taller}(x, y)))$
- D.  $(\exists x)(\text{boy}(x) \wedge (\forall y)(\text{girl}(y) \rightarrow \text{taller}(x, y)))$

[gate2004-cse](#) [mathematical-logic](#) [easy](#) [isro2007](#) [first-order-logic](#)

Answer 

### 3.1.7 First Order Logic: GATE CSE 2005 | Question: 41 [top](#)

<https://gateoverflow.in/1166>



What is the first order predicate calculus statement equivalent to the following?

"Every teacher is liked by some student"

- A.  $\forall(x) [\text{teacher}(x) \rightarrow \exists(y) [\text{student}(y) \rightarrow \text{likes}(y, x)]]$
- B.  $\forall(x) [\text{teacher}(x) \rightarrow \exists(y) [\text{student}(y) \wedge \text{likes}(y, x)]]$
- C.  $\exists(y) \forall(x) [\text{teacher}(x) \rightarrow [\text{student}(y) \wedge \text{likes}(y, x)]]$
- D.  $\forall(x) [\text{teacher}(x) \wedge \exists(y) [\text{student}(y) \rightarrow \text{likes}(y, x)]]$

[gate2005-cse](#) [mathematical-logic](#) [easy](#) [first-order-logic](#)

Answer 

**3.1.8 First Order Logic: GATE CSE 2006 | Question: 26** top ↗<https://gateoverflow.in/989>

Which one of the first order predicate calculus statements given below correctly expresses the following English statement?

**Tigers and lions attack if they are hungry or threatened.**

- A.  $\forall x[(\text{tiger}(x) \wedge \text{lion}(x)) \rightarrow (\text{hungry}(x) \vee \text{threatened}(x)) \rightarrow \text{attacks}(x)]$
- B.  $\forall x[(\text{tiger}(x) \vee \text{lion}(x)) \rightarrow (\text{hungry}(x) \vee \text{threatened}(x)) \wedge \text{attacks}(x)]$
- C.  $\forall x[(\text{tiger}(x) \vee \text{lion}(x)) \rightarrow \text{attacks}(x) \rightarrow (\text{hungry}(x) \vee \text{threatened}(x))]$
- D.  $\forall x[(\text{tiger}(x) \vee \text{lion}(x)) \rightarrow (\text{hungry}(x) \vee \text{threatened}(x)) \rightarrow \text{attacks}(x)]$

gate2006-cse mathematical-logic normal first-order-logic

Answer

**3.1.9 First Order Logic: GATE CSE 2007 | Question: 22** top ↗<https://gateoverflow.in/1220>

Let  $\text{Graph}(x)$  be a predicate which denotes that  $x$  is a graph. Let  $\text{Connected}(x)$  be a predicate which denotes that  $x$  is connected. Which of the following first order logic sentences **DOES NOT** represent the statement:

“Not every graph is connected”

- A.  $\neg \forall x (\text{Graph}(x) \implies \text{Connected}(x))$
- B.  $\exists x (\text{Graph}(x) \wedge \neg \text{Connected}(x))$
- C.  $\neg \forall x (\neg \text{Graph}(x) \vee \text{Connected}(x))$
- D.  $\forall x (\text{Graph}(x) \implies \neg \text{Connected}(x))$

gate2007-cse mathematical-logic easy first-order-logic

Answer

**3.1.10 First Order Logic: GATE CSE 2008 | Question: 30** top ↗<https://gateoverflow.in/441>

Let  $\text{fsa}$  and  $\text{pda}$  be two predicates such that  $\text{fsa}(x)$  means  $x$  is a finite state automaton and  $\text{pda}(y)$  means that  $y$  is a pushdown automaton. Let  $\text{equivalent}$  be another predicate such that  $\text{equivalent}(a, b)$  means  $a$  and  $b$  are equivalent. Which of the following first order logic statements represent the following?

Each finite state automaton has an equivalent pushdown automaton

- A.  $(\forall x \text{ fsa}(x)) \implies (\exists y \text{ pda}(y) \wedge \text{equivalent}(x, y))$
- B.  $\neg \forall y (\exists x \text{ fsa}(x) \implies \text{pda}(y) \wedge \text{equivalent}(x, y))$
- C.  $\forall x \exists y (\text{fsa}(x) \wedge \text{pda}(y) \wedge \text{equivalent}(x, y))$
- D.  $\forall x \exists y (\text{fsa}(y) \wedge \text{pda}(x) \wedge \text{equivalent}(x, y))$

gate2008-cse easy mathematical-logic first-order-logic

Answer

**3.1.11 First Order Logic: GATE CSE 2009 | Question: 23** top ↗<https://gateoverflow.in/800>

Which one of the following is the most appropriate logical formula to represent the statement?

“Gold and silver ornaments are precious”.

The following notations are used:

- $G(x)$  :  $x$  is a gold ornament
- $S(x)$  :  $x$  is a silver ornament
- $P(x)$  :  $x$  is precious

- A.  $\forall x(P(x) \implies (G(x) \wedge S(x)))$
- B.  $\forall x((G(x) \wedge S(x)) \implies P(x))$
- C.  $\exists x((G(x) \wedge S(x)) \implies P(x))$
- D.  $\forall x((G(x) \vee S(x)) \implies P(x))$

gate2009-cse mathematical-logic easy first-order-logic

Answer 

### 3.1.12 First Order Logic: GATE CSE 2009 | Question: 26 top

 <https://gateoverflow.in/803>



Consider the following well-formed formulae:

- I.  $\neg\forall x(P(x))$
- II.  $\neg\exists x(P(x))$
- III.  $\neg\exists x(\neg P(x))$
- IV.  $\exists x(\neg P(x))$

Which of the above are equivalent?

- A. I and III
- B. I and IV
- C. II and III
- D. II and IV

gate2009-cse mathematical-logic normal first-order-logic

Answer 

### 3.1.13 First Order Logic: GATE CSE 2010 | Question: 30 top

 <https://gateoverflow.in/1156>



Suppose the predicate  $F(x, y, t)$  is used to represent the statement that person  $x$  can fool person  $y$  at time  $t$ .

Which one of the statements below expresses best the meaning of the formula,

$$\forall x \exists y \exists t (\neg F(x, y, t))$$

- A. Everyone can fool some person at some time
- B. No one can fool everyone all the time
- C. Everyone cannot fool some person all the time
- D. No one can fool some person at some time

gate2010-cse mathematical-logic easy first-order-logic

Answer 

### 3.1.14 First Order Logic: GATE CSE 2011 | Question: 30 top

 <https://gateoverflow.in/2132>



Which one of the following options is CORRECT given three positive integers  $x, y$  and  $z$ , and a predicate

$$P(x) = \neg(x = 1) \wedge \forall y (\exists z (x = y * z) \Rightarrow (y = x) \vee (y = 1))$$

- A.  $P(x)$  being true means that  $x$  is a prime number
- B.  $P(x)$  being true means that  $x$  is a number other than 1
- C.  $P(x)$  is always true irrespective of the value of  $x$
- D.  $P(x)$  being true means that  $x$  has exactly two factors other than 1 and  $x$

gate2011-cse mathematical-logic normal first-order-logic

Answer 

### 3.1.15 First Order Logic: GATE CSE 2012 | Question: 13 top

 <https://gateoverflow.in/45>



What is the correct translation of the following statement into mathematical logic?

“Some real numbers are rational”

- A.  $\exists x (\text{real}(x) \vee \text{rational}(x))$
- B.  $\forall x (\text{real}(x) \rightarrow \text{rational}(x))$
- C.  $\exists x (\text{real}(x) \wedge \text{rational}(x))$

- D.  $\exists x(rational(x) \rightarrow real(x))$

[gate2012-cse](#) [mathematical-logic](#) [easy](#) [first-order-logic](#)

Answer 

### 3.1.16 First Order Logic: GATE CSE 2013 | Question: 27 [top](#)

<https://gateoverflow.in/1538>



What is the logical translation of the following statement?

"None of my friends are perfect."

- A.  $\exists x(F(x) \wedge \neg P(x))$
- B.  $\exists x(\neg F(x) \wedge P(x))$
- C.  $\exists x(\neg F(x) \wedge \neg P(x))$
- D.  $\neg \exists x(F(x) \wedge P(x))$

[gate2013-cse](#) [mathematical-logic](#) [easy](#) [first-order-logic](#)

Answer 

### 3.1.17 First Order Logic: GATE CSE 2013 | Question: 47 [top](#)

<https://gateoverflow.in/80>



Which one of the following is NOT logically equivalent to  $\neg \exists x(\forall y(\alpha) \wedge \forall z(\beta))$  ?

- A.  $\forall x(\exists z(\neg \beta) \rightarrow \forall y(\alpha))$
- B.  $\forall x(\forall z(\beta) \rightarrow \exists y(\neg \alpha))$
- C.  $\forall x(\forall y(\alpha) \rightarrow \exists z(\neg \beta))$
- D.  $\forall x(\exists y(\neg \alpha) \rightarrow \exists z(\neg \beta))$

[mathematical-logic](#) [normal](#) [marks-to-all](#) [gate2013-cse](#) [first-order-logic](#)

Answer 

### 3.1.18 First Order Logic: GATE CSE 2014 Set 1 | Question: 1 [top](#)

<https://gateoverflow.in/769>



Consider the statement

"Not all that glitters is gold"

Predicate  $glitters(x)$  is true if  $x$  glitters and predicate  $gold(x)$  is true if  $x$  is gold. Which one of the following logical formulae represents the above statement?

- A.  $\forall x : glitters(x) \Rightarrow \neg gold(x)$
- B.  $\forall x : gold(x) \Rightarrow glitters(x)$
- C.  $\exists x : gold(x) \wedge \neg glitters(x)$
- D.  $\exists x : glitters(x) \wedge \neg gold(x)$

[gate2014-cse-set1](#) [mathematical-logic](#) [first-order-logic](#)

Answer 

### 3.1.19 First Order Logic: GATE CSE 2014 Set 3 | Question: 53 [top](#)

<https://gateoverflow.in/2087>



The CORRECT formula for the sentence, "not all Rainy days are Cold" is

- A.  $\forall d(Rainy(d) \wedge \neg Cold(d))$
- B.  $\forall d(\neg Rainy(d) \rightarrow Cold(d))$
- C.  $\exists d(\neg Rainy(d) \rightarrow Cold(d))$
- D.  $\exists d(Rainy(d) \wedge \neg Cold(d))$

[gate2014-cse-set3](#) [mathematical-logic](#) [easy](#) [first-order-logic](#)

Answer 

**3.1.20 First Order Logic: GATE CSE 2015 Set 2 | Question: 55** [top ↴](#)<https://gateoverflow.in/8259>

Which one of the following well-formed formulae is a tautology?

- A.  $\forall x \exists y R(x, y) \leftrightarrow \exists y \forall x R(x, y)$
- B.  $(\forall x [\exists y R(x, y) \rightarrow S(x, y)]) \rightarrow \forall x \exists y S(x, y)$
- C.  $[\forall x \exists y (P(x, y) \rightarrow R(x, y))] \leftrightarrow [\forall x \exists y (\neg P(x, y) \vee R(x, y))]$
- D.  $\forall x \forall y P(x, y) \rightarrow \forall x \forall y P(y, x)$

[gate2015-cse-set2](#) [mathematical-logic](#) [normal](#) [first-order-logic](#)

Answer

**3.1.21 First Order Logic: GATE CSE 2016 Set 2 | Question: 27** [top ↴](#)<https://gateoverflow.in/39618>

Which one of the following well-formed formulae in predicate calculus is **NOT** valid?

- A.  $(\forall_x p(x) \implies \forall_x q(x)) \implies (\exists_x \neg p(x) \vee \forall_x q(x))$
- B.  $(\exists_x p(x) \vee \exists_x q(x)) \implies \exists_x(p(x) \vee q(x))$
- C.  $\exists_x(p(x) \wedge q(x)) \implies (\exists_x p(x) \wedge \exists_x q(x))$
- D.  $\forall_x(p(x) \vee q(x)) \implies (\forall_x p(x) \vee \forall_x q(x))$

[gate2016-cse-set2](#) [mathematical-logic](#) [first-order-logic](#) [normal](#)

Answer

**3.1.22 First Order Logic: GATE CSE 2017 Set 1 | Question: 02** [top ↴](#)<https://gateoverflow.in/118701>

Consider the first-order logic sentence  $F: \forall x(\exists y R(x, y))$ . Assuming non-empty logical domains, which of the sentences below are *implied* by  $F$ ?

- I.  $\exists y(\exists x R(x, y))$
- II.  $\exists y(\forall x R(x, y))$
- III.  $\forall y(\exists x R(x, y))$
- IV.  $\neg \exists x(\forall y \neg R(x, y))$

- A. IV only
- B. I and IV only
- C. II only
- D. II and III only

[gate2017-cse-set1](#) [mathematical-logic](#) [first-order-logic](#)

Answer

**3.1.23 First Order Logic: GATE CSE 2018 | Question: 28** [top ↴](#)<https://gateoverflow.in/204102>

Consider the first-order logic sentence

$$\varphi \equiv \exists s \exists t \exists u \forall v \forall w \forall x \forall y \psi(s, t, u, v, w, x, y)$$

where  $\psi(s, t, u, v, w, x, y)$  is a quantifier-free first-order logic formula using only predicate symbols, and possibly equality, but no function symbols. Suppose  $\varphi$  has a model with a universe containing 7 elements.

Which one of the following statements is necessarily true?

- A. There exists at least one model of  $\varphi$  with universe of size less than or equal to 3
- B. There exists no model of  $\varphi$  with universe of size less than or equal to 3
- C. There exists no model of  $\varphi$  with universe size of greater than 7
- D. Every model of  $\varphi$  has a universe of size equal to 7

[gate2018-cse](#) [mathematical-logic](#) [normal](#) [first-order-logic](#)

Answer

**3.1.24 First Order Logic: GATE CSE 2019 | Question: 35** top ↺<https://gateoverflow.in/302813>

Consider the first order predicate formula  $\varphi$ :

$$\forall x[(\forall z z|x \Rightarrow ((z = x) \vee (z = 1))) \rightarrow \exists w(w > x) \wedge (\forall z z|w \Rightarrow ((w = z) \vee (z = 1)))]$$

Here  $a | b$  denotes that ' $a$  divides  $b$ ', where  $a$  and  $b$  are integers. Consider the following sets:

- $S_1 : \{1, 2, 3, \dots, 100\}$
- $S_2 : \text{Set of all positive integers}$
- $S_3 : \text{Set of all integers}$

Which of the above sets satisfy  $\varphi$ ?

- A.  $S_1$  and  $S_2$   
 B.  $S_1$  and  $S_3$   
 C.  $S_2$  and  $S_3$   
 D.  $S_1, S_2$  and  $S_3$

[gate2019-cse](#) [engineering-mathematics](#) [discrete-mathematics](#) [mathematical-logic](#) [first-order-logic](#)

Answer

**3.1.25 First Order Logic: GATE CSE 2020 | Question: 39** top ↺<https://gateoverflow.in/333192>

Which one of the following predicate formulae is NOT logically valid?

Note that  $W$  is a predicate formula without any free occurrence of  $x$ .

- A.  $\forall x(p(x) \vee W) \equiv \forall x(p(x)) \vee W$   
 B.  $\exists x(p(x) \wedge W) \equiv \exists x(p(x)) \wedge W$   
 C.  $\forall x(p(x) \rightarrow W) \equiv \forall x(p(x)) \rightarrow W$   
 D.  $\exists x(p(x) \rightarrow W) \equiv \exists x(p(x)) \rightarrow W$

[gate2020-cse](#) [first-order-logic](#) [mathematical-logic](#)

Answer

**3.1.26 First Order Logic: GATE IT 2004 | Question: 3** top ↺<https://gateoverflow.in/3644>

Let  $a(x, y), b(x, y)$  and  $c(x, y)$  be three statements with variables  $x$  and  $y$  chosen from some universe. Consider the following statement:

$$(\exists x)(\forall y)[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)]$$

Which one of the following is its equivalent?

- A.  $(\forall x)(\exists y)[(a(x, y) \vee b(x, y)) \rightarrow c(x, y)]$   
 B.  $(\exists x)(\forall y)[(a(x, y) \vee b(x, y)) \wedge \neg c(x, y)]$   
 C.  $\neg(\forall x)(\exists y)[(a(x, y) \wedge b(x, y)) \rightarrow c(x, y)]$   
 D.  $\neg(\forall x)(\exists y)[(a(x, y) \vee b(x, y)) \rightarrow c(x, y)]$

[gate2004-it](#) [mathematical-logic](#) [normal](#) [discrete-mathematics](#) [first-order-logic](#)

Answer

**3.1.27 First Order Logic: GATE IT 2005 | Question: 36** top ↺<https://gateoverflow.in/3783>

Let  $P(x)$  and  $Q(x)$  be arbitrary predicates. Which of the following statements is always **TRUE**?

- A.  $((\forall x(P(x) \vee Q(x)))) \implies ((\forall xP(x)) \vee (\forall xQ(x)))$   
 B.  $(\forall x(P(x) \implies Q(x))) \implies ((\forall xP(x)) \implies (\forall xQ(x)))$   
 C.  $(\forall x(P(x)) \implies \forall x(Q(x))) \implies (\forall x(P(x) \implies Q(x)))$   
 D.  $(\forall x(P(x)) \Leftrightarrow (\forall x(Q(x)))) \implies (\forall x(P(x) \Leftrightarrow Q(x)))$

[gate2005-it](#) [mathematical-logic](#) [first-order-logic](#) [normal](#)

[Answer](#)

### 3.1.28 First Order Logic: GATE IT 2006 | Question: 21 [top](#)

<https://gateoverflow.in/3560>



Consider the following first order logic formula in which  $R$  is a binary relation symbol.

$$\forall x \forall y (R(x, y) \implies R(y, x))$$

The formula is

- A. satisfiable and valid
- B. satisfiable and so is its negation
- C. unsatisfiable but its negation is valid
- D. satisfiable but its negation is unsatisfiable

[gate2006-it](#) [mathematical-logic](#) [normal](#) [first-order-logic](#)

[Answer](#)

### 3.1.29 First Order Logic: GATE IT 2007 | Question: 21 [top](#)

<https://gateoverflow.in/3454>



Which one of these first-order logic formulae is valid?

- A.  $\forall x (P(x) \implies Q(x)) \implies (\forall x P(x) \implies \forall x Q(x))$
- B.  $\exists x (P(x) \vee Q(x)) \implies (\exists x P(x) \implies \exists x Q(x))$
- C.  $\exists x (P(x) \wedge Q(x)) \iff (\exists x P(x) \wedge \exists x Q(x))$
- D.  $\forall x \exists y P(x, y) \implies \exists y \forall x P(x, y)$

[gate2007-it](#) [mathematical-logic](#) [normal](#) [first-order-logic](#)

[Answer](#)

### 3.1.30 First Order Logic: GATE IT 2008 | Question: 21 [top](#)

<https://gateoverflow.in/3282>



Which of the following first order formulae is logically valid? Here  $\alpha(x)$  is a first order formula with  $x$  as a free variable, and  $\beta$  is a first order formula with no free variable.

- A.  $[\beta \rightarrow (\exists x, \alpha(x))] \rightarrow [\forall x, \beta \rightarrow \alpha(x)]$
- B.  $[\exists x, \beta \rightarrow \alpha(x)] \rightarrow [\beta \rightarrow (\forall x, \alpha(x))]$
- C.  $[(\exists x, \alpha(x)) \rightarrow \beta] \rightarrow [\forall x, \alpha(x) \rightarrow \beta]$
- D.  $[(\forall x, \alpha(x)) \rightarrow \beta] \rightarrow [\forall x, \alpha(x) \rightarrow \beta]$

[gate2008-it](#) [first-order-logic](#) [normal](#)

[Answer](#)

### 3.1.31 First Order Logic: GATE IT 2008 | Question: 22 [top](#)

<https://gateoverflow.in/3283>



Which of the following is the negation of  $[\forall x, \alpha \rightarrow (\exists y, \beta \rightarrow (\forall u, \exists v, y))]$

- A.  $[\exists x, \alpha \rightarrow (\forall y, \beta \rightarrow (\exists u, \forall v, y))]$
- B.  $[\exists x, \alpha \rightarrow (\forall y, \beta \rightarrow (\exists u, \forall v, \neg y))]$
- C.  $[\forall x, \neg \alpha \rightarrow (\exists y, \neg \beta \rightarrow (\forall u, \exists v, \neg y))]$
- D.  $[\exists x, \alpha \wedge (\forall y, \beta \wedge (\exists u, \forall v, \neg y))]$

[gate2008-it](#) [mathematical-logic](#) [normal](#) [first-order-logic](#)

[Answer](#)

## Answers: First Order Logic

### 3.1.1 First Order Logic: GATE CSE 1989 | Question: 14a [top](#)

<https://gateoverflow.in/93179>



- ✓  $M(x) \rightarrow x$  is mother  
 $Ch(y, x) \rightarrow y$  is child of  $x$

$Lo(x, y) \rightarrow x \text{ loves } y$

$\forall x \forall y [(M(x) \wedge C(y, x)) \rightarrow Lo(x, y)]$

25 votes

-- bhuv (3.5k points)

### 3.1.2 First Order Logic: GATE CSE 1991 | Question: 15,b top ↗

https://gateoverflow.in/26748



Let's break it down. Consider an ordered structure (directed graph).

- $\forall x \exists y : R(x, y) \equiv$  Every vertex has at least 1 outgoing edge.
- $\forall x \forall y : (R(x, y) \implies \neg R(y, x)) \equiv$  If there is a directed edge from vertex  $u$  to vertex  $v$ , there should not be an edge back from  $v$  to  $u$ . That is, our relation  $R(x, y)$  is antisymmetric.
- $\forall x \forall y \forall z : (R(x, y) \wedge R(y, z) \implies R(x, z)) \equiv$  If  $u \rightarrow v \rightarrow z$ , then  $u \rightarrow z$  is also true. That is, our relation  $R(x, y)$  is transitive.
- $\forall x : \neg R(x, x) \equiv$  We cannot have a self-loop in the graph. That is,  $R(x, y)$  is irreflexive.

Now, such a non-trivial (size > 0) finite structure cannot exist.

Proof by contradiction:

Assume, for the sake of contradiction, that such a finite structure  $S = (V, E)$  exists. Since it is finite, let the number of vertices in this structure be  $|V| = n, n \in \mathbb{N}, n > 0$ .

Edit: A summarized version of the following proof is in the comments. You can directly skip to that.

**Lemma 1:**  $v_n$  has an incoming edge from every vertex  $v_i, i < n$

Proof by Induction:

Induction Hypothesis:  $P(n) =$  For every  $1 \leq i < j \leq n$ , there is an out edge from vertex  $v_i$  to vertex  $v_j$ , that is  $v_i \rightarrow v_j$ .

Base Cases:

- Let  $n = 2$ .  
 $v_1 \rightarrow v_2$  must be true since there has to be an out edge from  $v_1$  (Property A) and the only available vertex is  $v_2$  (no self loops allowed - Property D).  
Hence, our hypothesis  $P(2)$  is satisfied.
- Let  $n = 3$ .  
There must be an out edge from  $v_1$  to some vertex. Let's call that vertex  $v_2$ , that is  $v_1 \rightarrow v_2$ .  
Similarly, there must be an out edge from  $v_2$ . But due to property B, we can't have an out edge from  $v_2$  back to  $v_1$ .  
Hence, the out edge from  $v_2$  must lead us to a new vertex. Lets call that  $v_3$ .  
Since  $v_1 \rightarrow v_2 \rightarrow v_3$ , due to Property C, we must have  $v_1 \rightarrow v_3$ .  
Hence, our hypothesis  $P(3)$  is satisfied.

Inductive Step:

For  $P(n + 1)$ : The  $n$ th vertex  $v_n$  must have an out edge. Since  $P(n)$  is true, the  $n$ th vertex has incoming edges from all vertices  $v_i, i < n$ . Hence, the out edge from  $v_n$  cannot be to any of those vertices. Self loops aren't allowed either.

Hence, the out edge from vertex  $v_n$  must be to the new vertex  $v_{n+1}$ . That is,  $v_n \rightarrow v_{n+1}$

Since every vertex  $v_i, i < n$  has an out edge to  $v_n$ , and  $v_n$  has an out edge to  $v_{n+1}$ , due to Property C, we have that  $v_i$  has an out edge to  $v_{n+1}$ . That is,  $v_i \rightarrow v_{n+1}, \forall i \leq n$ .

This is exactly what  $P(n + 1)$  states.

Hence,  $P(n) \implies P(n + 1)$ .

Q.E.D

Since  $P(n)$  is true as proven above, every vertex  $v_i$  must have an out edge to the vertex  $v_n$ .

Since the  $n$ th vertex has incoming edges from all other vertices (Lemma 1), it cannot have an out edge to any vertex. It can't have self loop either. Thus, it fails to satisfy Property A.

Hence, our assumption that S exists leads to a contradiction.

**Q.E.D**

The given logic formula can be satisfied by an infinite model.

For example,  $R(x, y) \iff x < y$ ,  $x, y \in S$ , where  $S$  is any infinite ordered set, satisfies the given formula.

32 votes

-- Pragy Agarwal (18.3k points)

### 3.1.3 First Order Logic: GATE CSE 1992 | Question: 92, xv top

<https://gateoverflow.in/256>



- A. The corresponding English meaning: If  $P(x)$  is true for all  $x$ , or if  $Q(x)$  is true for all  $x$ , then for all  $x$ , either  $P(x)$  is true or  $Q(x)$  is true. This is always true and hence valid. To understand deeply, consider  $X = \{3, 6, 9, 12\}$ . For LHS of implication to be true, either  $P(x)$  must be true for all elements in  $X$  or  $Q(x)$  must be true for all elements in  $X$ . In either case, if we take each element  $x$  in  $X$ , either one of  $P(x)$  or  $Q(x)$  will be true. Hence, this implication is always valid.  
If still in doubt, let  $P(x)$  mean  $x$  is a multiple of 3 and  $Q(x)$  means  $x$  is a multiple of 2.
- B. The corresponding English meaning: If  $P(x)$  is true for at least one  $x$ , and if  $Q(x)$  is true for at least one  $x$ , then there is at least one  $x$  for which both  $P(x)$  and  $Q(x)$  are true. This is not always true as  $P(x)$  can be true for one  $x$  and  $Q(x)$  can be true for some other  $x$ . To understand deeply, consider  $X = \{3, 6, 9, 12\}$ . Let  $P(x)$  be  $x$  is a multiple of 9 and  $Q(x)$  be  $x$  is a multiple of 6. Now, LHS of implication is true, since  $P(x)$  is true for  $x = 9$ , and  $Q(x)$  is true for  $x = 6$ . But RHS of implication is not true as there is no  $x$  for which both  $P(x)$  and  $Q(x)$  holds. Hence, this implication is not valid.
- C. If for each  $x$ , either  $P(x)$  is true or  $Q(x)$  is true then  $P(x)$  is true for all  $x$  or  $Q(x)$  is true for all  $x$ . Just one read is enough to see this is an invalid implication. Consider set  $\{2, 4, 5\}$ . Here every element is either a multiple of 2 or 5. But all elements are neither multiple of 2 nor 5.
- D. If there is at least one  $x$  for which either  $P(x)$  or  $Q(x)$  is true then either it is not the case that  $P(x)$  is true for all  $x$  or  $Q(x)$  is true for at least one  $x$ . This is clearly invalid as LHS of implication becomes true if  $P(x)$  is true for some  $x$  and  $Q(x)$  is not true for any  $x$ , but RHS will be false (if  $P(x)$  is true for all  $x$ ).

A little modification to the statement is enough to make it valid:

$$\exists(x)(P(x) \vee Q(x)) \implies \sim(\forall(x)\sim P(x)) \vee \exists(x)Q(x)$$

which means if there is at least one  $x$  for which either  $P(x)$  or  $Q(x)$  is true then either it is not the case that  $\sim P(x)$  is true for all  $x$  (which means  $P(x)$  is true for some  $x$ ) or  $Q(x)$  is true for some  $x$ .

**Note:**

- De Morgan's law is applicable in first order logic and is quite useful:

$$\forall(x)(P(x)) \equiv \neg\exists(x)(\neg P(x))$$

- This is a logical reasoning statement which means if  $P(x)$  is true for all  $x$ , then there can never exist an  $x$  for which  $P(x)$  is not true. This formula is quite useful in proving validity of many statements as is its converse given below:

$$\exists(x)(P(x)) \equiv \neg\forall(x)(\neg P(x))$$

Correct Answer: A

65 votes

-- gatecse (60k points)

### 3.1.4 First Order Logic: GATE CSE 2003 | Question: 32 top

<https://gateoverflow.in/922>



(D) is the answer.

- A. Let  $X = \{3, 6, 9, 8\}$ . Let  $\alpha$  denote multiple of 3 and  $\beta$  denote multiple of 4.  $(\forall x)[\alpha]$  becomes false as 8 is not a multiple of 3, and so  $(\forall x)[\alpha] \Rightarrow (\forall x)[\beta]$  becomes TRUE. Now, this won't imply  $(\forall x)[\alpha \Rightarrow \beta]$  as multiple of 3 doesn't imply multiple of 4 for 3, 6 or 9.
- B. Let  $X = \{3, 6, 9\}$ . Let  $\alpha$  denote multiple of 3 and  $\beta$  denote multiple of 4. Now LHS is TRUE but RHS is false as none of the  $x$  in  $X$ , is a multiple of 4.
- C. Let  $X = \{3, 6, 9, 7\}$ . Let  $\alpha$  denote multiple of 3 and  $\beta$  denote multiple of 4. Now  $(\forall x)[\alpha \vee \beta]$  becomes false and hence LHS =  $((\forall x)[\alpha \vee \beta] \Rightarrow (\exists x)[\alpha])$  becomes true. But RHS is false as 7 is not a multiple of 3.

D. This is valid. LHS is saying that if  $\alpha$  is holding for any  $x$ , then  $\beta$  also holds for that  $x$ . RHS is saying if  $\alpha$  is holding for all  $x$ , then  $\beta$  also holds for all  $x$ . Clearly LHS  $\implies$  RHS (but RHS does not imply LHS).  
 For example, let  $X = \{4, 8, 12\}$ ,  $\alpha$  denote multiple of 2 and  $\beta$  denote multiple of 4. LHS  $= (\forall x)[\alpha \Rightarrow \beta]$ , is TRUE. RHS is also true. If we add '3' to  $X$ , then LHS is true, first part of RHS becomes false and thus RHS also becomes TRUE. There is no way we can make LHS true and RHS false here. But if we add 2 and 3 to  $X$ , RHS will be true and LHS will be false. So, we can't say RHS implies LHS.

53 votes

-- Arjun Suresh (328k points)

### 3.1.5 First Order Logic: GATE CSE 2003 | Question: 33

<https://gateoverflow.in/923>

- ✓ Given:  $(\alpha : (\forall x)[P_x \Leftrightarrow (\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]] \Rightarrow (\forall x)[\neg P_x])$   
 $Q_{yy}$  is always True, this makes  $\neg Q_{yy}$  False.

Writing  $(\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]$  is same as writing  $(\forall y)[Q_{xy} \Leftrightarrow \text{False}]$

This is equivalent to saying that, for all  $y$   $Q_{xy}$  is false and finally we can rewrite  $(\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]$  as  $(\forall y)[\neg Q_{xy}]$

$$\alpha : (\forall x)[P_x \Leftrightarrow (\forall y)[\neg Q_{xy}]] \Rightarrow (\forall x)[\neg P_x]$$

$$\text{LHS} : (\forall x)[P_x \Leftrightarrow (\forall y)[\neg Q_{xy}]]$$

consider only  $(\forall y)[\neg Q_{xy}]$  it says all values of  $y$  does not divide  $x$ , but there will be at least one value of  $y$  (when  $y = x$ , or when  $y = 1$ ) that divides  $x$ , i.e.  $\neg Q_{xy}$  is not true for all values of  $y$ .  $(\forall y)[\neg Q_{xy}]$  is false.

Now LHS becomes  $(\forall x)[P_x \Leftrightarrow \text{False}]$ , " $P_x \Leftrightarrow \text{False}$ " this means  $P_x$  is False, which is same as writing " $\neg P_x$ ".

Finally, we reduced LHS to  $(\forall x)[\neg P_x]$

$$\alpha : (\forall x)[\neg P_x] \Rightarrow (\forall x)[\neg P_x] \quad (\text{which is trivial, } P(x) \Rightarrow P(x) \text{ is trivially true})$$

Hence  $(\forall x)[\neg P_x] \Rightarrow (\forall x)[\neg P_x]$  is trivially true for any  $P(x)$ , doesn't matter if  $P(x)$  is for prime number or for composite number ( $I_1$  or  $I_2$ ).

$\Rightarrow I_1$  and  $I_2$  both satisfies  $\alpha$ .

Option D.

216 votes

-- Sachin Mittal (15.8k points)

$$\alpha : (\forall x)[P_x \Leftrightarrow (\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]] \Rightarrow (\forall x)[\neg P_x]$$

This is can be interpreted as:

- $\alpha : ((\forall x)[P_x \Leftrightarrow (\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]]) \Rightarrow ((\forall x)[\neg P_x])$

See the RHS. It says  $P(x)$  is false for any natural number. But there are natural numbers which are prime and hence this RHS is FALSE. Now, to make  $\alpha$  TRUE, LHS must be FALSE for any  $x$ . Here, LHS is bit complex, so lets consider it separately.

$$(\forall x)[P_x \Leftrightarrow (\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]]$$

LHS is TRUE only if the given implication is TRUE for all  $x$ . Here the rightmost double implication  $(\forall y)[Q_{xy} \Leftrightarrow \neg Q_{yy}]$  is always FALSE, because  $x$  can be equal to  $y$  and hence **forall** can never be TRUE. So the LHS reduces to just  $(\forall x)\neg P(x)$  and returns FALSE as we have prime as well as non-prime natural numbers. So, FALSE  $\Rightarrow$  FALSE returns TRUE making both  $I_1$  and  $I_2$  satisfy  $\alpha$ . D choice.

52 votes

-- Arjun Suresh (328k points)

### 3.1.6 First Order Logic: GATE CSE 2004 | Question: 23, ISRO2007-32

<https://gateoverflow.in/1020>

- ✓ Now many people get confused when to use  $\wedge$  and when to use  $\implies$ . This question tests exactly that.

We use  $\wedge$  when we want to say that the both predicates in this statement are always true, no matter what the value of  $x$  is. We use  $\implies$  when we want to say that although there is no need for left predicate to be true always, but whenever it becomes true, right predicate must also be true.

Now we have been given the statement "Some boys in the class are taller than all the girls". Now we know for sure that there is at least a boy in class. So we want to proceed with " $(\exists x)(boy(x) \wedge$ " and not " $(\exists x)(boy(x) \implies$ ", because latter would have meant that we are putting no restriction on the existence of boy i.e. there may be a boy-less class, which is clearly we don't want, because in the statement itself, we are given that there are some boys in the class. So options (A) and (C) are ruled out.

Now if we see option (B), it says, every  $y$  in class is a girl i.e. every person in class is a girl, which is clearly false. So we eliminate this option also, and we get correct option (D). Let us see option (D) explicitly also whether it is true or not. So it says that if person  $y$  is a girl, then  $x$  is taller than  $y$ , which is really we wanted to say.

So option (D) is correct.

[http://www.cse.iitd.ac.in/~mittal/gate/gate\\_math\\_2004.html](http://www.cse.iitd.ac.in/~mittal/gate/gate_math_2004.html)

### References



161 votes

-- Anu (4.7k points)

### 3.1.7 First Order Logic: GATE CSE 2005 | Question: 41 top

<https://gateoverflow.in/1166>



- ✓ Answer is (B). In simpler way we can say "If  $X$  is a teacher then there exists some  $Y$  who is a student and likes  $X$ ".

(A) choice: If  $X$  is a teacher, then there exists a  $Y$  such that if  $Y$  is a student, then  $Y$  likes  $X$ .

(C) choice: There exist a student who likes all teachers.

(D) choice: Everyone is a teacher and there exists a  $Y$  such that if  $Y$  is student then  $y$  likes  $X$ . Assuming one cannot be both student and teacher at same time, this just means, everyone is a teacher.

50 votes

-- Manali (2.1k points)

### 3.1.8 First Order Logic: GATE CSE 2006 | Question: 26 top

<https://gateoverflow.in/989>



- ✓ The statement "Tigers and lions attack if they are hungry or threatened" means that if an animal is either tiger or lion, then if it is hungry or threatened, it will attack. So option (D) is correct.

Do not get confused by "and" between tigers and lions in the statement. This "and" does not mean that we will write "tiger( $x$ )  $\wedge$  lion( $x$ )", because that would have meant that an animal is both tiger and lion, which is not what we want.

[http://www.cse.iitd.ac.in/~mittal/gate/gate\\_math\\_2006.html](http://www.cse.iitd.ac.in/~mittal/gate/gate_math_2006.html)

### References



40 votes

-- Anu (4.7k points)

### 3.1.9 First Order Logic: GATE CSE 2007 | Question: 22 top

<https://gateoverflow.in/1220>



- ✓ D says "all graphs are not connected" but the question says "not every graph is connected". i.e "there exists at least one graph which is not connected". Hence the answer is (D)

37 votes

-- Manali (2.1k points)

### 3.1.10 First Order Logic: GATE CSE 2008 | Question: 30 top

<https://gateoverflow.in/441>



- ✓ None of these.

- A. If everything is a FSA, then there exists an equivalent PDA for everything.
- B. It is not the case that for all  $y$  if there exist a FSA then it has an equivalent PDA.
- C. Everything is a FSA and has an equivalent PDA.
- D. Everything is a PDA and has exist an equivalent FSA.

The correct answer would be

$$\forall x (\text{fsa}(x) \implies (\exists y \text{pda}(y) \wedge \text{equivalent}(x, y)))$$

72 votes

-- Arjun Suresh (328k points)

### 3.1.11 First Order Logic: GATE CSE 2009 | Question: 23 top

<https://gateoverflow.in/800>



- ✓ The statement could be translated as, if  $x$  is either Gold or Silver, then it would be precious. Rather than, If  $x$  is both Gold and Silver, as an item cannot both Gold and silver at the same time.

Hence Ans is (D).

45 votes

-- Sona Praneeth Akula (3.4k points)

### 3.1.12 First Order Logic: GATE CSE 2009 | Question: 26 top

<https://gateoverflow.in/803>



✓ Option (B) is correct. I and IV are equivalent.

$$\neg \forall x(P(x)) \equiv \exists x(\neg P(x)) \quad [\text{De morgan's Law}]$$

Alternate approach:

Let's take an example.

Let  $P(x) \implies$  Student  $x$  is pass

- I  $\implies$  Not all students are pass. (which means "Some students are fail")
- II  $\implies$  There does not exist a student who is pass. (which means "Every student is fail")
- III  $\implies$  There does not exist a student who is not pass (which means "Every student is pass")
- IV  $\implies$  Some students are not pass. (which means "Some students are fail")

I and IV are equivalent.

16 votes

-- Soumya Jain (12.4k points)

### 3.1.13 First Order Logic: GATE CSE 2010 | Question: 30 top

<https://gateoverflow.in/1156>



✓  $F(x, y, t) \implies$  person  $x$  can fool person  $y$  at time  $t$ .

For the sake of simplicity propagate negation sign outward by applying De Morgan's law.

$$\forall x \exists y \exists t (\neg F(x, y, t)) \equiv \neg \exists x \forall y \forall t (F(x, y, t)) \quad [\text{By applying De Morgan's law.}]$$

Now converting  $\neg \exists x \forall y \forall t (F(x, y, t))$  to English is simple.

$\neg \exists x \forall y \forall t (F(x, y, t)) \implies$  There does not exist a person who can fool everyone all the time.

Which means No one can fool everyone all the time.

So, option (B) is correct.

86 votes

-- Soumya Jain (12.4k points)

B is the correct answer. The trick is to bring the negate sign to the extreme left. Form a sentence without using negate and just negate that.

$$\begin{aligned} & \forall x \exists y \exists t (\neg F(x, y, t)) \\ & \equiv \neg (\neg \forall x \neg \exists y \neg \exists t) (\neg F(x, y, t)) \\ & \equiv \neg (\neg \forall x \neg \exists y \neg \exists t (F(x, y, t))) \\ & \equiv \neg (\exists x \forall y \forall t (F(x, y, t))). \end{aligned}$$

45 votes

-- Bhagirathi Nayak (11.7k points)

### 3.1.14 First Order Logic: GATE CSE 2011 | Question: 30 top

<https://gateoverflow.in/2132>



✓ Answer is (A).

$$P(x) = (\neg(x = 1) \wedge \forall y (\exists z (x = y * z) \implies ((y = x) \vee (y = 1))))$$

**Statement:**  $x$  is not equal to 1 and if there exists some  $z$  for all  $y$  such that product of  $y$  and  $z$  is  $x$ , then  $y$  is either the number itself or 1. This is the definition of prime numbers.

Alternative approach:

The formula

$$\exists x \forall y \forall z [\times(y, z, x) \rightarrow ((y = 1) \vee (z = 1))]$$

expresses the statement "there exists a prime number" (the number 1 also satisfies this statement).

Note here that  $\times(y, z, x)$  is equivalent to  $(x = y * z)$ .

but  $\neg(x = 1)$  removes 1 as satisfying given number in question's formula, so the option (A) is True.

ref@ [https://en.wikibooks.org/wiki/Logic\\_for\\_Computer\\_Science/First-Order\\_Logic#Semantics](https://en.wikibooks.org/wiki/Logic_for_Computer_Science/First-Order_Logic#Semantics)

ref@ <http://math.stackexchange.com/questions/1037795/what-is-the-meaning-of-this-predicate-statement>

References



46 votes

-- Sona Praneeth Akula (3.4k points)

### 3.1.15 First Order Logic: GATE CSE 2012 | Question: 13 [top](#)

<https://gateoverflow.in/45>



✓ Meaning of each choices:

- A. There exists a number which is either real or rational
- B. If a number is real it is rational
- C. There exists a number which is real and rational
- D. There exists a number such that if it is rational, it is real

So, (C) is the answer.

39 votes

-- Arjun Suresh (328k points)

### 3.1.16 First Order Logic: GATE CSE 2013 | Question: 27 [top](#)

<https://gateoverflow.in/1538>



✓

- A. some of my friends are not perfect
- B. some of those who are not my friends are perfect
- C. some of those who are not my friends are not perfect
- D. NOT (some of my friends are perfect) / none of my friends are perfect

Correct Answer: D

49 votes

-- Bhagirathi Nayak (11.7k points)

- $F(x)$  :  $x$  is my friend.
- $P(x)$  :  $x$  is perfect.

“None of my friends are perfect” can be written like

$$\begin{aligned} \forall x[F(x) \implies \neg P(x)] \\ \equiv \forall x[\neg F(x) \vee \neg P(x)] \\ \equiv \forall x[\neg(F(x) \wedge P(x))] \\ \equiv \neg \exists x[F(x) \wedge P(x)] \end{aligned}$$

So, the answer is D.

36 votes

-- VNC (2.1k points)

### 3.1.17 First Order Logic: GATE CSE 2013 | Question: 47 [top](#)

<https://gateoverflow.in/80>



✓ A useful rule:

$$\forall x(\alpha) = \neg \exists(x)(\neg \alpha)$$

i.e.; If some property  $\alpha$  is true for all  $x$ , then it is equivalent to say that no  $x$  exists such that property  $\alpha$  does not hold for it.

Starting with choices:

- A.  $\forall x(\exists z(\neg \beta) \rightarrow \forall y(\alpha))$   
 $\implies \forall x(\neg \exists z(\neg \beta) \vee \forall y(\alpha))$   
 $\implies \forall x(\forall z(\beta) \vee \forall y(\alpha))$   
 $\implies \neg \exists x \neg (\forall z(\beta) \vee \forall y(\alpha))$   
 $\implies \neg \exists x(\neg \forall z(\beta) \wedge \neg \forall y(\alpha))$

So, A is not matching with the logical statement in question.

$$\begin{aligned}
 \text{B. } & \forall x(\forall z(\beta) \rightarrow \exists y(\neg\alpha)) \\
 & \implies \forall x(\neg\forall z(\beta) \vee \exists y(\neg\alpha)) \\
 & \implies \neg\exists x \neg(\neg\forall z(\beta) \vee \exists y(\neg\alpha)) \\
 & \implies \neg\exists x(\forall z(\beta) \wedge \neg\exists y(\neg\alpha)) \\
 & \implies \neg\exists x(\forall z(\beta) \wedge \forall y(\alpha))
 \end{aligned}$$

Hence, matches with the given statement.

$$\begin{aligned}
 \text{C. } & \forall x(\forall y(\alpha) \rightarrow \exists z(\neg\beta)) \\
 & \implies \forall x(\neg\forall y(\alpha) \vee \exists z(\neg\beta)) \\
 & \implies \neg\exists x \neg(\neg\forall y(\alpha) \vee \exists z(\neg\beta)) \\
 & \implies \neg\exists x(\forall y(\alpha) \wedge \neg\exists z(\neg\beta)) \\
 & \implies \neg\exists x(\forall y(\alpha) \wedge \forall z(\beta))
 \end{aligned}$$

Hence, matches with the given statement.

$$\begin{aligned}
 \text{D. } & \forall x(\exists y(\neg\alpha) \rightarrow \exists z(\beta)) \\
 & \implies \forall x(\neg\exists y(\neg\alpha) \vee \exists z(\beta)) \\
 & \implies \forall x(\forall y(\alpha) \vee \exists z(\beta)) \\
 & \implies \neg\exists x \neg(\forall y(\alpha) \vee \exists z(\beta)) \\
 & \implies \neg\exists x(\neg\forall y(\alpha) \wedge \neg\exists z(\beta)) \\
 & \implies \neg\exists x(\neg\forall y(\alpha) \wedge \forall z(\beta))
 \end{aligned}$$

So, D is not matching with the logical statement in question.

Thus both (A) and (D) are not logically equivalent to the given statement.

*In GATE 2013 marks were given to all for this question*

57 votes

-- Arjun Suresh (32.8k points)

### 3.1.18 First Order Logic: GATE CSE 2014 Set 1 | Question: 1 top

<https://gateoverflow.in/769>



✓ "Not all that glitters is gold" can be expressed as :

$$\neg(\forall x(\text{glitters}(x) \implies \text{gold}(x)))$$

(as restriction of universal quantification is same as universal quantification of a conditional statement.)

"Not all that glitters is gold" means "some glitters are not gold" which can be expressed as

$$\exists x(\text{glitters}(x) \wedge \neg\text{gold}(x))$$

(as restriction of an existential quantification is same as existential quantification of a conjunction.)

So option (D) is correct.

23 votes

-- Soumya Jain (12.4k points)

### 3.1.19 First Order Logic: GATE CSE 2014 Set 3 | Question: 53 top

<https://gateoverflow.in/2087>



✓ Not all rainy days are cold.

In other words it says ``Some rainy days are not cold''

Given statement is

$$\begin{aligned}
 & \neg\forall d[R(d) \rightarrow C(d)] \\
 & \equiv \neg\forall d[\neg R(d) \vee C(d)] \\
 & \equiv \exists d[R(d) \wedge \neg C(d)]
 \end{aligned}$$

Hence option (D) is correct.

32 votes

-- Srinath Jayachandran (2.9k points)

- A. No rainy days are cold
- B. All non-rainy days are cold
- C. Some non-rainy days are cold.
- D. Some rainy days are not cold.

Option D.

25 votes

-- Manali (2.1k points)

### 3.1.20 First Order Logic: GATE CSE 2015 Set 2 | Question: 55 top

<https://gateoverflow.in/8259>



#### ✓ Note 1 :

When no information is given about Domain of variables for a First Order Logic (FOL) formula, then consider that domain for all variables in the given FOL formula is same. Unless otherwise explicitly stated, domain should be taken same for all variables of a given FOL formula.

#### Note 2 :

For propositional logic(PL) / Sentential logic, “Tautology” of an expression means same thing as “Validity” of that expression. But this is Not true in FOL.

#### Tautology/Validity in Propositional Logic :

Tautologies are a key concept in propositional logic, where a tautology is defined as a propositional formula that is true under any possible Boolean valuation of its propositional variables.

Given propositional logic expression (PLE) G is said to be Valid or Tautology iff G is ALWAYS True, regardless of which valuation is used for the propositional variables.

Some examples of Tautologies in PL :

$$A \vee \neg A$$

$$(A \vee B) \rightarrow (A \vee B)$$

$$(A \rightarrow B) \rightarrow (\neg B \rightarrow \neg A)$$

In propositional logic, there is no distinction between a tautology and a logically valid formula. So,

In Propositional logic :  $\text{Valid} \equiv \text{Tautology} \equiv \text{True}$

#### Tautology/Validity in First Order Logic(FOL) :

From Wikipedia :

The definition of tautology can be extended to sentences in predicate logic, which may contain quantifiers—a feature absent from sentences of propositional logic. Indeed, in propositional logic, there is no distinction between a tautology and a logically valid formula. In the context of predicate logic, many authors define a tautology to be a sentence that can be obtained by taking a tautology of propositional logic, and uniformly replacing each propositional variable by a first-order formula (one formula per propositional variable). The set of such formulas is a proper subset of the set of logically valid sentences of predicate logic (i.e., sentences that are true in every model).

The fundamental definition of a tautology is in the context of propositional logic. The definition can be extended, however, to sentences in first-order logic. These sentences may contain quantifiers, unlike sentences of propositional logic. In the context of first-order logic, a distinction is maintained between logical validities, sentences that are true in every model, and tautologies, which are a proper subset of the first-order logical validities. In the context of propositional logic, these two terms coincide.

**A tautology in first-order logic is a sentence that can be obtained by taking a tautology of propositional logic and uniformly replacing each propositional variable by a first-order formula (one formula per propositional variable). (Note that Propositional logic manipulations can be done on the given formula, but No FOL manipulation should be done.)**

For example, because  $A \vee \neg A$  is a tautology of propositional logic,  $(\forall x(x = x)) \vee \neg(\forall x(x = x))$  is a tautology in first order logic.

[https://en.wikipedia.org/wiki/Tautology\\_\(logic\)#Tautologies\\_versus\\_validities\\_in\\_first-order\\_logic](https://en.wikipedia.org/wiki/Tautology_(logic)#Tautologies_versus_validities_in_first-order_logic)

Example 2 :

$$\forall x[(\forall y \neg Py \rightarrow \neg Px) \rightarrow (Px \rightarrow \neg \forall y \neg Py)] \text{ is a FOL Tautology}$$

because it can be obtained from a contraposition tautology  $(A \rightarrow \neg B) \rightarrow (B \rightarrow \neg A)$  by replacing  $A$  by  $\forall y \neg Py$  and  $B$  by  $Px$ .

Example 3 :

$\forall x \forall y P(x, y) \rightarrow \forall x \forall y P(x, y)$  is a FOL tautology because it can be obtained from a PL Tautology  $A \rightarrow A$  by replacing  $A$  with  $\forall x \forall y P(x, y)$ .

**Not all logical validities are tautologies in first-order logic.**

For example, the sentence  $(\forall x Rx) \rightarrow \neg \exists x \neg Rx$

is true/valid in any first-order interpretation BUT it is Not a FOL Tautology, because it corresponds to the propositional sentence  $A \rightarrow B$  which is not a tautology of propositional logic.

**Example 2 :**

$\forall x(Px \rightarrow Px)$  is NOT a FOL Tautology because it corresponds to the propositional sentence  $A$  which is not a tautology of propositional logic. NOTE that  $\forall x(Px \rightarrow Px)$  is FOL Valid formula But Not Tautology.

**Example 3 :**

$(\forall xPx) \rightarrow Pc$  is NOT a FOL Tautology because it corresponds to the propositional sentence  $A \rightarrow B$  (By replacing  $(\forall xPx)$  with  $A$  and  $Pc$  with  $B$ ) which is not a tautology of propositional logic. NOTE that  $(\forall xPx) \rightarrow Pc$  is FOL Valid formula But Not Tautology.

**Example 4:**

The following is an example of a logical truth that is not a tautology:  $\exists xCube(x) \vee \exists x\neg Cube(x)$ . Because the validity of the argument depends on the meaning of the existential quantifier  $\exists$ , and not just on the meaning of the connective  $\vee$ .

A sentence containing quantifiers that is a tautology is this:  $\forall xCube(x) \vee \neg\forall xCube(x)$  which is just an instance of the tautologous form  $A \vee \neg A$ .

So that's that.

**NOTE : Every FOL Tautology is FOL validity BUT Not vice versa.**

**So, If a given FOL formula is Not valid, then it is Not a FOL Tautology.**

---

**Now coming back to the given question :**

**Option A :**

Option A is NOT at all valid in FOL.

$\forall x\exists yR(x, y) \leftarrow \exists y\forall xR(x, y)$  is FOL Validity. But it is Not FOL Tautology.

$\forall x\exists yR(x, y) \rightarrow \exists y\forall xR(x, y)$  is NOT FOL Validity. So, it is Not FOL Tautology as well.

**Option B :**

$(\forall x[\exists yR(x, y) \rightarrow S(x, y)]) \rightarrow \forall x\exists yS(x, y)$  is NOT at all valid.

For example, Let  $A$  be a set  $\{a, b\}$  and let relation  $R$  on  $A$  be  $\{(a, a)\}$  and let relation  $S$  on  $A$  be  $\{(a, a)\}$  then clearly  $\forall x\exists yS(x, y)$  is false. Also  $(\forall x[\exists yR(x, y) \rightarrow S(x, y)])$  is true. So, we can say that option B is NOT Valid. So, it is Not a Tautology.

**Option C :**

$[\forall x\exists y(P(x, y) \rightarrow R(x, y))] \leftrightarrow [\forall x\exists y(\neg P(x, y) \vee R(x, y))]$  is a FOL Tautology.

Note that we can do Propositional logic manipulations, so,  $A \rightarrow B$  can be written  $A' \vee B$ .

So,

$[\forall x\exists y(P(x, y) \rightarrow R(x, y))] \leftrightarrow [\forall x\exists y(\neg P(x, y) \vee R(x, y))]$  is same as  
 $[\forall x\exists y(\neg P(x, y) \vee R(x, y))] \leftrightarrow [\forall x\exists y(\neg P(x, y) \vee R(x, y))]$

under only propositional logic manipulation.

Now, we can take  $A = [\forall x\exists y(\neg P(x, y) \vee R(x, y))]$  and so \$A \leftrightarrow A\$ \$ is tautology in PL.

**Option 4 :**

$\forall x\forall yP(x, y) \rightarrow \forall x\forall yP(y, x)$  is FOL Valid But Not FOL Tautology. NOTE that If we replace  $\forall x\forall yP(x, y)$  by  $A$  then  $\forall x\forall yP(y, x)$  is some B. But  $A \rightarrow B$  is Not tautology in PL.

**References :**

<https://math.stackexchange.com/questions/2091052/predicate-logic-why-%E2%88%80xpx-%E2%8A%83-px-is-not-a-tautology>

<https://math.stackexchange.com/questions/1540933/how-to-check-whether-the-formula-is-a-tautology>

[https://en.wikipedia.org/wiki/Tautology\\_\(logic\)#Tautologies\\_versus\\_validities\\_in\\_first-order\\_logic](https://en.wikipedia.org/wiki/Tautology_(logic)#Tautologies_versus_validities_in_first-order_logic)

Page number 115 in the below book :

<http://agnigarh.tezu.ernet.in/~zubin/isc/extr/MathematicalIntroductionToLogic-Enderton.pdf>

<https://faculty.washington.edu/smcohen/120/Chapter10.pdf>

**References**



3 votes

-- Deepak Poonia (23k points)

### 3.1.21 First Order Logic: GATE CSE 2016 Set 2 | Question: 27 top

<https://gateoverflow.in/39618>



- ✓ Here, (D) is not valid

Let me prove by an example

What (D) is saying here is:

For all  $x$  ( $x$  is even no or  $x$  is odd no)  $\implies$  For all  $x$  ( $x$  is even no) or For all  $x$  ( $x$  is odd no)

OR

If every  $x$  is either even or odd, then every  $x$  must be even or every  $x$  must be odd.

If our domain is the set of natural numbers LHS is true but RHS is false as not all natural numbers are even or odd.

Answer is (D).

52 votes

-- Akash Kanase (36k points)

### 3.1.22 First Order Logic: GATE CSE 2017 Set 1 | Question: 02 top

<https://gateoverflow.in/118701>



- ✓ Ans is B.

1st Method:  $F : \forall x(\exists yR(x, y))$

Take option 4:  $\neg\exists x(\forall y\neg R(x, y))$

$\equiv \forall x(\exists yR(x, y))$  (Since we know that  $\neg\forall x \equiv \exists x$  And  $\neg\exists x = \forall x$ )

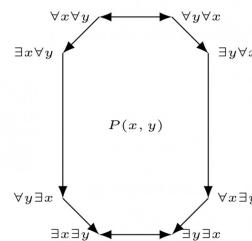
F: For all girls there exist a boyfriend. (Given)

( $x$  for girl and  $y$  for boys)

- I. There exists some boys who have girlfriends. (True)
- II. There exists some boys for whom all the girls are girlfriend. (False)
- III. For all boys there exists a girlfriend. (False)
- IV. For all girls, there exists a boyfriend (True) (Same as given statement  $F$ )

96 votes

-- Ahwan Mishra (10.1k points)



Solution.

- I.  $\forall x\exists yR(x, y) \rightarrow \exists y\exists xR(x, y)$  True
- II.  $\forall x\exists yR(x, y) \rightarrow \exists y\forall xR(x, y)$  False
- III.  $\forall x\exists yR(x, y) \rightarrow \exists x\exists yR(x, y)$  False
- IV.  $\forall x\exists yR(x, y) \rightarrow \neg\exists x(\forall y\neg R(x, y))$   
 $\rightarrow \forall x\exists yR(x, y)$  True

So, I and IV are only true.

Answer is option B.

67 votes

-- Akash Dinkar (27.9k points)

### 3.1.23 First Order Logic: GATE CSE 2018 | Question: 28 top

<https://gateoverflow.in/204102>



✓ Answer - A.

Quick logic review -

$$\alpha : \forall x \exists y \ y < x$$

Is  $\alpha$  true for domain of **all integers** ?, Yes it is true. You pick any number  $x$ , I can always give you  $y$  that is less than your number  $x$ .

Is  $\alpha$  true for domain of **Non Negative integers**  $\{0, 1, 2, 3, \dots\}$  ? No, it is not true. (You pick any number  $x$ ) If you pick 0 then I can not give you  $y$  which is less than 0.

Definition of Model - **Domain** for which my sentence is true. For above sentence  $\alpha$ , **all integers** is model and there can be many other models, like - **real numbers**.

(Definition of Co Model - **Domain** for which my sentence is False.)

Given that Predicate  $\Phi \equiv \exists s \exists t \exists u \forall v \forall w \forall x \forall y \Psi(s, t, u, v, w, x, y)$  has a model with universe containing 7 elements.

I.e. there is a domain with 7 elements which satisfies my  $\Phi$ .

Now let  $\Phi \equiv \exists s \exists t \exists u \forall v \forall w \forall x \forall y \ s + t + u + v + w + x + y > 200$ . Can you suggest me a set (domain) that is model for  $\Phi$ ? (i.e. the domain for which you can satisfy  $\Phi$ ).

$\{10, 20, 30, 40, 50, 60, 100\}$ , now if I choose  $s = 50$ ,  $t = 60$  and  $u = 100$  [1] and let anyone choose values of  $v, u, x$  and  $y$  then  $\Phi$  is always satisfiable for any values (or write like this - for all values) of  $v, u, x$  and  $y$ . The key point is you have to choose values of  $s, t$  and  $u$  carefully and once  $u$  fixed these values then it should work for all remaining universal quantifiers values.

Actually I have problem with first element of set "10". Can I remove it and the resultant set will still work as model?  $\{20, 30, 40, 50, 60, 100\}$ , Of course this is model for  $\Phi$  (Why? - take  $s = 50$ ,  $t = 60$  and  $u = 100$  and let any other variable value be anything).

Similarly,  $\{50, 60, 100\}$  is also model for  $\Phi$ .

**Idea is once you have your s, t and u in set then that set is model** (because remaining quantifiers can take any value).

Even the singleton set  $\{100\}$  is also model for  $\Phi$ .

Now there is always one model of universe size 3, and depending on your predicate you can have model of less than size 3 too (like above singleton set).

<sup>1</sup>  $s = t = u = 100$  also works.

Now, Lets generalize this for better understanding-

let  $\Phi$  has following model of size 7-  $\{e_1, e_2, e_3, e_4, e_5, e_6, e_7\}$ , and let  $s = e_2, t = e_5, u = e_1$  is the **only** setting which works for any (for all) values of  $v, w, x$  and  $y$ , then Can we reduce model size? - Yes, we can have a model of size 3  $\{e_1, e_2, e_5\}$ . Can we reduce size further? - We can not ( Because  $s = e_2, t = e_5, u = e_1$  is the **only** setting which works for any value of  $v, w, x, y$ ). But if  $s = t$  or  $t = u$ , we can even have a model of size less than 3.

112 votes

-- Sachin Mittal (1.5.8k points)

### 3.1.24 First Order Logic: GATE CSE 2019 | Question: 35 top

<https://gateoverflow.in/302813>



✓  $\forall x[(\forall z z|x \Rightarrow ((z = x) \vee (z = 1))) \Rightarrow \exists w (w > x) \wedge (\forall z z|w \Rightarrow ((w = z) \vee (z = 1)))]$

Lets divide above statement into three parts:

1.  $(\forall z z|x \Rightarrow ((z = x) \vee (z = 1)))$
2.  $\exists w (w > x)$
3.  $(\forall z z|w \Rightarrow ((w = z) \vee (z = 1)))$

$$\forall x[1 \Rightarrow 2 \Rightarrow 3]$$

Meaning of each part:

1. If  $x$  is PRIME this statement is TRUE
2. If there exist a  $w$  which is greater than  $x$  this statement is TRUE
3. If  $w$  is prime (Keep in mind  $z$  is local here) this statement is TRUE

That means for every  $x$  there exist a  $w$  which is greater than  $x$  and it is prime.

- $S_1$  : FALSE. If  $x = 97$  then 101 is not in the  $S_1$
- $S_2$  : TRUE
- $S_3$  : TRUE. Negative can't be PRIME so statement 1 is FALSE. Apply logic of implication, if  $p$  is false in  $p \Rightarrow q$ , statement is TRUE.

Edit 1 (by Deepak Poonia) : Refer my comment here for detailed analysis :

<https://gateoverflow.in/302813/gate2019-35?show=327668#c327668>

### References



48 votes

-- Digvijay (44.9k points)

### 3.1.25 First Order Logic: GATE CSE 2020 | Question: 39 [top](#)

<https://gateoverflow.in/333192>



- ✓ (A) Let's consider two cases.

W-True. This makes both LHS and RHS True.

W-False. The value of LHS depends upon the truth value of  $\forall x P(x)$ . Same will be the case for RHS. Hence LHS = RHS.

(B) Using analogy in (A), we can prove that this is also valid.

W-True. LHS=RHS=True

W-False. LHS=RHS=False always.

(C)  $\forall x(P(x) \rightarrow W) \equiv \forall xP(x) \rightarrow W$

LHS can be re-written as  $\forall x(\neg P(x) \vee W) \equiv \exists xP(x) \vee W$

(C) is not logically valid.

(D)  $\exists x(P(x) \rightarrow W) \equiv \exists x(\neg P(x) \vee W)$

Using Demorgan law for quantifiers we can again rewrite it as:

$\neg \forall xP(x) \vee W \equiv \forall xP(x) \rightarrow W$

Option (D) is valid.

19 votes

-- Ayush Upadhyaya (28.2k points)

### 3.1.26 First Order Logic: GATE IT 2004 | Question: 3 [top](#)

<https://gateoverflow.in/3644>



- ✓  $(\exists x)(\forall y)[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)]$

$$\equiv \neg(\forall x)\neg(\forall y)[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)] \\ (\because (\exists x)F(x) = \neg\forall x\neg F(x))$$

$$\equiv \neg(\forall x)(\exists y)\neg[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)] \\ (\because (\forall x)F(x) = \neg\exists x\neg F(x), \neg\neg F(x) = F(x))$$

$$\equiv \neg(\forall x)(\exists y)[\neg(a(x, y) \wedge b(x, y)) \vee c(x, y)]$$

$$\equiv \neg(\forall x)(\exists y)[(a(x, y) \wedge b(x, y)) \rightarrow c(x, y)]$$

(C) choice.

48 votes

-- Arjun Suresh (328k points)

### 3.1.27 First Order Logic: GATE IT 2005 | Question: 36 [top](#)

<https://gateoverflow.in/3783>



- ✓ **Procedure to be followed:** For each option assume LHS to be TRUE and try to make RHS be False by selecting some values which makes LHS true in every condition.

(one can also start from RHS assuming it to be false and trying to make LHS to be true)

A.  $[(\forall x(P(x) \vee Q(x)))] \implies [(\forall xP(x)) \vee (\forall xQ(x))]$

Let us assume the domain of  $x$  such that, for the first half of the values  $P(x)$  is True &  $Q(x)$  is False while for the other half,  $Q(x)$  is True and  $P(x)$  is False.

LHS: Since for LHS to be true either  $P(x)$  or  $Q(x)$  should be true. Hence our assumption of the domain will make LHS be TRUE.

RHS: for  $(\forall x P(x))$  or  $(\forall x Q(x))$  to be true, each must be true for all values which is not possible as per assumption we have made. Thus, RHS becomes FALSE.

Thus,  $T \rightarrow F$  makes **statement A False**.

$$C. [\forall x(P(x)) \Rightarrow \forall x(Q(x))] \Rightarrow [\forall x(P(x) \Rightarrow Q(x))]$$

Let us assume some values of  $P(x)$  and  $Q(x)$  as follows :

$x$	$P(x)$	$Q(x)$
$x_1$	F	T
$x_2$	T	F

LHS: for assumed domain  $\forall x(P(x))$  will becomes False and  $\forall x(Q(x))$  will also be false. Since  $F \rightarrow F$  is True, LHS becomes TRUE.

RHS: for  $x_1$   $(P(x) \Rightarrow Q(x))$  is True and for  $x_2$   $(P(x) \Rightarrow Q(x))$  is False. As a whole  $\forall x(P(x) \Rightarrow Q(x))$  becomes False, thus RHS becomes FALSE.

Thus,  $T \rightarrow F$  makes **statement C as False**.

$$D. [\forall x(P(x)) \Leftrightarrow (\forall x(Q(x)))] \Rightarrow [\forall x(P(x) \Leftrightarrow Q(x))]$$

if we assume same domain as in above option C,then observations are as following :

LHS:  $\forall x(P(x))$  becomes false as  $x_1$  is false. Also  $(\forall x(Q(x)))$  becomes false as  $x_2$  is false. Thus  $F \leftrightarrow F$  implies LHS is TRUE.

RHS:  $(P(x) \Leftrightarrow Q(x))$  will be false for both  $x_1$  and  $x_2$ . Hence  $\forall x(P(x) \Leftrightarrow Q(x))$  becomes False which makes RHS to be FALSE.

Thus  $T \rightarrow F$  makes **statement D as False**.

$$B. [\forall x(P(x) \Rightarrow Q(x))] \Rightarrow [(\forall x P(x)) \Rightarrow (\forall x Q(x))]$$

As we are assuming LHS to be TRUE then we'll not make any selection in which  $P(x)$  is True and  $Q(x)$  is false as it will make our assumption false. Thus values can be like this:

$x$	$P(x)$	$Q(x)$
$x_1$	T	T
$x_2$	F	T
$x_3$	F	F

LHS:  $(P(x) \Rightarrow Q(x))$  becomes TRUE for each value and thus  $\forall x(P(x) \Rightarrow Q(x))$  become TRUE.

RHS:  $(\forall x P(x))$  and  $(\forall x Q(x))$  both becomes false for assumed values which implies  $F \rightarrow F$  and thus makes RHS to be TRUE.

$T \rightarrow T$  makes **statement B to be TRUE. Thus Answer is B.**

55 votes

-- AAKASH SAINI (1.6k points)



### 3.1.28 First Order Logic: GATE IT 2006 | Question: 21 top

https://gateoverflow.in/3560

- The given relation is nothing but symmetry. We have both symmetric relations possible as well as anti-symmetric but neither always holds for all sets. So they both are not valid but are satisfiable. (B) option.

61 votes

-- Arjun Suresh (328k points)



### 3.1.29 First Order Logic: GATE IT 2007 | Question: 21 top

https://gateoverflow.in/3454

- (A) is the answer

- LHS: For every  $x$ , if  $P$  holds then  $Q$  holds  
RHS: If  $P(x)$  holds for all  $x$ , then  $Q(x)$  holds for all  $x$ .

LHS implies RHS but RHS does not imply LHS.

B. LHS: An  $x$  exist for which either  $P(x)$  is true or  $Q(x)$  is true.

RHS: If an  $x$  exist for which  $P(x)$  is true then another  $x$  exist for which  $Q(x)$  is true.

LHS does not imply RHS, but on RHS if we change  $\exists x P(x)$  to  $\sim \exists x P(x)$ , implication becomes TRUE.

C. LHS: There exist an  $x$  for which both  $P(x)$  and  $Q(x)$  are true.

RHS: There exist an  $x$  for which  $P(x)$  is true and there exist an  $x$  for which  $Q(x)$  is true.

LHS implies RHS but RHS does not imply LHS as the 'x' for  $P$  and  $Q$  can be different on the RHS

D. LHS: For every  $x$ , there exist a  $y$  such that  $P(x, y)$  holds.

RHS: There exist a  $y$  such that for all  $x$   $P(x, y)$  holds.

Here RHS implies LHS but LHS does not imply RHS as the  $y$  on LHS can be different for each  $x$ .

51 votes

-- Arjun Suresh (328k points)

### 3.1.30 First Order Logic: GATE IT 2008 | Question: 21 [top](#)

<https://gateoverflow.in/3282>



A.  $[\beta \rightarrow (\exists x, \alpha(x))] \rightarrow [\forall x, \beta \rightarrow \alpha(x)]$

LHS: If  $\beta$  (some condition) is true, then there exists an  $x$  for which  $\alpha(x)$  is true.

RHS: For all  $x$ , if  $\beta$  is true then  $\alpha(x)$  is true. This is same as saying if  $\beta$  is true then for all  $x$ ,  $\alpha(x)$  is true. ( $\beta \implies \forall x, \alpha(x)$ ).

So,

$\text{RHS} \implies \text{LHS}$  and  $\text{LHS} \implies \text{RHS}$ .

B.  $[\exists x, \beta \rightarrow \alpha(x)] \rightarrow [\beta \rightarrow (\forall x, \alpha(x))]$

LHS: There exists an  $x$  such that if  $\beta$  is true then  $\alpha(x)$  is true.

RHS: If  $\beta$  is true then for all  $x$ ,  $\alpha(x)$  is true.

So,

$\text{RHS} \implies \text{LHS}$  and  $\text{LHS} \implies \text{RHS}$ .

C.  $[(\exists x, \alpha(x)) \rightarrow \beta] \rightarrow [\forall x, \alpha(x) \rightarrow \beta]$

LHS: If there is an  $x$  such that  $\alpha(x)$  is true, then  $\beta$  is true.

RHS: For all  $x$ , if  $\alpha(x)$  is true, then  $\beta$  is true.

Here, both LHS and RHS are in fact same as  $\beta$  is a formula which is independent of  $x$ . (if  $\beta$  is true for one  $x$ , it is true for every  $x$  and vice versa).

So,

$\text{RHS} \implies \text{LHS}$  and  $\text{LHS} \implies \text{RHS}$ .

D.  $[(\forall x, \alpha(x)) \rightarrow \beta] \rightarrow [\forall x, \alpha(x) \rightarrow \beta]$

LHS: If  $\alpha(x)$  is true for every  $x$ , then  $\beta$  is true.

RHS: For every  $x$ , if  $\alpha(x)$  is true then  $\beta$  is true.

So,

$\text{RHS} \implies \text{LHS}$  and  $\text{LHS} \implies \text{RHS}$ .

So, answer here is **option C**.

Any of options A, B, or D could be valid if their implication is reversed. For option C, LHS, and RHS being equivalent, even if the implication is reversed (or changed to double implies) it remains valid.

47 votes

-- Arjun Suresh (328k points)

### 3.1.31 First Order Logic: GATE IT 2008 | Question: 22 [top](#)

<https://gateoverflow.in/3283>

✓  $[\forall x, \alpha \rightarrow (\exists y, \beta \rightarrow (\forall u, \exists v, y))] \equiv [\forall x, \neg \alpha \vee (\exists y, \neg \beta \vee (\forall u, \exists v, y))]$

Now, doing complement gives (complement of  $\forall$  is  $\exists$  and vice versa while propagating negation inwards as  $\forall x(P) \equiv \neg \exists x(\neg P)$  and  $\exists x(P) \equiv \neg \forall x(\neg P)$ )

$[\exists x, \alpha \wedge (\forall y, \beta \wedge (\exists u, \forall v, \neg y))]$

(D) choice

44 votes

-- Arjun Suresh (328k points)

## 3.2

## Logical Reasoning (3)

## 3.2.1 Logical Reasoning: GATE CSE 2012 | Question: 1

<https://gateoverflow.in/33>

Consider the following logical inferences.

$I_1$ : If it rains then the cricket match will not be played.  
 The cricket match was played.  
 Inference: There was no rain.

$I_2$ : If it rains then the cricket match will not be played.  
 It did not rain.  
 Inference: The cricket match was played.

Which of the following is **TRUE**?

- A. Both  $I_1$  and  $I_2$  are correct inferences
- B.  $I_1$  is correct but  $I_2$  is not a correct inference
- C.  $I_1$  is not correct but  $I_2$  is a correct inference
- D. Both  $I_1$  and  $I_2$  are not correct inferences

[gate2012-cse](#) [mathematical-logic](#) [easy](#) [logical-reasoning](#)

Answer

## 3.2.2 Logical Reasoning: GATE CSE 2015 Set 2 | Question: 3

<https://gateoverflow.in/8049>

Consider the following two statements.

- $S_1$ : If a candidate is known to be corrupt, then he will not be elected
- $S_2$ : If a candidate is kind, he will be elected

Which one of the following statements follows from  $S_1$  and  $S_2$  as per sound inference rules of logic?

- A. If a person is known to be corrupt, he is kind
- B. If a person is not known to be corrupt, he is not kind
- C. If a person is kind, he is not known to be corrupt
- D. If a person is not kind, he is not known to be corrupt

[gate2015-cse-set2](#) [mathematical-logic](#) [normal](#) [logical-reasoning](#)

Answer

## 3.2.3 Logical Reasoning: GATE CSE 2015 Set 3 | Question: 24

<https://gateoverflow.in/8427>

In a room there are only two types of people, namely Type 1 and Type 2. Type 1 people always tell the truth and Type 2 people always lie. You give a fair coin to a person in that room, without knowing which type he is from and tell him to toss it and hide the result from you till you ask for it. Upon asking the person replies the following

"The result of the toss is head if and only if I am telling the truth"

Which of the following options is correct?

- A. The result is head
- B. The result is tail
- C. If the person is of Type 2, then the result is tail
- D. If the person is of Type 1, then the result is tail

[gate2015-cse-set3](#) [mathematical-logic](#) [difficult](#) [logical-reasoning](#)

Answer

## Answers: Logical Reasoning

### 3.2.1 Logical Reasoning: GATE CSE 2012 | Question: 1 top ↴

<https://gateoverflow.in/33>



✓  $I_1$  is a correct inference.  $I_2$  is not a correct inference as it was not mentioned what would have happened if it hadn't rained- They might have played or they might not have played.

43 votes

-- Arjun Suresh (32.8k points)

### 3.2.2 Logical Reasoning: GATE CSE 2015 Set 2 | Question: 3 top ↴

<https://gateoverflow.in/8049>



- ✓  $S_1 = C \rightarrow \neg E$
- $S_2 = K \rightarrow E$

so, writing them using primary operators :

$$S_1 = \neg C \vee \neg E$$

$$S_2 = \neg K \vee E$$

on using resolution principle

$\neg E$  and  $E$  cancels each other out

and conclusion =  $\neg C \vee \neg K$

which can also be written as  $K \rightarrow \neg C$  which is translated into English as = **option C**

26 votes

-- Amar Vashishth (25.2k points)

Option c. If a person is kind, he is not known to be corrupt

Let

- $C(x)$  :  $x$  is known to be corrupt
- $K(x)$  :  $x$  is kind
- $E(x)$  :  $x$  will be elected

- $S1 : C(x) \rightarrow \neg E(x)$
- $S2 : K(x) \rightarrow E(x)$

$S1$  can be written as  $E(x) \rightarrow \neg C(x)$  as  $A \rightarrow B = \neg A \rightarrow B$ .

Thus, from  $S1$  and  $S2$ ,

$$K(x) \rightarrow E(x) \rightarrow \neg C(x).$$

Thus we get C option.

56 votes

-- Anoop Sonkar (4.1k points)

### 3.2.3 Logical Reasoning: GATE CSE 2015 Set 3 | Question: 24 top ↴

<https://gateoverflow.in/8427>



- ✓ We do not know the type of the person from whom those words are coming from and so can have two cases :

1. Truth-teller : definitely implies that result of toss is Head.
2. Liar : the reality will be the negation of the statement.

The negation of  $(x \iff y)$  is exactly one of  $x$  or  $y$  holds. So, we negate the statement : "The result of the toss is head if and only if I am telling the truth". This give rise to two possibilities

- it is head and lie spoken
- it is not head and truth spoken

Clearly the second one cannot be true because it cannot be a reality that the liar speaks the truth.

So, this implies that even if we negate the statement to see the reality or don't do that; The reality is that the toss yielded a Head.

Answer = **option (A)**.

118 votes

-- Amar Vashishth (25.2k points)

Person 1 (truth teller), result is head. No doubt here as he is a truth teller.

Person 2(lie teller). result is head if and only if he is telling truth. He is telling lies. So, the truth is the opposite of his statement. We can analyze his statement as two

1. If I'm telling the truth result is head
2. If result is head I'm telling the truth

Both these are of the form  $A \rightarrow B = \neg A \vee B$ . Now, the truth will be the negation of these statements which will be  $A \wedge \neg B$  which can be expressed as

1. I'm telling the truth and result is not head
2. Result is head and I'm telling false

Both of these means, the result is head as the person is lie teller. (Actually even if iff is replaced with if, answer would be A) So, option A.

51 votes

-- Arjun Suresh (328k points)

### 3.3

### Propositional Logic (38) top ↴

#### 3.3.1 Propositional Logic: GATE CSE 1987 | Question: 10e top ↴

<https://gateoverflow.in/82457>



Show that the conclusion  $(r \rightarrow q)$  follows from the premises:  $p, (p \rightarrow q) \vee (p \wedge (r \rightarrow q))$

gate1987 mathematical-logic propositional-logic proof descriptive

Answer

#### 3.3.2 Propositional Logic: GATE CSE 1988 | Question: 2vii top ↴

<https://gateoverflow.in/93947>



Define the validity of a well-formed formula(wff)?

gate1988 descriptive mathematical-logic propositional-logic

Answer

#### 3.3.3 Propositional Logic: GATE CSE 1989 | Question: 3-v top ↴

<https://gateoverflow.in/87126>



Which of the following well-formed formulas are equivalent?

- A.  $P \rightarrow Q$
- B.  $\neg Q \rightarrow \neg P$
- C.  $\neg P \vee Q$
- D.  $\neg Q \rightarrow P$

gate1989 normal mathematical-logic propositional-logic multiple-selects

Answer

#### 3.3.4 Propositional Logic: GATE CSE 1990 | Question: 3-x top ↴

<https://gateoverflow.in/84861>



Indicate which of the following well-formed formulae are valid:

- A.  $(P \Rightarrow Q) \wedge (Q \Rightarrow R) \Rightarrow (P \Rightarrow R)$
- B.  $(P \Rightarrow Q) \Rightarrow (\neg P \Rightarrow \neg Q)$
- C.  $(P \wedge (\neg P \vee \neg Q)) \Rightarrow Q$
- D.  $(P \Rightarrow R) \vee (Q \Rightarrow R) \Rightarrow ((P \vee Q) \Rightarrow R)$

gate1990 normal mathematical-logic propositional-logic multiple-selects

Answer

#### 3.3.5 Propositional Logic: GATE CSE 1991 | Question: 03,xii top ↴

<https://gateoverflow.in/526>



If  $F_1, F_2$  and  $F_3$  are propositional formulae such that  $F_1 \wedge F_2 \rightarrow F_3$  and  $F_1 \wedge F_2 \rightarrow \sim F_3$  are both tautologies, then which of the following is true:

- A. Both  $F_1$  and  $F_2$  are tautologies

- B. The conjunction  $F_1 \wedge F_2$  is not satisfiable  
 C. Neither is tautologous  
 D. Neither is satisfiable  
 E. None of the above

gate1991 | mathematical-logic | normal | propositional-logic | multiple-selects

Answer 

### 3.3.6 Propositional Logic: GATE CSE 1992 | Question: 02,xvi top

<https://gateoverflow.in/574>



Which of the following is/are a tautology?

- A.  $a \vee b \rightarrow b \wedge c$   
 B.  $a \wedge b \rightarrow b \vee c$   
 C.  $a \vee b \rightarrow (b \rightarrow c)$   
 D.  $a \rightarrow b \rightarrow (b \rightarrow c)$

gate1992 | mathematical-logic | easy | propositional-logic | multiple-selects

Answer 

### 3.3.7 Propositional Logic: GATE CSE 1992 | Question: 15.a top

<https://gateoverflow.in/594>



Use Modus ponens ( $A, A \rightarrow B \vdash B$ ) or resolution to show that the following set is inconsistent:

1.  $Q(x) \rightarrow P(x) \vee \sim R(a)$
2.  $R(a) \vee \sim Q(a)$
3.  $Q(a)$
4.  $\sim P(y)$

where  $x$  and  $y$  are universally quantified variables,  $a$  is a constant and  $P, Q, R$  are monadic predicates.

gate1992 | normal | mathematical-logic | propositional-logic | descriptive

Answer 

### 3.3.8 Propositional Logic: GATE CSE 1993 | Question: 18 top

<https://gateoverflow.in/2315>



Show that proposition  $C$  is a logical consequence of the formula

$$A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A)$$

using truth tables.

gate1993 | mathematical-logic | normal | propositional-logic | proof | descriptive

Answer 

### 3.3.9 Propositional Logic: GATE CSE 1993 | Question: 8.2 top

<https://gateoverflow.in/2300>



The proposition  $p \wedge (\sim p \vee q)$  is:

- A. a tautology  
 B. logically equivalent to  $p \wedge q$   
 C. logically equivalent to  $p \vee q$   
 D. a contradiction  
 E. none of the above

gate1993 | mathematical-logic | easy | propositional-logic

Answer 

### 3.3.10 Propositional Logic: GATE CSE 1994 | Question: 3.13 top

<https://gateoverflow.in/2499>



Let  $p$  and  $q$  be propositions. Using only the Truth Table, decide whether

- $p \iff q$  does not imply  $p \rightarrow \neg q$

is **True or False**.

[gate1994](#) [mathematical-logic](#) [normal](#) [propositional-logic](#) [true-false](#)

Answer 

### 3.3.11 Propositional Logic: GATE CSE 1995 | Question: 13 [top](#)

<https://gateoverflow.in/2649>



Obtain the principal (canonical) conjunctive normal form of the propositional formula

$$(p \wedge q) \vee (\neg q \wedge r)$$

where  $\wedge$  is logical and,  $\vee$  is inclusive or and  $\neg$  is negation.

[gate1995](#) [mathematical-logic](#) [propositional-logic](#) [normal](#) [descriptive](#)

Answer 

### 3.3.12 Propositional Logic: GATE CSE 1995 | Question: 2.19 [top](#)

<https://gateoverflow.in/2631>



If the proposition  $\neg p \rightarrow q$  is true, then the truth value of the proposition  $\neg p \vee (p \rightarrow q)$ , where  $\neg$  is negation,  $\vee$  is inclusive OR and  $\rightarrow$  is implication, is

- True
- Multiple Values
- False
- Cannot be determined

[gate1995](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

Answer 

### 3.3.13 Propositional Logic: GATE CSE 1996 | Question: 2.3 [top](#)

<https://gateoverflow.in/2732>



Which of the following is NOT True?

(Read  $\wedge$  as AND,  $\vee$  as OR,  $\neg$  as NOT,  $\rightarrow$  as one way implication and  $\leftrightarrow$  as two way implication)

- $((x \rightarrow y) \wedge x) \rightarrow y$
- $((\neg x \rightarrow y) \wedge (\neg x \rightarrow \neg y)) \rightarrow x$
- $(x \rightarrow (x \vee y))$
- $((x \vee y) \leftrightarrow (\neg x \rightarrow \neg y))$

[gate1996](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

Answer 

### 3.3.14 Propositional Logic: GATE CSE 1997 | Question: 3.2 [top](#)

<https://gateoverflow.in/2233>



Which of the following propositions is a tautology?

- $(p \vee q) \rightarrow p$
- $p \vee (q \rightarrow p)$
- $p \vee (p \rightarrow q)$
- $p \rightarrow (p \rightarrow q)$

[gate1997](#) [mathematical-logic](#) [easy](#) [propositional-logic](#)

Answer 

### 3.3.15 Propositional Logic: GATE CSE 1998 | Question: 1.5 [top](#)

<https://gateoverflow.in/1642>



What is the converse of the following assertion?

- I stay only if you go

- A. I stay if you go
- B. If I stay then you go
- C. If you do not go then I do not stay
- D. If I do not stay then you go

gate1998 | mathematical-logic | easy | propositional-logic

Answer 

### 3.3.16 Propositional Logic: GATE CSE 1999 | Question: 14 top ↗

<https://gateoverflow.in/1513>



Show that the formula  $[(\sim p \vee q) \Rightarrow (q \Rightarrow p)]$  is not a tautology.

Let  $A$  be a tautology and  $B$  any other formula. Prove that  $(A \vee B)$  is a tautology.

gate1999 | mathematical-logic | normal | propositional-logic | proof | descriptive

Answer 

### 3.3.17 Propositional Logic: GATE CSE 2000 | Question: 2.7 top ↗

<https://gateoverflow.in/654>



Let  $a, b, c, d$  be propositions. Assume that the equivalence  $a \Leftrightarrow (b \vee \neg b)$  and  $b \Leftrightarrow c$  hold. Then the truth-value of the formula  $(a \wedge b) \rightarrow (a \wedge c) \vee d$  is always

- A. True
- B. False
- C. Same as the truth-value of  $b$
- D. Same as the truth-value of  $d$

gate2000-cse | mathematical-logic | normal | propositional-logic

Answer 

### 3.3.18 Propositional Logic: GATE CSE 2001 | Question: 1.3 top ↗

<https://gateoverflow.in/696>



Consider two well-formed formulas in propositional logic

$$F_1 : P \Rightarrow \neg P \quad F_2 : (P \Rightarrow \neg P) \vee (\neg P \Rightarrow P)$$

Which one of the following statements is correct?

- A.  $F_1$  is satisfiable,  $F_2$  is valid
- B.  $F_1$  unsatisfiable,  $F_2$  is satisfiable
- C.  $F_1$  is unsatisfiable,  $F_2$  is valid
- D.  $F_1$  and  $F_2$  are both satisfiable

gate2001-cse | mathematical-logic | easy | propositional-logic

Answer 

### 3.3.19 Propositional Logic: GATE CSE 2002 | Question: 1.8 top ↗

<https://gateoverflow.in/812>



"If  $X$  then  $Y$  unless  $Z$ " is represented by which of the following formulas in propositional logic? (" $\neg$ " is negation, " $\wedge$ " is conjunction, and " $\rightarrow$ " is implication)

- A.  $(X \wedge \neg Z) \rightarrow Y$
- B.  $(X \wedge Y) \rightarrow \neg Z$
- C.  $X \rightarrow (Y \wedge \neg Z)$
- D.  $(X \rightarrow Y) \wedge \neg Z$

gate2002-cse | mathematical-logic | normal | propositional-logic

Answer 

### 3.3.20 Propositional Logic: GATE CSE 2002 | Question: 5b top ↗

<https://gateoverflow.in/3915>



Determine whether each of the following is a tautology, a contradiction, or neither (" $\vee$ " is disjunction, " $\wedge$ " is

conjunction, " $\rightarrow$ " is implication, " $\neg$ " is negation, and " $\leftrightarrow$ " is biconditional (if and only if).

1.  $A \leftrightarrow (A \vee A)$
2.  $(A \vee B) \rightarrow B$
3.  $A \wedge (\neg(A \vee B))$

[gate2002-cse](#) [mathematical-logic](#) [easy](#) [descriptive](#) [propositional-logic](#)

Answer 

### 3.3.21 Propositional Logic: GATE CSE 2003 | Question: 72 top ↴

<https://gateoverflow.in/959>



The following resolution rule is used in logic programming.

Derive clause  $(P \vee Q)$  from clauses  $(P \vee R)$ ,  $(Q \vee \neg R)$

Which of the following statements related to this rule is FALSE?

- A.  $((P \vee R) \wedge (Q \vee \neg R)) \Rightarrow (P \vee Q)$  is logically valid
- B.  $(P \vee Q) \Rightarrow ((P \vee R) \wedge (Q \vee \neg R))$  is logically valid
- C.  $(P \vee Q)$  is satisfiable if and only if  $(P \vee R) \wedge (Q \vee \neg R)$  is satisfiable
- D.  $(P \vee Q) \Rightarrow \text{FALSE}$  if and only if both  $P$  and  $Q$  are unsatisfiable

[gate2003-cse](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

Answer 

### 3.3.22 Propositional Logic: GATE CSE 2004 | Question: 70 top ↴

<https://gateoverflow.in/1064>



The following propositional statement is  $(P \implies (Q \vee R)) \implies ((P \wedge Q) \implies R)$

- A. satisfiable but not valid
- B. valid
- C. a contradiction
- D. None of the above

[gate2004-cse](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

Answer 

### 3.3.23 Propositional Logic: GATE CSE 2005 | Question: 40 top ↴

<https://gateoverflow.in/1165>



Let  $P, Q$  and  $R$  be three atomic propositional assertions. Let  $X$  denote  $(P \vee Q) \rightarrow R$  and  $Y$  denote  $(P \rightarrow R) \vee (Q \rightarrow R)$ . Which one of the following is a tautology?

- A.  $X \equiv Y$
- B.  $X \rightarrow Y$
- C.  $Y \rightarrow X$
- D.  $\neg Y \rightarrow X$

[gate2005-cse](#) [mathematical-logic](#) [propositional-logic](#) [normal](#)

Answer 

### 3.3.24 Propositional Logic: GATE CSE 2006 | Question: 27 top ↴

<https://gateoverflow.in/990>



Consider the following propositional statements:

- $P_1 : ((A \wedge B) \rightarrow C) \equiv ((A \rightarrow C) \wedge (B \rightarrow C))$
- $P_2 : ((A \vee B) \rightarrow C) \equiv ((A \rightarrow C) \vee (B \rightarrow C))$

Which one of the following is true?

- A.  $P_1$  is a tautology, but not  $P_2$
- B.  $P_2$  is a tautology, but not  $P_1$
- C.  $P_1$  and  $P_2$  are both tautologies
- D. Both  $P_1$  and  $P_2$  are not tautologies

gate2006-cse mathematical-logic normal propositional-logic

Answer 

### 3.3.25 Propositional Logic: GATE CSE 2008 | Question: 31

<https://gateoverflow.in/442>



$P$  and  $Q$  are two propositions. Which of the following logical expressions are equivalent?

- I.  $P \vee \neg Q$
- II.  $\neg(\neg P \wedge Q)$
- III.  $(P \wedge Q) \vee (P \wedge \neg Q) \vee (\neg P \wedge \neg Q)$
- IV.  $(P \wedge Q) \vee (P \wedge \neg Q) \vee (\neg P \wedge Q)$

- A. Only I and II
- B. Only I, II and III
- C. Only I, II and IV
- D. All of I, II, III and IV

gate2008-cse normal mathematical-logic propositional-logic

Answer 

### 3.3.26 Propositional Logic: GATE CSE 2009 | Question: 24

<https://gateoverflow.in/801>



The binary operation  $\square$  is defined as follows

P	Q	$P \square Q$
T	T	T
T	F	T
F	T	F
F	F	T

Which one of the following is equivalent to  $P \vee Q$ ?

- A.  $\neg Q \square \neg P$
- B.  $P \square \neg Q$
- C.  $\neg P \square Q$
- D.  $\neg P \square \neg Q$

gate2009-cse mathematical-logic easy propositional-logic

Answer 

### 3.3.27 Propositional Logic: GATE CSE 2014 Set 1 | Question: 53

<https://gateoverflow.in/1933>



Which one of the following propositional logic formulas is TRUE when exactly two of  $p, q$  and  $r$  are TRUE?

- A.  $((p \leftrightarrow q) \wedge r) \vee (p \wedge q \wedge \sim r)$
- B.  $(\sim(p \leftrightarrow q) \wedge r) \vee (p \wedge q \wedge \sim r)$
- C.  $((p \rightarrow q) \wedge r) \vee (p \wedge q \wedge \sim r)$
- D.  $(\sim(p \leftrightarrow q) \wedge r) \wedge (p \wedge q \wedge \sim r)$

gate2014-cse-set1 mathematical-logic normal propositional-logic

Answer 

### 3.3.28 Propositional Logic: GATE CSE 2014 Set 2 | Question: 53

<https://gateoverflow.in/2020>



Which one of the following Boolean expressions is NOT a tautology?

- A.  $((a \rightarrow b) \wedge (b \rightarrow c)) \rightarrow (a \rightarrow c)$
- B.  $(a \rightarrow c) \rightarrow (\sim b \rightarrow (a \wedge c))$
- C.  $(a \wedge b \wedge c) \rightarrow (c \vee a)$
- D.  $a \rightarrow (b \rightarrow a)$

gate2014-cse-set2 mathematical-logic propositional-logic normal

Answer 

### 3.3.29 Propositional Logic: GATE CSE 2014 Set 3 | Question: 1

 <https://gateoverflow.in/2035>



Consider the following statements:

- P: Good mobile phones are not cheap
- Q: Cheap mobile phones are not good

L: P implies Q

M: Q implies P

N: P is equivalent to Q

Which one of the following about L, M, and N is CORRECT?

- A. Only L is TRUE.
- B. Only M is TRUE.
- C. Only N is TRUE.
- D. L, M and N are TRUE.

gate2014-cse-set3 mathematical-logic easy propositional-logic

Answer 

### 3.3.30 Propositional Logic: GATE CSE 2015 Set 1 | Question: 14

 <https://gateoverflow.in/8209>



Which one of the following is NOT equivalent to  $p \leftrightarrow q$ ?

- A.  $(\neg p \vee q) \wedge (p \vee \neg q)$
- B.  $(\neg p \vee q) \wedge (q \rightarrow p)$
- C.  $(\neg p \wedge q) \vee (p \wedge \neg q)$
- D.  $(\neg p \wedge \neg q) \vee (p \wedge q)$

gate2015-cse-set1 mathematical-logic easy propositional-logic

Answer 

### 3.3.31 Propositional Logic: GATE CSE 2016 Set 1 | Question: 1

 <https://gateoverflow.in/39663>



Let  $p, q, r, s$  represents the following propositions.

- $p : x \in \{8, 9, 10, 11, 12\}$
- $q : x$  is a composite number.
- $r : x$  is a perfect square.
- $s : x$  is a prime number.

The integer  $x \geq 2$  which satisfies  $\neg((p \Rightarrow q) \wedge (\neg r \vee \neg s))$  is \_\_\_\_\_.

gate2016-cse-set1 mathematical-logic normal numerical-answers propositional-logic

Answer 

### 3.3.32 Propositional Logic: GATE CSE 2016 Set 2 | Question: 01

 <https://gateoverflow.in/39568>



Consider the following expressions:

- i. *false*
- ii.  $Q$
- iii. *true*
- iv.  $P \vee Q$
- v.  $\neg Q \vee P$

The number of expressions given above that are logically implied by  $P \wedge (P \Rightarrow Q)$  is \_\_\_\_\_.

gate2016-cse-set2 mathematical-logic normal numerical-answers propositional-logic

Answer 

### 3.3.33 Propositional Logic: GATE CSE 2017 Set 1 | Question: 01

<https://gateoverflow.in/118698>



The statement  $(\neg p) \Rightarrow (\neg q)$  is logically equivalent to which of the statements below?

- I.  $p \Rightarrow q$
  - II.  $q \Rightarrow p$
  - III.  $(\neg q) \vee p$
  - IV.  $(\neg p) \vee q$
- A. I only  
 B. I and IV only  
 C. II only  
 D. II and III only

gate2017-cse-set1 mathematical-logic propositional-logic easy

Answer 

### 3.3.34 Propositional Logic: GATE CSE 2017 Set 1 | Question: 29

<https://gateoverflow.in/118310>



Let  $p, q$  and  $r$  be propositions and the expression  $(p \rightarrow q) \rightarrow r$  be a contradiction. Then, the expression  $(r \rightarrow p) \rightarrow q$  is

- A. a tautology  
 B. a contradiction  
 C. always TRUE when  $p$  is FALSE  
 D. always TRUE when  $q$  is TRUE

gate2017-cse-set1 mathematical-logic propositional-logic

Answer 

### 3.3.35 Propositional Logic: GATE CSE 2017 Set 2 | Question: 11

<https://gateoverflow.in/118151>



Let  $p, q, r$  denote the statements "It is raining", "It is cold", and "It is pleasant", respectively. Then the statement "It is not raining and it is pleasant, and it is not pleasant only if it is raining and it is cold" is represented by

- A.  $(\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q))$   
 B.  $(\neg p \wedge r) \wedge ((p \wedge q) \rightarrow \neg r)$   
 C.  $(\neg p \wedge r) \vee ((p \wedge q) \rightarrow \neg r)$   
 D.  $(\neg p \wedge r) \vee (r \rightarrow (p \wedge q))$

gate2017-cse-set2 mathematical-logic propositional-logic

Answer 

### 3.3.36 Propositional Logic: GATE CSE 2021 Set 1 | Question: 7

<https://gateoverflow.in/357445>



Let  $p$  and  $q$  be two propositions. Consider the following two formulae in propositional logic.

$$S_1 : (\neg p \wedge (p \vee q)) \rightarrow q$$

$$S_2 : q \rightarrow (\neg p \wedge (p \vee q))$$

Which one of the following choices is correct?

- A. Both  $S_1$  and  $S_2$  are tautologies.  
 B.  $S_1$  is a tautology but  $S_2$  is not a tautology  
 C.  $S_1$  is not a tautology but  $S_2$  is a tautology  
 D. Neither  $S_1$  nor  $S_2$  is a tautology

[gate2021-cse-set1](#) [mathematical-logic](#) [propositional-logic](#)
[Answer](#)
**3.3.37 Propositional Logic: GATE CSE 2021 Set 2 | Question: 15**
[top](#)
<https://gateoverflow.in/357525>


Choose the correct choice(s) regarding the following propositional logic assertion  $S$ :

$$S : ((P \wedge Q) \rightarrow R) \rightarrow ((P \wedge Q) \rightarrow (Q \rightarrow R))$$

- A.  $S$  is neither a tautology nor a contradiction
- B.  $S$  is a tautology
- C.  $S$  is a contradiction
- D. The antecedent of  $S$  is logically equivalent to the consequent of  $S$

[gate2021-cse-set2](#) [multiple-selects](#) [mathematical-logic](#) [propositional-logic](#)
[Answer](#)
**3.3.38 Propositional Logic: GATE IT 2004 | Question: 31**
[top](#)
<https://gateoverflow.in/3674>


Let  $p, q, r$  and  $s$  be four primitive statements. Consider the following arguments:

- $P : [(\neg p \vee q) \wedge (r \rightarrow s) \wedge (p \vee r)] \rightarrow (\neg s \rightarrow q)$
- $Q : [(\neg p \wedge q) \wedge [q \rightarrow (p \rightarrow r)]] \rightarrow \neg r$
- $R : [[(q \wedge r) \rightarrow p] \wedge (\neg q \vee p)] \rightarrow r$
- $S : [p \wedge (p \rightarrow r) \wedge (q \vee \neg r)] \rightarrow q$

Which of the above arguments are valid?

- A.  $P$  and  $Q$  only
- B.  $P$  and  $R$  only
- C.  $P$  and  $S$  only
- D.  $P, Q, R$  and  $S$

[gate2004-it](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)
[Answer](#)
**Answers: Propositional Logic**
**3.3.1 Propositional Logic: GATE CSE 1987 | Question: 10e**
[top](#)
<https://gateoverflow.in/82457>


✓  $P_1 : p$

$$P_2 : (p \rightarrow q) \vee (p \wedge (r \rightarrow q))$$

$$P_1 \wedge P_2 \rightarrow (r \rightarrow q)$$

$$\begin{aligned} &\equiv [p \wedge [(\neg p \vee q) \vee (p \wedge \neg r \vee (p \wedge q))] \rightarrow (r \rightarrow q)] \\ &\equiv [p \wedge [\neg p \vee q \vee (p \wedge \neg r) \vee (p \wedge q)]] \rightarrow (r \rightarrow q) \\ &\equiv [(p \wedge \neg r) \vee (p \wedge q)] \rightarrow (r \rightarrow q) \\ &\equiv [(\neg p \vee r) \wedge (\neg p \vee \neg q) \vee \neg r \vee q] \\ &\equiv [\neg p \vee (r \wedge \neg q) \vee \neg r \vee q] \\ &\equiv [\neg p \vee \neg q \vee \neg r \vee q] \\ &\equiv [\neg p \vee (q \vee \neg q) \vee \neg r] \\ &\equiv 1 \text{ (Tautology)} \end{aligned}$$

Hence, proved.

16 votes

-- Prashant Singh (47.2k points)

### 3.3.2 Propositional Logic: GATE CSE 1988 | Question: 2vii top ↴

▪ <https://gateoverflow.in/93947>



- ✓ **Valid:** A wff which is always true (tautology) is valid. i.e., its value is true for any set of assignment to its variables.

**Satisfiable:** A wff which is not a contradiction (always false) is satisfiable. It may be a tautology.

16 votes

-- Kantikumar (3.4k points)

### 3.3.3 Propositional Logic: GATE CSE 1989 | Question: 3-V top ↴

▪ <https://gateoverflow.in/87126>



- ✓
- $P \rightarrow Q \equiv \neg P \vee Q$
  - $\neg Q \rightarrow \neg P \equiv Q \vee \neg P$
  - $\neg P \vee Q \equiv \neg P \vee Q$

So, A, B, C are equivalent .

15 votes

-- kunal chalotra (13.6k points)

### 3.3.4 Propositional Logic: GATE CSE 1990 | Question: 3-X top ↴

▪ <https://gateoverflow.in/84861>



- ✓ **Ans is (A)**

⇒ To make a formula valid it must be true for all cases (Tautology)

a.  $\underbrace{(P \Rightarrow Q) \wedge (Q \Rightarrow R)}_{T} \Rightarrow \underbrace{(P \Rightarrow R)}_{F}$  :To make it invalid

**assume:**

$$\underbrace{P}_{T} \Rightarrow \underbrace{R}_{F} : F$$

Now,

$$\underbrace{(P \Rightarrow Q)}_{T} \wedge \underbrace{(Q \Rightarrow R)}_{T}$$

We know,

$$P = T; R = F$$

$$\underbrace{(T \Rightarrow Q)}_{T} \wedge \underbrace{(Q \Rightarrow F)}_{T}$$

$Q \neq F$ ; it should be T.       $Q \neq T$ ; it should be F.

Since ,value of Q is ambiguous. it tells that our original assumption of  $P = T; R = F$  and  $P \Rightarrow R : F$ ; is wrong.  $T \Rightarrow F$  is not possible. **Hence its valid.**

b.  $\underbrace{(P \Rightarrow Q)}_{T} \Rightarrow \underbrace{(\neg P \Rightarrow \neg Q)}_{F}$  ; to make it invalid the case must hold.

So,  $\underbrace{\neg P}_{T} \Rightarrow \underbrace{\neg Q}_{F}$ ; for this to be false.

$\therefore P = F; Q = T$  which makes  $P \Rightarrow Q : T$

So,  $T \Rightarrow F$  does hold. **Hence invalid.**

c.  $\underbrace{(P \Rightarrow R) \vee (Q \Rightarrow R)}_{T} \Rightarrow \underbrace{((P \vee Q) \Rightarrow R)}_{F}$

$$\underbrace{(P \Rightarrow R)}_{T} \vee \underbrace{(Q \Rightarrow R)}_{T} \quad \underbrace{(P \vee Q)}_{T} \Rightarrow \underbrace{R}_{F}$$

or,

$$(P \Rightarrow F) \vee (Q \Rightarrow F) \quad [\because R = F]$$

assume  $P = T$  and  $Q = F$  which makes the above T (LHS) and F (RHS)

So, again  $T \Rightarrow F$  hold. **Hence invalid.**

30 votes

-- Tuhin Dutta (9.1k points)

**3.3.5 Propositional Logic: GATE CSE 1991 | Question: 03,xii** top <https://gateoverflow.in/526>

- ✓ answer is option (B).

False  $\rightarrow$  anything = True, always

26 votes

-- Amar Vashishth (25.2k points)

**3.3.6 Propositional Logic: GATE CSE 1992 | Question: 02,xvi** top <https://gateoverflow.in/574>

- ✓ Answer: (B)

$$\begin{aligned} (a \wedge b) &\rightarrow b \vee c \\ \implies \neg(a \wedge b) &\vee b \vee c \\ \implies \neg a \vee \neg b &\vee b \vee c \\ \implies T & \end{aligned}$$

Option (A) is not TRUE when  $c$  is FALSE.

Option (C) is not TRUE when  $b$  is TRUE and  $c$  is FALSE.

Option (D) is not TRUE when  $a$  and  $b$  are TRUE and  $c$  is FALSE.

21 votes

-- Rajarshi Sarkar (27.8k points)

**3.3.7 Propositional Logic: GATE CSE 1992 | Question: 15.a** top <https://gateoverflow.in/594>

- ✓  $\because x$  and  $y$  are universally quantified variable, we can write the given arguments as follows :-

1.  $\forall x(Q(x) \rightarrow (P(x) \vee \sim R(a)))$
2.  $(R(a) \vee \sim Q(a))$
3.  $Q(a)$
4.  $\forall y(\sim P(y))$

Now using Universal instantiation, 1. becomes

5.  $Q(a) \rightarrow (P(a) \vee \sim R(a))$  where  $a$  is an arbitrary constant given in question.

Similarly 4. becomes

6.  $\sim P(a)$

Using Modus Ponens 5. and 3.

$$\begin{array}{c} Q(a) \rightarrow (P(a) \vee \sim R(a)) \\ Q(a) \\ \hline \end{array}$$

7.  $\therefore P(a) \vee \sim R(a)$

Using resolution 7. and 2.

$$\begin{array}{c} R(a) \vee \sim Q(a) \\ \sim R(a) \vee P(a) \\ \hline \end{array}$$

8.  $\therefore P(a) \vee \sim Q(a)$

Using 6. and 8.

$$\begin{array}{c} P(a) \vee \sim Q(a) \\ \sim P(a) \\ \hline \therefore \sim Q(a) \end{array}$$

After applying appropriate rules of inference, at last we get  $\sim Q(a)$ , which is **inconsistent** with (3) which requires  $Q(a)$ .

6 votes

-- Prateek Khade (2.1k points)

### 3.3.8 Propositional Logic: GATE CSE 1993 | Question: 18 [top](#)

<https://gateoverflow.in/2315>



$$\begin{aligned} & \checkmark A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A) \\ & \equiv A \wedge (\neg A \vee B \vee C)(\neg A \vee \neg B) \\ & \equiv (A \wedge \neg B) \wedge (\neg A \vee B \vee C) \\ & \equiv (A \wedge \neg B \wedge C) \end{aligned}$$

$C$  is logical consequence of a formula  $X$  if,  $X \rightarrow C$  is true.

$$\begin{aligned} \text{Here, } X &\equiv A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A) \\ &\equiv A \wedge \neg B \wedge C \end{aligned}$$

Checking,

$$\begin{aligned} & (A \wedge \neg B \wedge C) \rightarrow C \\ & \equiv \neg(A \wedge \neg B \wedge C) \vee C \\ & \equiv \neg A \vee B \vee \neg C \vee C \\ & \equiv 1. \end{aligned}$$

So,  $C$  is logical consequence of  $A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A)$ .

22 votes

-- Digvijay (44.9k points)

### 3.3.9 Propositional Logic: GATE CSE 1993 | Question: 8.2 [top](#)

<https://gateoverflow.in/2300>



$$\begin{aligned} & \checkmark p \wedge (\sim p \vee q) \\ & \equiv (p \wedge \sim p) \vee (p \wedge q) \\ & \equiv F \vee (p \wedge q) \\ & \equiv (p \wedge q) \end{aligned}$$

Hence, Option(B) logically equivalent to  $(p \wedge q)$ .

19 votes

-- Leen Sharma (28.6k points)

### 3.3.10 Propositional Logic: GATE CSE 1994 | Question: 3.13 [top](#)

<https://gateoverflow.in/2499>



✓

p	q	$p \leftrightarrow q$	$p \rightarrow \neg q$	$(p \leftrightarrow q) \rightarrow (p \rightarrow \neg q)$
0	0	1	1	1
0	1	0	1	1
1	0	0	1	1
1	1	1	0	0

So, "imply" is FALSE making does not imply TRUE.

31 votes

-- Arjun Suresh (328k points)

### 3.3.11 Propositional Logic: GATE CSE 1995 | Question: 13 [top](#)

<https://gateoverflow.in/2649>



✓ Note:-

1. Canonical conjunctive normal form means in our Digital logic it is Canonical Product of Sum term Form.
2. Canonical Disjunctive normal form means in our Digital logic it is Canonical Sum of Product term Form.

$$pq + q'r$$

Putting in k-map, we will get

$$\sum(1, 5, 6, 7) = \prod(0, 2, 3, 4) = (p \vee q \vee r) \wedge (p \vee \neg q \vee r) \wedge (p \vee \neg q \vee \neg r) \wedge (\neg p \vee q \vee r)$$

27 votes

-- Rajesh Pradhan (18.9k points)

3.3.12 Propositional Logic: GATE CSE 1995 | Question: 2.19 [top](#)<https://gateoverflow.in/2631>

## ✓ Cannot be determined.

From the axiom  $\neg p \rightarrow q$ , we can conclude that  $p \vee q$ .

So, either  $p$  or  $q$  must be TRUE.

$$\neg p \vee (p \rightarrow q)$$

$$\equiv \neg p \vee (\neg p \vee q)$$

$$\equiv \neg p \vee q$$

Since nothing can be said about the Truth value of  $p$ , it implies that  $\neg p \vee q$  can also be True or False.

Hence, the value cannot be determined.

50 votes

-- Pragy Agarwal (18.3k points)

3.3.13 Propositional Logic: GATE CSE 1996 | Question: 2.3 [top](#)<https://gateoverflow.in/2732>✓ A.  $((x \rightarrow y) \wedge x) \rightarrow y$ 

$$\equiv \neg((\neg x \vee y) \wedge x) \vee y$$

$$\equiv ((x \wedge \neg y) \vee \neg x) \vee y$$

$$\equiv ((x \vee \neg x) \wedge (\neg x \vee \neg y)) \vee y$$

$$\equiv (T \wedge (\neg x \vee \neg y)) \vee y$$

$$\equiv (\neg x \vee \neg y) \vee y$$

$$\equiv (y \vee \neg y) \vee \neg x$$

$$\equiv T \vee \neg x$$

$$\equiv T$$

B.  $((\neg x \rightarrow y) \wedge (\neg x \rightarrow \neg y)) \rightarrow x$ 

$$\equiv \neg((x \vee y) \wedge (x \vee \neg y)) \vee x$$

$$\equiv ((\neg x \wedge \neg y) \vee (\neg x \wedge y)) \vee x$$

$$\equiv ((\neg x \wedge (\neg y \vee y)) \vee x$$

$$\equiv (\neg x \wedge T) \vee x$$

$$\equiv (\neg x \vee x)$$

$$\equiv T$$

C.  $(x \rightarrow (x \vee y))$ 

$$\equiv (\neg x \vee (x \vee y))$$

$$\equiv (\neg x \vee x) \vee y$$

$$\equiv T \vee y$$

$$\equiv T$$

D.  $((x \vee y) \Leftrightarrow (\neg x \rightarrow \neg y))$ 

$$\equiv ((x \vee y) \Leftrightarrow (x \vee \neg y))$$

$$\equiv ((x \vee y) \rightarrow (x \vee \neg y)) \wedge ((x \vee \neg y) \rightarrow (x \vee y))$$

$$\equiv (\neg(x \vee y) \vee (x \vee \neg y)) \wedge (\neg(x \vee \neg y) \vee (x \vee y))$$

$$\equiv ((\neg x \wedge \neg y) \vee (x \vee \neg y)) \wedge (\neg x \wedge y) \vee ((x \vee y))$$

$$\equiv (((\neg x \wedge \neg y) \vee x) \neg y) \wedge (((\neg x \wedge y) \vee x) \vee y)$$

$$\equiv (((\neg x \wedge x) \wedge (x \vee \neg y)) \vee \neg y) \wedge (((\neg x \wedge x) \wedge (x \vee y)) \vee y)$$

$$\equiv ((T \wedge (x \vee \neg y)) \vee \neg y) \wedge ((T \wedge (x \vee y)) \vee y)$$

$$\equiv ((x \vee \neg y) \wedge (x \vee y))$$

$$\equiv (x \wedge x) \vee (x \wedge y) \vee (x \wedge \neg y) \vee (\neg y \wedge y)$$

$$\equiv x \vee (x \wedge y) \vee (x \wedge \neg y) \vee F$$

$$\equiv x \vee (x \wedge y) \vee (x \wedge \neg y)$$

$$\equiv x$$

Hence, Option(D).  $((x \vee y) \Leftrightarrow (\neg x \rightarrow \neg y))$ .

16 votes

-- Leen Sharma (28.6k points)

**3.3.14 Propositional Logic: GATE CSE 1997 | Question: 3.2**<https://gateoverflow.in/2233>

✓ A.  $(p \vee q) \rightarrow p$   
 $\equiv \neg(p \vee q) \vee p$   
 $\equiv (\neg p \wedge \neg q) \vee p$   
 $\equiv (\neg p \vee p) \wedge (\neg q \vee p)$   
 $\equiv (p \vee \neg q)$

B.  $p \vee (q \rightarrow p)$   
 $\equiv p \vee (\neg q \vee p)$   
 $\equiv (p \vee p) \vee \neg q$   
 $\equiv p \vee \neg q$

C.  $p \vee (p \rightarrow q)$   
 $\equiv p \vee (\neg p \vee q)$   
 $\equiv (p \vee \neg p) \vee q$   
 $\equiv T \vee q$   
 $\equiv T$

D.  $p \rightarrow (p \rightarrow q)$   
 $\equiv p \rightarrow (\neg p \vee q)$   
 $\equiv \neg p \vee (\neg p \vee q)$   
 $\equiv (\neg p \vee \neg p) \vee q$   
 $\equiv \neg p \vee q$

Hence, Option(C)  $p \vee (p \rightarrow q)$ .

8 votes

-- Leen Sharma (28.6k points)

**3.3.15 Propositional Logic: GATE CSE 1998 | Question: 1.5**<https://gateoverflow.in/1642>

- ✓ "I stay only if you go" is equivalent to "If I stay then you go."  
 $\therefore A$  only if  $B \equiv (A \rightarrow B)$

$A = \text{"I stay" and } B = \text{"You go"}$

Converse  $(A \rightarrow B) = B \rightarrow A$

"If you go then I stay"

Answer is (A).

32 votes

-- Manali (2.1k points)

**3.3.16 Propositional Logic: GATE CSE 1999 | Question: 14**<https://gateoverflow.in/1513>

✓ a.  $[(\sim p \vee q) \Rightarrow (q \Rightarrow p)] = \sim(\sim p \vee q) \vee (q \Rightarrow p) = (p \wedge \sim q) \vee (\sim q \vee p) = p \vee \sim q$

Hence not tautology.

b.  $(A \vee B) = T \vee B = T$

13 votes

-- Arjun Suresh (328k points)

**3.3.17 Propositional Logic: GATE CSE 2000 | Question: 2.7**<https://gateoverflow.in/654>

- ✓ Given that  $a \Leftrightarrow (b \vee \sim b)$  and  $b \Leftrightarrow c$

Now,

$$\begin{aligned} (a \wedge b) &\rightarrow (a \wedge c) \vee d \\ &\equiv (a \wedge b) \rightarrow (a \wedge b) \vee d \\ &\equiv (\because b \Leftrightarrow c) \\ &\equiv \neg(a \wedge b) \vee (a \wedge b) \vee d \\ &\equiv T \vee d \\ &\equiv T \end{aligned}$$

Hence, Option(A) True.

37 votes

-- Leen Sharma (28.6k points)

### 3.3.18 Propositional Logic: GATE CSE 2001 | Question: 1.3 top

<https://gateoverflow.in/696>



✓ F1:  $P \rightarrow \neg P$

$$= \neg P \wedge \neg P$$

$= \neg P$ . can be true when P is false ( Atleast one T hence satisfiable)

F2:  $(P \rightarrow \neg P) \wedge (\neg P \rightarrow P)$

$$= \neg P \vee (P \vee P)$$

$$= \neg P \vee P$$

$$= T.$$

**VALID**

Option (A)

28 votes

-- Manali (2.1k points)

### 3.3.19 Propositional Logic: GATE CSE 2002 | Question: 1.8 top

<https://gateoverflow.in/812>



✓ Answer is a)  $(X \wedge \neg Z) \rightarrow Y$

(refer page 6,7 Discrete Math,ed 7, Kenneth H Rosen)

Implication " $P$  implies  $Q$ " i.e.,  $(P \rightarrow Q)$ , where  $P$  is Premise and  $Q$  is Conclusion, can be equivalently expressed in many ways. And the two equivalent expression relevant to the question are as follows:

1. "If  $P$  then  $Q$ "
2. " $Q$  unless  $\neg P$ "

Both of these are equivalent to the propositional formula  $(P \rightarrow Q)$ ,

Now compare "If  $X$  then  $Y$  unless  $Z$ " with " $Q$  unless  $\neg P$ ", here  $(\neg P = Z)$  so  $(P = \neg Z)$  and  $(Q = Y)$

Compare with "if  $P$  then  $Q$ ", here  $(P = X), (Q = Y)$

So we get premise  $P = X$  and  $\neg Z$ , conclusion  $Q = Y$

Equivalent propositional formula  $(X \wedge \neg Z) \rightarrow Y$

PS: Someone messaged me that i have taken "If  $X$  then ( $Y$  unless  $Z$ )" in above explanation and how to know if we take "(If  $X$  then  $Y$ ) unless  $Z$ " or "If  $X$  then ( $Y$  unless  $Z$ )". So let me show that both way gives the same answer.

"(If  $X$  then  $Y$ ) unless  $Z$ "  $\equiv (X \rightarrow Y) \text{ unless } Z$

$$\begin{aligned} &\equiv \neg Z \rightarrow (X \rightarrow Y) \\ &\equiv \neg Z \rightarrow (\neg X \vee Y) \\ &\equiv Z \vee \neg X \vee Y \\ &\equiv \neg(X \wedge \neg Z) \vee Y \\ &\equiv (X \wedge \neg Z) \rightarrow Y \end{aligned}$$

63 votes

-- Sourav Das (263 points)

**3.3.20 Propositional Logic: GATE CSE 2002 | Question: 5b** top ↴<https://gateoverflow.in/3915>

- ✓ This can be solved by Truth table. But there is something else which can be done quickly. See what each formula means:

1.  $A \leftrightarrow (A \vee A)$  It says if A then ( $A \vee A$ ) and if ( $A \vee A$ ) then A. Always a tautology
2.  $(A \vee B) \rightarrow B$  If A or B then B. No guarantee that if only A is true, B need to be true. Hence neither tautology nor contradiction
3.  $A \wedge (\neg(A \vee B))$  When A is true  $\neg(A \vee B)$  will be false. So, this formula is a contradiction

28 votes

-- Arjun Suresh (328k points)

**3.3.21 Propositional Logic: GATE CSE 2003 | Question: 72** top ↴<https://gateoverflow.in/959>

- ✓ Taking option (A)

$$((P \vee R) \wedge (Q \vee \neg R)) \Rightarrow (P \vee Q) \text{ is logically valid.}$$

$$\begin{aligned} ((P \vee R) \wedge (Q \vee \neg R)) &\Rightarrow (P \vee Q) \\ &\equiv \neg((P \vee R) \wedge (Q \vee \neg R)) \vee (P \vee Q) \\ &\equiv ((\neg P \wedge \neg R) \vee (\neg Q \wedge R)) \vee (P \vee Q) \\ &\equiv P \vee \neg R \vee Q \vee R \\ &\equiv 1 \vee P \vee Q \\ &\equiv 1. \end{aligned}$$

So, Tautology (Logically VALID). True

Option B

$$(P \vee Q) \Rightarrow ((P \vee R) \wedge (Q \vee \neg R)) \text{ is logically valid}$$

$$\begin{aligned} (P \vee Q) &\Rightarrow ((P \vee R) \wedge (Q \vee \neg R)) \\ &\equiv \neg(P \vee Q) \vee ((P \vee R) \wedge (Q \vee \neg R)) \\ &\equiv (\neg P \wedge \neg Q) \vee (P \wedge Q) \vee (P \wedge \neg R) \vee (Q \wedge R) \end{aligned}$$

which is a contingency (can be TRUE or FALSE depending on values of  $P, Q$  and  $R$ ) and hence not logically valid.

Answer B.

18 votes

-- Prashant Singh (47.2k points)

**3.3.22 Propositional Logic: GATE CSE 2004 | Question: 70** top ↴<https://gateoverflow.in/1064>

- ✓ Answer a

It is false when  $P = T, Q = T, R = F$

It is true (satisfiable) when  $P = T, Q = T, R = T$

28 votes

-- Anu (4.7k points)

**3.3.23 Propositional Logic: GATE CSE 2005 | Question: 40** top ↴<https://gateoverflow.in/1165>

$$\begin{aligned} X &\equiv (P \vee Q) \rightarrow R \\ &\equiv \neg(P \vee Q) \vee R \\ &\equiv (\neg P \wedge \neg Q) \vee R \\ &\equiv (\neg P \vee R) \wedge (\neg Q \vee R) \\ &\equiv (P \rightarrow R) \wedge (Q \rightarrow R) \end{aligned}$$

So,  $X \rightarrow Y$  is true as  $(A \wedge B) \rightarrow (A \vee B)$  is always TRUE but reverse implication is not always true.

Hence, B.

37 votes

-- Arjun Suresh (328k points)

**3.3.24 Propositional Logic: GATE CSE 2006 | Question: 27** [top](#)<https://gateoverflow.in/990>

- ✓ (D) Both  $P_1$  and  $P_2$  are not tautologies.

$P_1$  : If  $A$  is true and  $B$  is false, LHS of  $P_1$  is true but RHS becomes false. Hence not tautology.

$P_2$  : Forward side is true. But reverse side is not true. When  $A$  is false and  $B$  is true and  $C$  is false, RHS is true but LHS is false.

LHS of  $P_2$  can be simplified as follows:

$$\begin{aligned} ((A \vee B) \rightarrow C) &\equiv ((A \vee B) \vee C) \\ &\equiv (A \wedge B) \vee C \\ &\equiv (A \vee C) \wedge (B \vee C) \\ &\equiv (A \rightarrow C) \wedge (B \rightarrow C) \end{aligned}$$

33 votes

-- Arjun Suresh (328k points)

**3.3.25 Propositional Logic: GATE CSE 2008 | Question: 31** [top](#)<https://gateoverflow.in/442>

- ✓ I and II are present in all options so need to check.

For III and IV

$$\begin{aligned} (P \wedge Q) \vee (P \wedge \neg Q) &\equiv P \wedge (Q \vee \neg Q) \text{ (By distributive law)} \\ &\equiv P \wedge T \\ &\equiv P \end{aligned}$$

For III.

$$P \vee (\neg P \wedge \neg Q) \equiv P \vee \neg Q \text{ (By Absorption Law)}$$

For IV.

$$P \vee (\neg P \wedge Q) \equiv P \vee Q \text{ (By Absorption Law)}$$

So Option B is correct.

I, II, III are logically equivalent.

21 votes

-- Soumya Jain (12.4k points)

**3.3.26 Propositional Logic: GATE CSE 2009 | Question: 24** [top](#)<https://gateoverflow.in/801>

- ✓ Answer is B because the truth values for option B is same as that of P "or" Q.

The given truth table is for  $Q \implies P$  which is  $\bar{Q} + P$ .

Now, with B option we get  $\bar{Q} + P = P + Q$

27 votes

-- chetna (297 points)

**3.3.27 Propositional Logic: GATE CSE 2014 Set 1 | Question: 53** [top](#)<https://gateoverflow.in/1933>

- ✓ A. will be true if  $P, Q, R$  are true,  $((p \leftrightarrow q) \wedge r)$  will return true. So "exactly two" is false
- C. if only  $r$  is true and  $p$  and  $q$  are false, first part of implication itself will result in true
- D. if  $r$  is true or false, this returns false due to  $r$  and  $\neg r$  present in conjunction. So, this is a CONTRADICTION.

B is the answer. B is true if  $p$  is TRUE and  $q$  is FALSE or vice versa, and  $r$  is true or if  $p$  and  $q$  are TRUE and  $r$  is FALSE.

PS: Actually the question should have been "TRUE ONLY when exactly two of  $p, q$  and  $r$  are TRUE"

36 votes

-- Manu Thakur (34k points)

**3.3.28 Propositional Logic: GATE CSE 2014 Set 2 | Question: 53** [top](#)<https://gateoverflow.in/2020>

- ✓ Another way to solve it...

Implication  $A \rightarrow B$  is not tautology if  $B$  is false and  $A$  is true.

For b option Let RHS ie.  $b \rightarrow (a \wedge c)$  be false ie  $b$  is false and  $(a \wedge c)$  is false.

Now,  $a$  AND  $c$  is false if both  $a$  and  $c$  are false or one of them is true and other is false.

Now, if  $a$  and  $c$  both are false then  $a \rightarrow c$  is true. Now ,LHS is true and RHS is false.

So option b is not tautology..

32 votes

-- Pooja Palod (24k points)

### 3.3.29 Propositional Logic: GATE CSE 2014 Set 3 | Question: 1 top

<https://gateoverflow.in/2035>



Correct Answer (D)

Lets break the given compound statements into atomic statements.

- A : Good mobile phones.
- B : Cheap mobile phones.

$$P : (A \rightarrow \neg B) \iff (\neg A \vee \neg B)$$

$$Q : (B \rightarrow \neg A) \iff ((\neg B \vee \neg A) \iff \neg A \vee \neg B) \text{ (Disjunction is commutative),}$$

Hence,  $(P \iff Q)$  which means  $(P \rightarrow Q)$  and  $(Q \rightarrow P)$ .

55 votes

-- Srinath Jayachandran (2.9k points)

### 3.3.30 Propositional Logic: GATE CSE 2015 Set 1 | Question: 14 top

<https://gateoverflow.in/8209>



$(p \iff q)$

$$= (p \rightarrow q) \wedge (q \rightarrow p)$$

$$= (\neg p \vee q) \wedge (q \rightarrow p) \quad \text{As } (p \rightarrow q = \neg p \vee q)$$

$$= (\neg p \vee q) \wedge (\neg q \vee p)$$

$$= (\neg p \wedge \neg q) \vee (p \wedge q)$$

So, answer C

33 votes

-- Priya\_das (603 points)

### 3.3.31 Propositional Logic: GATE CSE 2016 Set 1 | Question: 1 top

<https://gateoverflow.in/39663>



$$\begin{aligned} & \checkmark \quad \neg((p \rightarrow q) \wedge (\neg r \vee \neg s)) \\ & \equiv \neg(\neg p \vee q) \vee \neg(\neg r \vee \neg s) \\ & \equiv (p \wedge \neg q) \vee (r \wedge s) \end{aligned}$$

which can be read as  $(x \in \{8, 9, 10, 11, 12\} \text{ AND } x \text{ is not a composite number}) \text{ OR } (x \text{ is a perfect square AND } x \text{ is a prime number})$

Now for

- $x$  is a perfect square and  $x$  is a prime number, this can never be true as every square has at least 3 factors, 1,  $x$  and  $x^2$ .

So, second condition can never be true.

which implies the first condition must be true.

$x \in \{8, 9, 10, 11, 12\}$  AND  $x$  is not a composite number

But here only 11 is not a composite number. so only 11 satisfies the above statement.

ANSWER 11.

95 votes

-- Abhilash Panicker (7.6k points)

### 3.3.32 Propositional Logic: GATE CSE 2016 Set 2 | Question: 01 top

<https://gateoverflow.in/39568>



4 should be the correct answer.

P	Q	$P \Rightarrow Q$	$P \wedge (P \Rightarrow Q)$
F	F	T	F
F	T	T	F
T	F	F	F
T	T	T	T

Suppose  $(P \wedge (P \Rightarrow Q)) \Leftrightarrow A$  (For notational convenience)

Thus for options, (i), (ii), (iii), (iv), (v)

If  $(A \Rightarrow \text{option x})$  is a **tautology**.

then  $P \wedge (P \Rightarrow Q)$  logically implies option x

else  $P \wedge (P \Rightarrow Q)$  does not logically implies option x.

P	Q	A	Option(i)	Option(ii)	Option(iii)	Option(iv)	Option(v)
			False $A \Rightarrow F$	$Q \quad A \Rightarrow Q$	True $A \Rightarrow \text{true}$	$(P \vee Q) \quad A \Rightarrow (P \vee Q)$	$\neg Q \vee P \quad A \Rightarrow (\neg Q \vee P)$
F	F	F	T	T	T	T	T
F	T	F	T	T	T	T	T
T	F	F	T	T	T	T	T
T	T	T	F	F	T	T	T

Answer = 4

**P.S:** Blank entries in the above truth table are like don't care conditions because in those rows the value of A is set to False. Hence,  $(A \Rightarrow \text{Anything})$  would be set to True.

153 votes

-- Anurag Pandey (10.5k points)

### 3.3.33 Propositional Logic: GATE CSE 2017 Set 1 | Question: 01

top ↗

↗ <https://gateoverflow.in/118698>



- ✓  $(\neg P \rightarrow \neg Q)$  can also be written as  $(P \vee \neg Q)$ , so statement 3 is correct.

Now taking the contrapositive of  $(\neg P \rightarrow \neg Q)$ , we get  $(Q \rightarrow P)$  hence statement 2 is correct.

So, the answer is OPTION (D).

21 votes

-- sriv\_shubham (2.8k points)

### 3.3.34 Propositional Logic: GATE CSE 2017 Set 1 | Question: 29

top ↗

↗ <https://gateoverflow.in/118310>



- ✓ Given  $(P \rightarrow Q) \rightarrow R$  is false. It is possible only when R is FALSE and  $(P \rightarrow Q)$  is TRUE.

Now even without checking any other option we can directly conclude option D is correct as  $(R \rightarrow P) \rightarrow Q$  can be written as  $\neg(R \rightarrow P) \vee Q$ .

Since, R is False,  $R \rightarrow P$  is true and  $\neg(R \rightarrow P)$  is False. So, it becomes  $(\text{False} \vee Q)$ . which is TRUE whenever Q is TRUE

Hence, option (D)

52 votes

-- sriv\_shubham (2.8k points)

### 3.3.35 Propositional Logic: GATE CSE 2017 Set 2 | Question: 11

top ↗

↗ <https://gateoverflow.in/118151>



- ✓ 1. "It is not raining and it is pleasant" can be written as  $(\neg p \wedge r)$

2. Now, "it is not pleasant only if it is raining and it is cold" is represented by  $\neg r \Rightarrow (p \wedge q)$  but  $(p \wedge q) \not\Rightarrow \neg r$ .

Why? Because if it is not pleasant then we can conclude it must be raining and it is cold. However, it is raining and cold does not assure that it will be unpleasant. i.e., p only if q can be written as if p then q (not double implication).

So, ANDing clause 1. and 2. we get  $(\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q))$

option A is correct.

36 votes

-- Prateek Kumar (1.1k points)

**3.3.36 Propositional Logic: GATE CSE 2021 Set 1 | Question: 7**<https://gateoverflow.in/357445>

✓  $S_1 : \neg p \wedge (p \vee q) \rightarrow q$

If consequence is false and hypothesis is true, then we will get False in the truth table.

Lets assume  $q$  is false. So consequence is FALSE.

Can it make Hypothesis TRUE?

Hypothesis:  $\neg p \wedge (p \vee q) \equiv \neg p \wedge (p \vee \text{FALSE}) \equiv \neg p \wedge (p) \equiv \text{FALSE}$ .

Hypothesis can't be true, So we can't get False in the Truth Table.

∴  $S_1$  is Tautology.

$$S_2 : q \rightarrow \neg p \wedge (p \vee q)$$

If hypothesis is true and consequence is false, then we will get False in the truth table.

Lets assume  $q$  is True, So Hypothesis is TRUE.

Can it make Consequence FALSE ?

Consequence:  $\neg p \wedge (p \vee q) \equiv \neg p \wedge (p \vee \text{TRUE}) \equiv \neg p \wedge (\text{TRUE}) \equiv \neg p$

Consequence can be true and so we can get False in the Truth Table.

∴  $S_2$  is not Tautology.

Correct Option: B



1

-- Shaik Masthan (50.2k points)

**3.3.37 Propositional Logic: GATE CSE 2021 Set 2 | Question: 15**<https://gateoverflow.in/357525>

✓ Antecedent of  $S : (P \wedge Q) \rightarrow R$

$$\equiv \neg(P \wedge Q) \vee R$$

$$\equiv \neg P \vee \neg Q \vee R$$

Consequent of  $S : (P \wedge Q) \rightarrow (Q \rightarrow R)$

$$\equiv (P \wedge Q) \rightarrow (\neg Q \vee R)$$

$$\equiv \neg(P \wedge Q) \vee (\neg Q \vee R)$$

$$\equiv \neg P \vee \neg Q \vee (\neg Q \vee R)$$

$$\equiv \neg P \vee \neg Q \vee R$$

Antecedent of  $S$  is equivalent to Consequent of  $S$ . Hence Option D is right.

$A \rightarrow A$  is a Tautology. Hence options A and C are wrong and option B is right.

Correct Answer: B;D



5

-- Shaik Masthan (50.2k points)

**3.3.38 Propositional Logic: GATE IT 2004 | Question: 31**<https://gateoverflow.in/3674>

- ✓ An argument form is **valid** if no matter what propositions are substituted for the propositional variables in its premises, the conclusion is true if the premises are all true.  
 i.e.  $(p_1 \wedge p_2 \wedge \dots \wedge p_n) \rightarrow q$  is a tautology.

$  \begin{array}{c}  P : \neg \cancel{p} \vee q \\  \neg \cancel{r} \vee s \\  \cancel{p} \vee \cancel{r} \\  \hline  s \vee q \text{ also, } \neg s \rightarrow q \quad \checkmark  \end{array}  $	$  \begin{array}{c}  Q : \neg p \\  \cancel{q} \\  \neg \cancel{q} \vee (\neg p \vee r) \\  \hline  \neg p \vee r \\  \cancel{\neq} \cancel{r}  \end{array}  $
$  R : \neg(q \wedge r) \vee p = \underline{\neg q \vee \neg r \vee p} \quad p \vee \neg q \vee \neg r \\  \neq r  $	$  S : \cancel{p} \neg \cancel{p} \vee \cancel{r} \cancel{q} \vee \neg \cancel{r} \\  \hline  q \quad \checkmark  $

Correct Answer: C

35 votes

-- Amar Vashishth (25.2k points)

## Answer Keys

3.1.1	N/A	3.1.2	N/A	3.1.3	A	3.1.4	D	3.1.5	D
3.1.6	D	3.1.7	B	3.1.8	D	3.1.9	D	3.1.10	X
3.1.11	D	3.1.12	B	3.1.13	B	3.1.14	A	3.1.15	C
3.1.16	D	3.1.17	X	3.1.18	D	3.1.19	D	3.1.20	C
3.1.21	D	3.1.22	B	3.1.23	A	3.1.24	C	3.1.25	C
3.1.26	C	3.1.27	B	3.1.28	B	3.1.29	A	3.1.30	C
3.1.31	D	3.2.1	B	3.2.2	C	3.2.3	A	3.3.1	N/A
3.3.2	N/A	3.3.3	A;B;C	3.3.4	A	3.3.5	B	3.3.6	B
3.3.7	N/A	3.3.8	N/A	3.3.9	B	3.3.10	True	3.3.11	N/A
3.3.12	D	3.3.13	D	3.3.14	C	3.3.15	A	3.3.16	N/A
3.3.17	A	3.3.18	A	3.3.19	A	3.3.20	N/A	3.3.21	B
3.3.22	A	3.3.23	B	3.3.24	D	3.3.25	B	3.3.26	B
3.3.27	B	3.3.28	B	3.3.29	D	3.3.30	C	3.3.31	11
3.3.32	4	3.3.33	D	3.3.34	D	3.3.35	A	3.3.36	B
3.3.37	B;D	3.3.38	C						

## 4

## Discrete Mathematics: Set Theory &amp; Algebra (161)



**Syllabus:** Sets, Relations, Functions, Partial orders, Lattices, **Monoids**, Groups.

Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
<b>1 Mark Count</b>	0	1	2	1	1	0	2	0	0	0	0.77	2
<b>2 Marks Count</b>	2	1	0	0	1	1	0	1	2	0	0.88	2
<b>Total Marks</b>	4	3	2	1	3	2	2	2	4	1	2.55	4

## 4.1

Binary Operation (8) top ↴4.1.1 Binary Operation: GATE CSE 1989 | Question: 1-v top ↴

☞ <https://gateoverflow.in/87051>



The number of possible commutative binary operations that can be defined on a set of  $n$  elements (for a given  $n$ ) is \_\_\_\_\_.

gate1989 descriptive set-theory&algebra binary-operation

Answer ✍

4.1.2 Binary Operation: GATE CSE 1994 | Question: 2.2 top ↴

☞ <https://gateoverflow.in/2469>



On the set  $N$  of non-negative integers, the binary operation \_\_\_\_\_ is associative and non-commutative.

gate1994 set-theory&algebra normal group-theory binary-operation fill-in-the-blanks

Answer ✍

4.1.3 Binary Operation: GATE CSE 2003 | Question: 38 top ↴

☞ <https://gateoverflow.in/929>



Consider the set  $\{a, b, c\}$  with binary operators  $+$  and  $*$  defined as follows:

+	a	b	c
a	b	a	c
b	a	b	c
c	a	c	b

*	a	b	c
a	a	b	c
b	b	c	a
c	c	c	b

For example,  $a + c = c$ ,  $c + a = a$ ,  $c * b = c$  and  $b * c = a$ .

Given the following set of equations:

- $(a * x) + (a * y) = c$
- $(b * x) + (c * y) = c$

The number of solution(s) (i.e., pair(s)  $(x, y)$ ) that satisfy the equations is

- 0
- 1
- 2
- 3

gate2003-cse set-theory&algebra normal binary-operation

Answer ✍

4.1.4 Binary Operation: GATE CSE 2006 | Question: 28 top ↴

☞ <https://gateoverflow.in/991>



A logical binary relation  $\odot$ , is defined as follows:

A	B	$A \odot B$
True	True	True
True	False	True
False	True	False
False	False	True

Let  $\sim$  be the unary negation (NOT) operator, with higher precedence than  $\odot$ .

Which one of the following is equivalent to  $A \wedge B$ ?

- A.  $(\sim A \odot B)$
- B.  $\sim (A \odot \sim B)$
- C.  $\sim (\sim A \odot \sim B)$
- D.  $\sim (\sim A \odot B)$

[gate2006-cse](#) [set-theory&algebra](#) [binary-operation](#)

Answer 

#### 4.1.5 Binary Operation: GATE CSE 2013 | Question: 1 [top](#)

<https://gateoverflow.in/59>



A binary operation  $\oplus$  on a set of integers is defined as  $x \oplus y = x^2 + y^2$ . Which one of the following statements is TRUE about  $\oplus$ ?

- A. Commutative but not associative
- B. Both commutative and associative
- C. Associative but not commutative
- D. Neither commutative nor associative

[gate2013-cse](#) [set-theory&algebra](#) [easy](#) [binary-operation](#)

Answer 

#### 4.1.6 Binary Operation: GATE CSE 2015 Set 1 | Question: 28 [top](#)

<https://gateoverflow.in/8226>



The binary operator  $\neq$  is defined by the following truth table.

p	q	$p \neq q$
0	0	0
0	1	1
1	0	1
1	1	0

Which one of the following is true about the binary operator  $\neq$ ?

- A. Both commutative and associative
- B. Commutative but not associative
- C. Not commutative but associative
- D. Neither commutative nor associative

[gate2015-cse-set1](#) [set-theory&algebra](#) [easy](#) [binary-operation](#)

Answer 

#### 4.1.7 Binary Operation: GATE CSE 2015 Set 3 | Question: 2 [top](#)

<https://gateoverflow.in/8393>



Let  $\#$  be the binary operator defined as

$X \# Y = X' + Y'$  where  $X$  and  $Y$  are Boolean variables.

Consider the following two statements.

- (S<sub>1</sub>)  $(P \# Q) \# R = P \# (Q \# R)$
- (S<sub>2</sub>)  $Q \# R = (R \# Q)$

Which are the following is/are true for the Boolean variables  $P, Q$  and  $R$ ?

- A. Only S<sub>1</sub> is true
- B. Only S<sub>2</sub> is true
- C. Both S<sub>1</sub> and S<sub>2</sub> are true
- D. Neither S<sub>1</sub> nor S<sub>2</sub> are true

[gate2015-cse-set3](#) [set-theory&algebra](#) [binary-operation](#) [normal](#)

Answer 

#### 4.1.8 Binary Operation: GATE IT 2006 | Question: 2 top ↴

 <https://gateoverflow.in/3539>



For the set  $N$  of natural numbers and a binary operation  $f : N \times N \rightarrow N$ , an element  $z \in N$  is called an identity for  $f$ , if  $f(a, z) = a = f(z, a)$ , for all  $a \in N$ . Which of the following binary operations have an identity?

- I.  $f(x, y) = x + y - 3$
- II.  $f(x, y) = \max(x, y)$
- III.  $f(x, y) = x^y$

- A. I and II only
- B. II and III only
- C. I and III only
- D. None of these

[gate2006-it](#) [set-theory&algebra](#) [easy](#) [binary-operation](#)

Answer 

#### Answers: Binary Operation

#### 4.1.1 Binary Operation: GATE CSE 1989 | Question: 1-v top ↴

 <https://gateoverflow.in/87051>



- ✓ Given the cardinality of the set =  $n$ .

Therefore the no: of entries in operation table (Cayley table) =  $n^2$ .

And hence if we consider lower triangular or upper triangular half , we have :  $\frac{(n^2 + n)}{2}$ .

And in an operation table , each entry can be filled in  $n$  ways by any one element out of given  $n$  elements of the set.

So no. of ways we can fill the upper or lower triangular half =  $n^{\frac{(n^2+n)}{2}}$

Each of these is nothing but an instance of operation table of commutative operation as say  $(i, j)$  entry is filled in the table so  $(j, i)$  entry will also be the same hence the choice for  $(j, i)$  entry is constrained to 1 as we are concerned about commutative operation table here.

$\therefore$  No of possible binary operations which are commutative =  $n^{\frac{(n^2+n)}{2}}$

 47 votes

-- HABIB MOHAMMAD KHAN (67.5k points)

#### 4.1.2 Binary Operation: GATE CSE 1994 | Question: 2.2 top ↴

 <https://gateoverflow.in/2469>



Define Binary operation  $*$  on  $(a, b)$  as :  $a * b = a$

1. It is associative :  $(a * b) * c = a * c = a$ , and  $a * (b * c) = a * b = a$
2. It is not commutative :  $a * b = a$ , whereas  $b * a = b$ .

 43 votes

-- Happy Mittal (8.2k points)

#### 4.1.3 Binary Operation: GATE CSE 2003 | Question: 38 top ↴

 <https://gateoverflow.in/929>



- ✓ Consider each pair

1.  $(a, a) : (a * a) + (a * a) = a + a = b \neq c$ . So,  $(a, a)$  is not possible

2.  $(a, b) : (a * a) + (a * b) = a + b = a \neq c$ . So,  $(a, b)$  is not possible

3.  $(a, c) : (a * a) + (a * c) = a + c = c$

$(b * a) + (c * c) = b + b = b \neq c$ . So,  $(a, c)$  is not possible

4.  $(b, a) : (a * b) + (a * a) = b + a = a \neq c$ . So,  $(b, a)$  is not possible

5.  $(b, b) : (a * b) + (a * b) = b + b = b \neq c$ . So,  $(b, b)$  is not possible

6.  $(b, c) : (a * b) + (a * c) = b + c = c$

$(b * b) + (c * c) = c + b = c$ . So,  $(b, c)$  is a solution

7.  $(c, a) : (a * c) + (a * a) = c + a = a \neq c$ . So,  $(c, a)$  is not possible

8.  $(c, b) : (a * c) + (a * b) = c + b = c$

$(b * c) + (c * b) = a + c = c$ . So,  $(c, b)$  is a solution

9.  $(c, c) : (a * c) + (a * c) = c + c = b \neq c$ . So,  $(c, c)$  is not possible

So, no. of possible solutions is 2.

Correct Answer: C

12 votes

-- Praveen Saini (41.9k points)

#### 4.1.4 Binary Operation: GATE CSE 2006 | Question: 28 top ↴

→ <https://gateoverflow.in/991>



- ✓ This question is easier to answer with Boolean Algebra.

$A \odot B \equiv B \rightarrow A$ , i.e.  $(\neg B \vee A)$ .

Now, lets look at Option D

$$\begin{aligned} \neg(\neg A \odot B) \\ \equiv \neg(B \rightarrow \neg A) \\ \equiv \neg(\neg B \vee \neg A) \\ \equiv B \wedge A \end{aligned}$$

So, Answer is D.

Other options:

- A.  $\neg B \vee \neg A$   
 B.  $\neg B \wedge \neg A$   
 C.  $\neg B \wedge A$

12 votes

-- Akash Kanase (36k points)

#### 4.1.5 Binary Operation: GATE CSE 2013 | Question: 1 top ↴

→ <https://gateoverflow.in/59>



- ✓ Answer is (A) Commutative but not associative.

$y \oplus x = y^2 + x^2 = x \oplus y$ . Hence, commutative.

$$\begin{aligned} (x \oplus y) \oplus z &= (x^2 + y^2) \oplus z = (x^2 + y^2)^2 + z^2 \\ x \oplus (y \oplus z) &= x \oplus (y^2 + z^2) = x^2 + (y^2 + z^2)^2 \end{aligned}$$

So,  $((x \oplus y) \oplus z) \neq (x \oplus (y \oplus z))$ , hence not associative.

12 votes

-- Arjun Suresh (328k points)

#### 4.1.6 Binary Operation: GATE CSE 2015 Set 1 | Question: 28 top ↴

→ <https://gateoverflow.in/8226>



- ✓ option A : as it is XOR operation

12 votes

-- GATERush (917 points)

#### 4.1.7 Binary Operation: GATE CSE 2015 Set 3 | Question: 2 top ↴

→ <https://gateoverflow.in/8393>



- ✓ Answer: B

$$(P \# Q) \# R = (P' + Q') \# R$$

$$= P \cdot Q + R'$$

whereas,

$$\begin{aligned} P\#(Q\#R) &= P' + (Q\#R)' \\ &= P' + (Q' + R')' \\ &= P' + QR \end{aligned}$$

25 votes

-- overtomanu (945 points)

#### 4.1.8 Binary Operation: GATE IT 2006 | Question: 2 top

<https://gateoverflow.in/3539>

##### ✓ Answer : A

An Element  $z \in N$  is called an Identity element for  $f$  if  $f(a, z) = f(z, a) = a, \forall a \in N$

$$\text{I: } f(x, y) = x + y - 3$$

We will say that  $z$  is an identity element if  $f(x, z) = x = f(z, x)$ , Hence,  $x + z - 3 = x = z + x - 3$

So, We have  $z = 3$ .

$$\text{II: } f(x, y) = \max(x, y)$$

We will say that  $z$  is an identity element if  $f(x, z) = x = f(z, x)$ , hence,  $\max(x, z) = x = \max(z, x), \forall x \in N$ .

So, We have  $z = 0$  (if  $N$  consists of 0)

Or We have  $z = 1$  (if  $N$  does not consist of 0)

NOTE : Whether 0 belongs to Set of natural numbers or not, is an ambiguous thing. In Number theory, generally we don't consider 0 as a Natural number. But in Computer Science, 0 is considered as a Natural number by many authors.

In this question, It doesn't matter whether or not 0 belong to  $N$  or not. We can say that the Set  $N$  will have an Identity element in both the cases. (Also See below NOTE 3)

$$\text{III: } f(x, y) = x^y$$

We will say that  $z$  is an identity element if  $f(x, z) = x = f(z, x)$ , hence,  $x^z = x = z^x, \forall x \in N$ .

But, we know that  $x^y$  is Not necessarily equal to  $y^x$ . (See below NOTE 2)

Hence, there is No identity element for this Binary Operation.

#### Some Extra Points :

NOTE 1:

For any Set  $A$ .

Saying that a Binary Operation  $f : A \times A \rightarrow A$ , is as good as saying that the Given Set  $A$  is Closed under the Binary Operation  $*$ .

NOTE 2 : Solutions of the Equation  $x^y = y^x$

Obvious partial solution is  $X = Y$ , but there are other solutions like 2, 4 and 4, 2.

In fact, these solutions and  $X = Y$  are the only solutions in positive integers. And the only integer solutions are  $X = Y$  and  $(2, 4), (4, 2), (-2, -4), (-4, -2)$

Refer Proof : <http://mathforum.org/library/drmath/view/66166.html>

NOTE 3 :

I had said in the Second Binary Operation that 0 or 1 could be the Identity element. But after seeing the Third Binary Operation, I can say that Whoever Professor set this Question, must have thought of 0 as a Non-Natural Number because If  $0 \in N$ , then  $f(0, 0)$  will be Indeterminate and  $f(0, 0) = 0$  or 1. Which will lead to  $f$  Not being an Binary Operation.

#### References



38 votes

-- Deepak Poonia (23k points)

## 4.2

#### Countable Uncountable Set (2) top

##### 4.2.1 Countable Uncountable Set: GATE CSE 1994 | Question: 3.9 top

<https://gateoverflow.in/2495>

Every subset of a countable set is countable.



State whether the above statement is true or false with reason.

gate1994 set-theory&algebra normal sets countable-uncountable-set true-false

Answer 

#### 4.2.2 Countable Uncountable Set: GATE CSE 2018 | Question: 27

<https://gateoverflow.in/204101>



Let  $N$  be the set of natural numbers. Consider the following sets,

- $P$  : Set of Rational numbers (positive and negative)
- $Q$  : Set of functions from  $\{0, 1\}$  to  $N$
- $R$  : Set of functions from  $N$  to  $\{0, 1\}$
- $S$  : Set of finite subsets of  $N$

Which of the above sets are countable?

- A.  $Q$  and  $S$  only
- B.  $P$  and  $S$  only
- C.  $P$  and  $R$  only
- D.  $P, Q$  and  $S$  only

gate2018-cse set-theory&algebra countable-uncountable-set normal

Answer 

#### Answers: Countable Uncountable Set

#### 4.2.1 Countable Uncountable Set: GATE CSE 1994 | Question: 3.9

<https://gateoverflow.in/2495>



✓ True

Reference: [https://proofwiki.org/wiki/Subset\\_of\\_Countable\\_Set\\_is\\_Countable](https://proofwiki.org/wiki/Subset_of_Countable_Set_is_Countable)

#### References



 11 votes

-- Anu (4.7k points)

#### 4.2.2 Countable Uncountable Set: GATE CSE 2018 | Question: 27

<https://gateoverflow.in/204101>



P: Set of Rational numbers are **countable**. Rational numbers are of the form  $\frac{p}{q}$  where  $p, q$  are integers. Enumeration procedure, take  $p + q$  and write down all possible values(positive and negative).

Q: Set of functions from  $\{0, 1\}$  to  $N$ . There are  $N^2$  such functions. Hence **countable**.

R: Set of functions from  $N$  to  $\{0, 1\}$ . There are  $2^N$  such functions. Important theorem  $\Rightarrow$

If a set  $S$  is countable, then  $\mathbb{P}(S)$  i.e  $2^S$  is uncountable.

Hence, statement R is **uncountable**.

S: Set of finite subsets of  $N$ . They are **countable**. Important theorem  $\Rightarrow$

Every subset of a countable set is either countable or finite.

Hence, Option (D).

 54 votes

-- Neelay Upadhyaya (1.1k points)

#### 4.3

#### Functions (27)

#### 4.3.1 Functions: GATE CSE 1987 | Question: 9b

<https://gateoverflow.in/82437>



How many one-to-one functions are there from a set  $A$  with  $n$  elements onto itself?

gate1987 set-theory&algebra functions descriptive

Answer 

**4.3.2 Functions: GATE CSE 1988 | Question: 13ii** [top](#)<https://gateoverflow.in/94634>

If the set  $S$  has a finite number of elements, prove that if  $f$  maps  $S$  onto  $S$ , then  $f$  is one-to-one.

[gate1988](#) [descriptive](#) [set-theory&algebra](#) [functions](#)

Answer

**4.3.3 Functions: GATE CSE 1989 | Question: 13c** [top](#)<https://gateoverflow.in/93178>

Find the number of single valued functions from set  $A$  to another set  $B$ , given that the cardinalities of the sets  $A$  and  $B$  are  $m$  and  $n$  respectively.

[gate1989](#) [descriptive](#) [functions](#) [set-theory&algebra](#)

Answer

**4.3.4 Functions: GATE CSE 1993 | Question: 8.6** [top](#)<https://gateoverflow.in/2304>

Let  $A$  and  $B$  be sets with cardinalities  $m$  and  $n$  respectively. The number of one-one mappings from  $A$  to  $B$ , when  $m < n$ , is

- A.  $m^n$
- B.  ${}^n P_m$
- C.  ${}^m C_n$
- D.  ${}^n C_m$
- E.  ${}^m P_n$

[gate1993](#) [set-theory&algebra](#) [functions](#) [easy](#)

Answer

**4.3.5 Functions: GATE CSE 1996 | Question: 1.3** [top](#)<https://gateoverflow.in/2707>

Suppose  $X$  and  $Y$  are sets and  $|X|$  and  $|Y|$  are their respective cardinality. It is given that there are exactly 97 functions from  $X$  to  $Y$ . From this one can conclude that

- A.  $|X| = 1, |Y| = 97$
- B.  $|X| = 97, |Y| = 1$
- C.  $|X| = 97, |Y| = 97$
- D. None of the above

[gate1996](#) [set-theory&algebra](#) [functions](#) [normal](#)

Answer

**4.3.6 Functions: GATE CSE 1996 | Question: 2.1** [top](#)<https://gateoverflow.in/2730>

Let  $R$  denote the set of real numbers. Let  $f : R \times R \rightarrow R \times R$  be a bijective function defined by  $f(x, y) = (x + y, x - y)$ . The inverse function of  $f$  is given by

- A.  $f^{-1}(x, y) = \left( \frac{1}{x+y}, \frac{1}{x-y} \right)$
- B.  $f^{-1}(x, y) = (x - y, x + y)$
- C.  $f^{-1}(x, y) = \left( \frac{x+y}{2}, \frac{x-y}{2} \right)$
- D.  $f^{-1}(x, y) = [2(x - y), 2(x + y)]$

[gate1996](#) [set-theory&algebra](#) [functions](#) [normal](#)

Answer

**4.3.7 Functions: GATE CSE 1997 | Question: 13** [top](#)<https://gateoverflow.in/2273>

Let  $F$  be the set of one-to-one functions from the set  $\{1, 2, \dots, n\}$  to the set  $\{1, 2, \dots, m\}$  where  $m \geq n \geq 1$ .

- How many functions are members of  $F$ ?
- How many functions  $f$  in  $F$  satisfy the property  $f(i) = 1$  for some  $i, 1 \leq i \leq n$ ?
- How many functions  $f$  in  $F$  satisfy the property  $f(i) < f(j)$  for all  $i, j$   $1 \leq i \leq j \leq n$ ?

gate1997 | set-theory&algebra | functions | normal | descriptive

Answer 

#### 4.3.8 Functions: GATE CSE 1998 | Question: 1.8

 <https://gateoverflow.in/1645>



The number of functions from an  $m$  element set to an  $n$  element set is

- A.  $m + n$
- B.  $m^n$
- C.  $n^m$
- D.  $m * n$

gate1998 | set-theory&algebra | combinatory | functions | easy

Answer 

#### 4.3.9 Functions: GATE CSE 2001 | Question: 2.3

 <https://gateoverflow.in/721>



Let  $f : A \rightarrow B$  a function, and let  $E$  and  $F$  be subsets of  $A$ . Consider the following statements about images.

- $S_1 : f(E \cup F) = f(E) \cup f(F)$
- $S_2 : f(E \cap F) = f(E) \cap f(F)$

Which of the following is true about  $S_1$  and  $S_2$ ?

- A. Only  $S_1$  is correct
- B. Only  $S_2$  is correct
- C. Both  $S_1$  and  $S_2$  are correct
- D. None of  $S_1$  and  $S_2$  is correct

gate2001-cse | set-theory&algebra | functions | normal

Answer 

#### 4.3.10 Functions: GATE CSE 2001 | Question: 4

 <https://gateoverflow.in/745>



Consider the function  $h : N \times N \rightarrow N$  so that  $h(a, b) = (2a + 1)2^b - 1$ , where  $N = \{0, 1, 2, 3, \dots\}$  is the set of natural numbers.

- Prove that the function  $h$  is an injection (one-one).
- Prove that it is also a Surjection (onto)

gate2001-cse | functions | set-theory&algebra | normal | descriptive

Answer 

#### 4.3.11 Functions: GATE CSE 2003 | Question: 37

 <https://gateoverflow.in/927>



Let  $f : A \rightarrow B$  be an injective (one-to-one) function. Define  $g : 2^A \rightarrow 2^B$  as:  
 $g(C) = \{f(x) \mid x \in C\}$ , for all subsets  $C$  of  $A$ .  
Define  $h : 2^B \rightarrow 2^A$  as:  $h(D) = \{x \mid x \in A, f(x) \in D\}$ , for all subsets  $D$  of  $B$ . Which of the following statements is always true?

- A.  $g(h(D)) \subseteq D$
- B.  $g(h(D)) \supseteq D$
- C.  $g(h(D)) \cap D = \emptyset$
- D.  $g(h(D)) \cap (B - D) \neq \emptyset$

gate2003-cse | set-theory&algebra | functions | normal

Answer 

#### 4.3.12 Functions: GATE CSE 2003 | Question: 39

<https://gateoverflow.in/930>



Let  $\Sigma = \{a, b, c, d, e\}$  be an alphabet. We define an encoding scheme as follows:

$$g(a) = 3, g(b) = 5, g(c) = 7, g(d) = 9, g(e) = 11.$$

Let  $p_i$  denote the  $i$ -th prime number ( $p_1 = 2$ ).

For a non-empty string  $s = a_1 \dots a_n$ , where each  $a_i \in \Sigma$ , define  $f(s) = \prod_{i=1}^n P_i^{g(a_i)}$ .

For a non-empty sequence  $\langle s_j, \dots, s_n \rangle$  of strings from  $\Sigma^+$ , define  $h(\langle s_i \dots s_n \rangle) = \prod_{i=1}^n P_i^{f(s_i)}$

Which of the following numbers is the encoding,  $h$ , of a non-empty sequence of strings?

- A.  $2^7 3^7 5^7$
- B.  $2^8 3^8 5^8$
- C.  $2^9 3^9 5^9$
- D.  $2^{10} 3^{10} 5^{10}$

gate2003-cse set-theory&algebra functions normal

Answer 

#### 4.3.13 Functions: GATE CSE 2005 | Question: 43

<https://gateoverflow.in/1168>



Let  $f : B \rightarrow C$  and  $g : A \rightarrow B$  be two functions and let  $h = fog$ . Given that  $h$  is an onto function which one of the following is TRUE?

- A.  $f$  and  $g$  should both be onto functions
- B.  $f$  should be onto but  $g$  need not to be onto
- C.  $g$  should be onto but  $f$  need not be onto
- D. both  $f$  and  $g$  need not be onto

gate2005-cse set-theory&algebra functions normal

Answer 

#### 4.3.14 Functions: GATE CSE 2006 | Question: 2

<https://gateoverflow.in/881>



Let  $X, Y, Z$  be sets of sizes  $x, y$  and  $z$  respectively. Let  $W = X \times Y$  and  $E$  be the set of all subsets of  $W$ . The number of functions from  $Z$  to  $E$  is

- A.  $z^{2^{xy}}$
- B.  $z \times 2^{xy}$
- C.  $z^{2^{x+y}}$
- D.  $2^{xyz}$

gate2006-cse set-theory&algebra normal functions

Answer 

#### 4.3.15 Functions: GATE CSE 2006 | Question: 25

<https://gateoverflow.in/988>



Let  $S = \{1, 2, 3, \dots, m\}$ ,  $m > 3$ . Let  $X_1, \dots, X_n$  be subsets of  $S$  each of size 3. Define a function  $f$  from  $S$  to the set of natural numbers as,  $f(i)$  is the number of sets  $X_j$  that contain the element  $i$ . That is  $f(i) = |\{j \mid i \in X_j\}|$  then  $\sum_{i=1}^m f(i)$  is:

- A.  $3m$
- B.  $3n$
- C.  $2m + 1$
- D.  $2n + 1$

gate2006-cse set-theory&algebra normal functions

Answer 

**4.3.16 Functions: GATE CSE 2007 | Question: 3** [top](#)<https://gateoverflow.in/1202>

What is the maximum number of different Boolean functions involving  $n$  Boolean variables?

- A.  $n^2$
- B.  $2^n$
- C.  $2^{2^n}$
- D.  $2^{n^2}$

[gate2007-cse](#) [combinatory](#) [functions](#) [normal](#)

Answer

**4.3.17 Functions: GATE CSE 2012 | Question: 37** [top](#)<https://gateoverflow.in/1759>

How many onto (or surjective) functions are there from an  $n$ -element ( $n \geq 2$ ) set to a 2-element set?

- A.  $2^n$
- B.  $2^n - 1$
- C.  $2^n - 2$
- D.  $2(2^n - 2)$

[gate2012-cse](#) [set-theory&algebra](#) [functions](#) [normal](#)

Answer

**4.3.18 Functions: GATE CSE 2014 Set 1 | Question: 50** [top](#)<https://gateoverflow.in/1930>

Let  $S$  denote the set of all functions  $f : \{0, 1\}^4 \rightarrow \{0, 1\}$ . Denote by  $N$  the number of functions from  $S$  to the set  $\{0, 1\}$ . The value of  $\log_2 \log_2 N$  is \_\_\_\_\_.

[gate2014-cse-set1](#) [set-theory&algebra](#) [functions](#) [combinatory](#) [numerical-answers](#)

Answer

**4.3.19 Functions: GATE CSE 2014 Set 3 | Question: 2** [top](#)<https://gateoverflow.in/2036>

Let  $X$  and  $Y$  be finite sets and  $f : X \rightarrow Y$  be a function. Which one of the following statements is TRUE?

- A. For any subsets  $A$  and  $B$  of  $X$ ,  $|f(A \cup B)| = |f(A)| + |f(B)|$
- B. For any subsets  $A$  and  $B$  of  $X$ ,  $f(A \cap B) = f(A) \cap f(B)$
- C. For any subsets  $A$  and  $B$  of  $X$ ,  $|f(A \cap B)| = \min\{|f(A)|, |f(B)|\}$
- D. For any subsets  $S$  and  $T$  of  $Y$ ,  $f^{-1}(S \cap T) = f^{-1}(S) \cap f^{-1}(T)$

[gate2014-cse-set3](#) [set-theory&algebra](#) [functions](#) [normal](#)

Answer

**4.3.20 Functions: GATE CSE 2014 Set 3 | Question: 49** [top](#)<https://gateoverflow.in/2083>

Consider the set of all functions  $f : \{0, 1, \dots, 2014\} \rightarrow \{0, 1, \dots, 2014\}$  such that  $f(f(i)) = i$ , for all  $0 \leq i \leq 2014$ . Consider the following statements:

- P. For each such function it must be the case that for every  $i$ ,  $f(i) = i$ .
- Q. For each such function it must be the case that for some  $i$ ,  $f(i) = i$ .
- R. Each function must be onto.

Which one of the following is CORRECT?

- A. P, Q and R are true
- B. Only Q and R are true
- C. Only P and Q are true
- D. Only R is true

[gate2014-cse-set3](#) [set-theory&algebra](#) [functions](#) [normal](#)

[Answer](#)**4.3.21 Functions: GATE CSE 2015 Set 1 | Question: 5** [top](#)<https://gateoverflow.in/8025>

If  $g(x) = 1 - x$  and  $h(x) = \frac{x}{x-1}$ , then  $\frac{g(h(x))}{h(g(x))}$  is:

- A.  $\frac{h(x)}{g(x)}$
- B.  $\frac{-1}{\frac{x}{g(x)}}$
- C.  $\frac{g(x)}{h(x)}$
- D.  $\frac{x}{(1-x)^2}$

[gate2015-cse-set1](#) [set-theory&algebra](#) [functions](#) [normal](#)[Answer](#)**4.3.22 Functions: GATE CSE 2015 Set 2 | Question: 40** [top](#)<https://gateoverflow.in/8212>

The number of onto functions (surjective functions) from set  $X = \{1, 2, 3, 4\}$  to set  $Y = \{a, b, c\}$  is \_\_\_\_\_.

[gate2015-cse-set2](#) [set-theory&algebra](#) [functions](#) [normal](#) [numerical-answers](#)[Answer](#)**4.3.23 Functions: GATE CSE 2015 Set 2 | Question: 54** [top](#)<https://gateoverflow.in/8257>

Let  $X$  and  $Y$  denote the sets containing 2 and 20 distinct objects respectively and  $F$  denote the set of all possible functions defined from  $X$  to  $Y$ . Let  $f$  be randomly chosen from  $F$ . The probability of  $f$  being one-to-one is \_\_\_\_\_.

[gate2015-cse-set2](#) [set-theory&algebra](#) [functions](#) [normal](#) [numerical-answers](#)[Answer](#)**4.3.24 Functions: GATE CSE 2016 Set 1 | Question: 28** [top](#)<https://gateoverflow.in/39717>

A function  $f : \mathbb{N}^+ \rightarrow \mathbb{N}^+$ , defined on the set of positive integers  $\mathbb{N}^+$ , satisfies the following properties:

$$f(n) = f(n/2) \text{ if } n \text{ is even}$$

$$f(n) = f(n + 5) \text{ if } n \text{ is odd}$$

Let  $R = \{i \mid \exists j : f(j) = i\}$  be the set of distinct values that  $f$  takes. The maximum possible size of  $R$  is \_\_\_\_\_.

[gate2016-cse-set1](#) [set-theory&algebra](#) [functions](#) [normal](#) [numerical-answers](#)[Answer](#)**4.3.25 Functions: GATE CSE 2021 Set 2 | Question: 11** [top](#)<https://gateoverflow.in/357529>

Consider the following sets, where  $n \geq 2$ :

- $S_1$ : Set of all  $n \times n$  matrices with entries from the set  $\{a, b, c\}$
- $S_2$ : Set of all functions from the set  $\{0, 1, 2, \dots, n^2 - 1\}$  to the set  $\{0, 1, 2\}$

Which of the following choice(s) is/are correct?

- A. There does not exist a bijection from  $S_1$  to  $S_2$
- B. There exists a surjection from  $S_1$  to  $S_2$
- C. There exists a bijection from  $S_1$  to  $S_2$
- D. There does not exist an injection from  $S_1$  to  $S_2$

[gate2021-cse-set2](#) [multiple-selects](#) [set-theory&algebra](#) [functions](#)[Answer](#)

**4.3.26 Functions: GATE IT 2005 | Question: 31** top ↴<https://gateoverflow.in/3777>

Let  $f$  be a function from a set  $A$  to a set  $B$ ,  $g$  a function from  $B$  to  $C$ , and  $h$  a function from  $A$  to  $C$ , such that  $h(a) = g(f(a))$  for all  $a \in A$ . Which of the following statements is always true for all such functions  $f$  and  $g$ ?

- A.  $g$  is onto  $\implies h$  is onto
- B.  $h$  is onto  $\implies f$  is onto
- C.  $h$  is onto  $\implies g$  is onto
- D.  $h$  is onto  $\implies f$  and  $g$  are onto

[gate2005-it](#) [set-theory&algebra](#) [functions](#) [normal](#)

Answer

**4.3.27 Functions: GATE IT 2006 | Question: 6** top ↴<https://gateoverflow.in/3545>

Given a boolean function  $f(x_1, x_2, \dots, x_n)$ , which of the following equations is NOT true?

- A.  $f(x_1, x_2, \dots, x_n) = x'_1 f(x_1, x_2, \dots, x_n) + x_1 f(x_1, x_2, \dots, x_n)$
- B.  $f(x_1, x_2, \dots, x_n) = x_2 f(x_1, x_2, \dots, x_n) + x'_2 f(x_1, x_2, \dots, x_n)$
- C.  $f(x_1, x_2, \dots, x_n) = x'_n f(x_1, x_2, \dots, 0) + x_n f(x_1, x_2, \dots, 1)$
- D.  $f(x_1, x_2, \dots, x_n) = f(0, x_2, \dots, x_n) + f(1, x_2, \dots, x_n)$

[gate2006-it](#) [set-theory&algebra](#) [functions](#) [normal](#)

Answer

**Answers: Functions****4.3.1 Functions: GATE CSE 1987 | Question: 9b** top ↴<https://gateoverflow.in/82437>

- ✓ There are  $n!$  one to one function possible from a set of  $n$  elements to itself.

i.e.,  $P(n)_n = n!$

21 votes

-- Prashant Singh (47.2k points)

**4.3.2 Functions: GATE CSE 1988 | Question: 13ii** top ↴<https://gateoverflow.in/94634>

- ✓ Let set  $S = \{1, 2, 3, 4\}$ .

Now see the mapping from  $S$  to  $S$ .

For  $f$  to be onto every element of codomain must be mapped by every element in domain.

Since, cardinality is same for both domain and codomain, we can not have mapping like  $f(1) = 1, f(2) = 1$  because if it happened then at least one element remain unmapped in codomain, which result in  $f$  being not onto but it is given that  $f$  is onto. So every element in codomain has exactly one element in domain. Thus  $f$  must be an one-to-one function.

NOTE: If  $S$  is infinite then this result may not be true.

28 votes

-- junaid ahmad (6.5k points)

**4.3.3 Functions: GATE CSE 1989 | Question: 13c** top ↴<https://gateoverflow.in/93178>

- ✓ A single-valued function is an emphatic term for a mathematical function in the usual sense. That is, each element of the function's domain maps to a single, well-defined element of its range. By default, we always consider function as a single-valued function except when clearly mentioned that function is a multi-valued function.

So, the number of single valued functions from  $A$  to  $B$  = number of functions from  $A$  to  $B$ .

Lets take an example:

$$A = \{1, 2\}, B = \{a, b\}$$

1.  $f(1) = f(2) = a$
2.  $f(1) = f(2) = b$
3.  $f(1) = a$  and  $f(2) = b$
4.  $f(1) = b$  and  $f(2) = a$

The total number of single-valued functions from set  $A$  to another set  $B = |B|^{|A|} = n^m$ . This is because for every

element in  $A$  we have  $|B|$  possibilities in the function.

The correct answer is  $n^m$ .

26 votes

-- Tariq Husain khan (6.3k points)

#### 4.3.4 Functions: GATE CSE 1993 | Question: 8.6 [top](#)

<https://gateoverflow.in/2304>

✓ Answer: B

Ref: Page 33 of <http://www.cs.toronto.edu/~stacho/macm101-2.pdf>

#### References



24 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.3.5 Functions: GATE CSE 1996 | Question: 1.3 [top](#)

<https://gateoverflow.in/2707>

✓ We can say  $|Y|^{|X|} = 97$ . Only option A satisfies this. Still, this can be concluded only because 97 is a prime number and hence no other power gives 97.

37 votes

-- Arjun Suresh (328k points)

#### 4.3.6 Functions: GATE CSE 1996 | Question: 2.1 [top](#)

<https://gateoverflow.in/2730>

✓ to find inverse of the function take

$$z_1 = x + y \rightarrow (1)$$

$$z_2 = x - y \rightarrow (2)$$

Adding (1) and (2) we get,

$$x = \frac{z_1+z_2}{2} \text{ and } y = \frac{z_1-z_2}{2}$$

$$\text{So, } f\left(\frac{z_1}{2}, \frac{z_2}{2}\right) = \left(\frac{z_1+z_2}{2}, \frac{z_1-z_2}{2}\right) = (x, y) \implies f^{-1}(x, y) = \left(\frac{z_1}{2}, \frac{z_2}{2}\right) = \left\{\frac{x+y}{2}, \frac{x-y}{2}\right\}$$

Correct Answer: C

36 votes

-- neha pawar (3.3k points)

Taking an example:

$$f(2, 3) = (2 + 3, 2 - 3) = (5, -1)$$

$$f^{-1}(5, -1) \text{ should be } (2, 3).$$

Substituting the values we get (C) as answer.

75 votes

-- Kumar Shikhar Deep (1.2k points)

#### 4.3.7 Functions: GATE CSE 1997 | Question: 13 [top](#)

<https://gateoverflow.in/2273>

✓ (a) A function from A to B must map every element in A. Being one-one, each element must map to a unique element in B. So, for  $n$  elements in A, we have  $m$  choices in B and so we can have  ${}^m P_n$  functions.

(b) Continuing from (a) part. Here, we are forced to fix  $f(i) = 1$ . So, one element from A and B gone with  $n$  possibilities for the element in A and 1 possibility for that in B, and we get  $n \times {}^{m-1} P_{n-1}$  such functions.

(c)  $f(i) < f(j)$  means only one order for the  $n$  selection permutations from B is valid. So, the answer from (a) becomes  ${}^m C_n$  here.

49 votes

-- Arjun Suresh (328k points)

**4.3.8 Functions: GATE CSE 1998 | Question: 1.8** top ↴<https://gateoverflow.in/1645>

- ✓ No. of functions from an  $m$  element set to an  $n$  element set is  $n^m$  as for each of the  $m$  element, we have  $n$  choices to map to, giving  $\underbrace{n \times n \times \dots n}_{m \text{ times}} = n^m$ .

PS: Each element of the domain set in a function must be mapped to some element of the co-domain set.

15 votes

-- Digvijay (44.9k points)

**4.3.9 Functions: GATE CSE 2001 | Question: 2.3** top ↴<https://gateoverflow.in/721>

- ✓ Say  $E = \{1, 2\}$  and  $F = \{3, 4\}$ .

- $f(1) = a$
- $f(2) = b$
- $f(3) = b$
- $f(4) = d$

$$\begin{aligned} f(E \cup F) &= f(1, 2, 3, 4) = \{a, b, d\} \\ f(E) \cup f(F) &= f(1, 2) \cup f(3, 4) = \{a, b\} \cup \{b, d\} = \{a, b, d\} \end{aligned}$$

Now,  $E \cap F = \emptyset$

$$f(E \cap F) = f(\emptyset) = \emptyset$$

$$\text{But, } f(E) \cap f(F) = f(1, 2) \cap f(3, 4) = \{a, b\} \cap \{b, d\} = \{b\}$$

So,  $S_2$  is not true.  $S_1$  is always true (no counter example exists)

Correct Answer: A

15 votes

-- srestha (85k points)

**4.3.10 Functions: GATE CSE 2001 | Question: 4** top ↴<https://gateoverflow.in/745>

The given function is  $h(a, b) = (2a + 1)2^b - 1$

$$h : N \times N \rightarrow N$$

**(i) injection:-**

$h$  will be one-to-one if,  $h(a, b) = h(c, d) \implies (a, b) = (c, d)$

$$h(a, b) = h(c, d)$$

$$\implies (2a + 1)2^b - 1 = (2c + 1)2^d - 1$$

$$\implies \frac{2a+1}{2c+1} = 2^{d-b}$$

If  $d \neq b$  then RHS will always be even, but LHS is (odd/odd) which is odd.

LHS = RHS only if  $d = b$ ,

$$\implies \frac{(2a+1)}{(2c+1)} = 1$$

$$\implies (2a + 1) = (2c + 1) \implies a = c$$

$$\implies (a, b) = (c, d), \text{ hence } h \text{ is one-one.}$$

**(ii) Surjection:-**

For  $h$  to be onto, there should not be any non-negative integer which can't be generated by the function. i.e. all the elements of co-domain should be mapped by some element of domain set.

Now look at the function it is  $(2a + 1)2^b - 1$

If  $b = 0$ ,  $(2a + 1)2^b - 1 = 2a \implies$  all non-negative even numbers generated.

If  $b \neq 0$ ,  $(2a + 1)2^b - 1 \implies$  all non-negative odd numbers generated.

So, all the numbers of co-domain (i.e.  $N$ ) are mapped by some  $(a, b)$  pair. Hence,  $h$  is onto (surjective).

15 votes

-- Ashish verma (7.1k points)

4.3.11 Functions: GATE CSE 2003 | Question: 37 [top](#)<https://gateoverflow.in/927>

- ✓  $f : A \rightarrow B$  is a one to one function. Every element in A will have a corresponding element in B. Therefore, the size of range for this is  $n(A)$  and  $n(B) \geq n(A)$ .

$g : 2^A \rightarrow 2^B, g(C) = \{f(x) \mid x \in C\}$ , since  $f$  is one to one, for every subset of A there will be corresponding subset of B. Therefore, this is also a one to one function and size of range for this is  $n(2^A)$ .

$h : 2^B \rightarrow 2^A, h(D) = \{x \mid x \in A, f(x) \in D\}$  this function is not a one to one function. Every subset of B will be mapped to subset of A for which it has all the images of subset of A. Size of range for this function will be  $n(2^A)$ .

That said, now  $g(h(D))$  will also have the range of size  $n(2^A)$ . Since  $n(A) \leq n(B), n(2^A)$  must be less than or equal to  $n(2^B)$ . The answer is  $g(h(D)) \subseteq D$ .

For example let  $A = \{1, 2\}$  and  $B = \{a, b, c\}$ . Let  $f(1) = a, f(2) = b$ . Now,

- $g(\{\}) = \{\}$
- $g(\{1\}) = \{a\}$
- $g(\{2\}) = \{b\}$
- $g(\{1, 2\}) = \{a, b\}$
- $h(\{\}) = \{\}$
- $h(\{a\}) = \{1\}$
- $h(\{b\}) = \{2\}$
- $h(\{c\}) = \{\}$
- $h(\{a, b\}) = \{1, 2\}$
- $h(\{a, c\}) = \{1\}$
- $h(\{b, c\}) = \{2\}$
- $h(\{a, b, c\}) = \{1, 2\}$

Now, we can see that for any  $D \subseteq B, g(h(D)) \subseteq D$ . Had the function  $f$  been bijective (one-one and onto or one-one and co-domain = range), we would have got  $g(h(D)) = D$ .

Correct Answer: A

47 votes

-- Mari Ganesh Kumar (1.5k points)

4.3.12 Functions: GATE CSE 2003 | Question: 39 [top](#)<https://gateoverflow.in/930>

- ✓ It is clear from the choices that there are 3 strings in the sequence as we have the first 3 prime numbers in the product. Now, in  $f(s)$  the first term is  $2^x$  for some  $x$ , so, A and C choices can be eliminated straight away as neither 7 nor 9 is a multiple of 2.

The sequence of strings are "a", "a" and "a"

$f(a) = 2^3 = 8$ . So, we get  $2^8 3^8 5^8$  as per the definition of  $h$ .

Correct Answer: B

34 votes

-- Arjun Suresh (328k points)

4.3.13 Functions: GATE CSE 2005 | Question: 43 [top](#)<https://gateoverflow.in/1168>

- ✓ B.  $g$  need not be onto.

Let,

$$A = \{0, 1, 2\}, B = \{0, 3, 4, 25\}, C = \{3, 4, 5\}$$

$$f = \{(0, 3), (3, 5), (4, 4), (25, 3)\}$$

$g = \{(1, 3), (2, 4), (0, 0)\}$  (25 in B not mapped to by  $g$ , hence  $g$  is not ONTO)

$$h = \{(0, 3), (1, 5), (2, 4)\}$$

Now,  $h$  is an onto function but  $g$  is not.

$f$  must be an onto function as otherwise we are sure to miss some elements in range of  $h$  making it not onto.

43 votes

-- Arjun Suresh (328k points)

#### 4.3.14 Functions: GATE CSE 2006 | Question: 2 [top](#)



✓ D is Correct.

$|E| = 2^{xy}$  which is the number of subsets of  $W$ .

Now, the mapping for a function from  $A$  to  $B$  with  $N$  and  $M$  elements respectively can be done in  $M^N$  ways.

Here,

$$|E|^z = \{2^{xy}\}^z = 2^{xyz}$$

40 votes

-- Snehil Joshi (221 points)

#### 4.3.15 Functions: GATE CSE 2006 | Question: 25 [top](#)



✓  $|S| = m$

No. of three elements subset =  $n = \binom{m}{3}$

Function  $f(i)$  is defined as No. of three elements subset which contain element  $i$ .

Without loss of generality, lets assume  $i = 1$

Now we need to count three elements subset which contain element 1.

All those subset will be of the form  $\{1, a, b\}$ , where  $a$  and  $b$  are distinct and not equal to 1.

We can choose all those  $a$  and  $b$  in  $\binom{m-1}{2}$  ways

So,  $f(1) = \binom{m-1}{2}$ , which is true for any  $i$

Therefore,  $f(i) = \binom{m-1}{2}$

Now,

$$\sum_{i=1}^m f(i) = \sum_{i=1}^m \binom{m-1}{2}$$

$$= m \binom{m-1}{2} = 3 \binom{m}{3} = 3n$$

Correct Answer: B

35 votes

-- Lakpa Tashi Bhutia (869 points)

#### Alternative Approach:

Total elements in  $S = m$

Total number of subsets of size 3 each can be  ${}^m C_3$ .

Now suppose take 1<sup>st</sup> element 1. Out of  ${}^m C_3$  subsets 1 wont be there in  ${}^{(m-1)} C_3$  subsets.

So 1 will be there in  ${}^m C_3 - {}^{(m-1)} C_3 = \frac{(m-1)(m-2)}{2}$  subsets.

$$\sum f(i) = \sum \frac{(m-1)(m-2)}{2} = \frac{m(m-1)(m-2)}{2}.$$

We know,  ${}^m c_3 = n$  (No. of  $X$  subset)  $\therefore \frac{m(m-1)(m-2)}{3!} = 3n$ .

63 votes

-- Madhur Rawat (2k points)

#### 4.3.16 Functions: GATE CSE 2007 | Question: 3

<https://gateoverflow.in/1202>



answer - C

size of domain = number of different combinations of inputs  $= 2^n$ .

size of codomain  $= 2(\{0, 1\})$ .

number of functions  $= (\text{size of co-domain})^{(\text{size of domain})}$

42 votes

-- Ankit Rokde (6.9k points)

#### 4.3.17 Functions: GATE CSE 2012 | Question: 37

<https://gateoverflow.in/1759>



- ✓ No. of onto (or surjective) functions are there from an  $n$ -element ( $n \geq 2$ ) set to a 2-element set = Total No of functions – (No of functions with 1 element from RHS not mapped) + (No of functions with 2 element from RHS not mapped). . . (So on Using Inclusion Exclusion principle  $= 2^n$  (Total no of functions)  $- 2 * 1^n$  (No of functions in which one element is excluded)  $+ 0$  (No element in RHS is selected)  $= 2^n - 2$ .

Hence, Ans is (C).

**alternate**

[https://gateoverflow.in/8212/gate2015-2\\_40](https://gateoverflow.in/8212/gate2015-2_40)

#### References



37 votes

-- Akash Kanase (36k points)

#### 4.3.18 Functions: GATE CSE 2014 Set 1 | Question: 50

<https://gateoverflow.in/1930>



- ✓ For a function from set  $A$  to set  $B$ , we need to have a mapping for all elements of  $A$  and mapping must be unique. Let number of elements in  $A$  be  $m$  and that in  $B$  be  $n$

So, if we consider an element from  $A$ , it can be mapped to any of the element from  $B$ . i.e., it has  $n$  possibilities when a function is formed. Similarly, for all other members also there are  $n$  possibilities as one element from  $A$  can be mapped to only a single element in  $B$  (though reverse need not true). So, for  $n$  elements in  $A$ , we totally have  $\underbrace{n \times \dots \times n}_{m \text{ times}} = n^m$  possible functions.

In the question Number of elements (functions) in  $f$  is  $2^{2^4}$  as  $\{0, 1\}^4$  contains  $2^4$  elements. So, number of functions from  $S$  to  $\{0, 1\}$  will be  $2^{2^4}$ . So,  $\log_2 \log_2 N = 2^4 = 16$ .

76 votes

-- Arjun Suresh (328k points)

#### 4.3.19 Functions: GATE CSE 2014 Set 3 | Question: 2

<https://gateoverflow.in/2036>



- ✓ D is answer.

3 out of 4 options can be eliminated with the help of a counter example.

Let  $X = \{a, b, c\}$  and  $Y = \{1, 2\}$

A Function  $f$  maps each element of  $X$  to exactly one element in  $Y$ .

Let  $f(a) = 1, f(b) = 1, f(c) = 1$  and  $A = \{a\}, B = \{b, c\}$

A)

LHS:  $|f(A \cup B)| = |f(\{a, b, c\})| = |\{1\}| = 1$

RHS:  $|f(A)| + |f(B)| = 1 + 1 = 2$ ,

**LHS != RHS.**

B)

LHS:  $f(A \cap B) = f(\{\}) = \{\}$ .

RHS:  $f(A) \cap f(B) = \{1\} \cap \{1\} = \{1\}$

**LHS!=RHS.**

C)

LHS:  $|f(A \cap B)| = |f(\{\})| = |\{\}| = 0$

RHS:  $\min\{|f(A)|, |f(B)|\} = \min(1, 1) = 1$

**LHS!=RHS.**

D) Its easy to see that this is true because in a function a value can be mapped only to one value. The option assumes inverse of function  $f$  exists.

67 votes

-- Srinath Jayachandran (2.9k points)

#### 4.3.20 Functions: GATE CSE 2014 Set 3 | Question: 49 top ↴

→ <https://gateoverflow.in/2083>



- ✓ Let  $f(i) = j$ . Now, we have  $f(j) = i$ , as per the given condition  $f(f(i)) = i$ .

For any  $i \neq j$ , we can have a mapping  $f(i) = j, f(j) = i$  thus avoiding the condition  $f(i) = i$ . But the domain containing odd number of elements, at least for one element we must have  $f(i) = i$ . So, Q must be TRUE.

Since  $f(i) = j$  and  $f(j) = i$ , and since  $0 \leq i \leq 2014$   $i$  must take all 2015 possible values (since  $f$  is a function, it must have a value for any element in the domain). We can easily see that  $f(i)$  cannot be the same for two different  $i$ s- because suppose  $f(2) = 5$ , and  $f(3) = 5$ . Now as per given condition,  $f(5) = 2$  and  $f(5) = 3$ , which is not allowed in a function. So, all  $f(i)$  values are unique  $\implies$  co-domain = range as there are only 2015 values in co-domain. So, R is true.

An identity function satisfies the given conditions. But that alone cant prove that P is true. We can also have a different function where all even numbers maps to the next odd number and all odd numbers map to the previous even number which satisfies the given conditions, except the last one as we have odd number in set. i.e.,  
 $f(0) = 1, f(1) = 0, f(2) = 3, f(3) = 2 \dots, f(2013) = 2012, f(2014) = 2014$ .

This proves, P is false.

So, (B) is the answer.

87 votes

-- Arjun Suresh (328k points)



#### 4.3.21 Functions: GATE CSE 2015 Set 1 | Question: 5 top ↴

→ <https://gateoverflow.in/8025>

- ✓ option a) is correct.

$$\begin{aligned} g(h(x)) &= g\left(\frac{x}{x-1}\right) \\ &= 1 - \frac{x}{x-1} \\ &= \frac{-1}{x-1} \end{aligned}$$

$$\begin{aligned} h(g(x)) &= h(1-x) \\ &= \frac{1-x}{-x} \end{aligned}$$

$$\frac{g(h(x))}{h(g(x))} = \frac{x}{(1-x)(x-1)} = \frac{h(x)}{g(x)}$$

option A)

31 votes

-- GateMaster Prime (1.2k points)



#### 4.3.22 Functions: GATE CSE 2015 Set 2 | Question: 40 top ↴

→ <https://gateoverflow.in/8212>

- ✓ We have 3 elements in set  $B$  and 4 elements in set  $A$  and surjection means every element in  $B$  must be mapped to. So, this problem reduces to distributing 4 distinct elements ( $r = 4$ ) among 3 distinct bins ( $n = 3$ ) such that no bin is empty, which is given by  $n!S(r, n)$ , where  $S(r, n)$  is Stirling's number of 2nd kind. So, here we need  $S(4, 3)$ .

We have  $S(r + 1, n) = n * S(r, n) + S(r, n - 1)$

So, Stirling numbers of second kind can be generated as follows:

1

1 1  
1 3 1  
1 7 6 1

So,  $S(4, 3) = 6$  and  $3! = 6$  giving, number of surjective functions  $= 6 * 6 = 36$ .

Ref: See Theorem 9:

<http://www.cse.iitm.ac.in/~theory/tcslab/mfcs98page/mfcshtml/notes1/partset.html>

Alternative approach ,

Answer is 36.

For onto function from a set A(m-element) to a set B(n-element),  $m \geq n$ .

Number of onto function  $= n^m - {}^n C_1(n-1)^m + {}^n C_2(n-2)^m - {}^n C_3(n-3)^m + \dots + {}^n C_n(n-n)^m$   
(+, - alternative)

$$= \sum_{i=0}^n (-1)^i nC_i (n-i)^m$$

Here  $m = 4$  and  $n = 3$

So, number of onto functions

$$\begin{aligned} &= 3^4 - {}^3 C_1(3-1)^4 + {}^3 C_2(3-2)^4 - {}^3 C_3(3-3)^4 \\ &= 81 - 3 * 16 + 3 * 1 - 1 * 0 \\ &= 36. \end{aligned}$$

ref@ <http://www.cse.iitd.ac.in/~mittal/stirling.html>

## References



52 votes

-- Arjun Suresh (328k points)

**Alternatively this is equivalent to putting 4 different balls into 3 different boxes**

**Such that each box contain atleast one ball**

**So Possible arrangements as (2, 1, 1) and its Permutation .**

So Total no. of ways  $= \binom{4}{2} \times \binom{2}{1} \times \binom{1}{1} \times 3 = 36$

43 votes

-- Jagdish Singh (413 points)

### 4.3.23 Functions: GATE CSE 2015 Set 2 | Question: 54

<https://gateoverflow.in/8257>



- For a function, the first element in  $X$  has 20 choices (to map to) and the second element also has 20 choices. For a one-to-one function the second element has only 19 choices left after 1 being taken by the first. So, required probability

$$= \frac{(20 \times 19)}{(20 \times 20)} = 0.95$$

45 votes

-- Vikrant Singh (11.2k points)

### 4.3.24 Functions: GATE CSE 2016 Set 1 | Question: 28

<https://gateoverflow.in/39717>



- Let us assume:  $f(1) = x$ .

Then,  $f(2) = f(2/2) = f(1) = x$   
 $f(3) = f(3+5) = f(8) = f(8/2) = f(4/2) = f(2/1) = f(1) = x$ .

Similarly,  $f(4) = x$

$$f(5) = f(5 + 5) = f(10/2) = f(5) = y.$$

So, it will have two values. All multiples of 5 will have value  $y$  and others will have value  $x$ .

161 votes

-- Kumar Shikhar Deep (1.2k points)

#### 4.3.25 Functions: GATE CSE 2021 Set 2 | Question: 11 [top ↴](#)

<https://gateoverflow.in/357529>



✓  $S_1$  : There are  $n^2$  elements in the matrix, we have 3 choices for each element, so number of such matrices  $= 3^{n^2}$ .

$S_2$  : There are  $n^2$  total elements with 3 choices for each element, so number of functions possible  $= 3^{n^2}$ .

As the cardinality of both the sets are same, we can establish a bijection from one set to another. As bijection is possible, surjection is also possible.

So options B and C.

1 votes

-- zxy123 (2.5k points)

#### 4.3.26 Functions: GATE IT 2005 | Question: 31 [top ↴](#)

<https://gateoverflow.in/3777>



✓ Let  $h$  be onto (onto means co-domain = range). So,  $h$  maps to every element in  $C$  from  $A$ . Since  $h(a) = g(f(a))$ ,  $g$  should also map to all elements in  $C$ . So,  $g$  is also onto.

⇒ option (C).

27 votes

-- Arjun Suresh (320k points)

#### 4.3.27 Functions: GATE IT 2006 | Question: 6 [top ↴](#)

<https://gateoverflow.in/3545>



✓ Answer: D

Proceed by taking  $f(x_1) = x_1$

LHS:  $f(x_1) = 0$  when  $x_1 = 0$

LHS:  $f(x_1) = 1$  when  $x_1 = 1$

RHS:  $f(0) + f(1) = 0 + 1 = \text{always } 1$

26 votes

-- Rajarshi Sarkar (27.8k points)

### 4.4

#### Group Theory (29) [top ↴](#)

##### 4.4.1 Group Theory: GATE CSE 1988 | Question: 2xviii [top ↴](#)

<https://gateoverflow.in/94353>



Show that if  $G$  is a group such that  $(a, b)^2 = a^2 \cdot b^2$  for all  $a, b$  belonging to  $G$ , then  $G$  is an abelian.

gate1988 descriptive group-theory

Answer

##### 4.4.2 Group Theory: GATE CSE 1990 | Question: 2-x [top ↴](#)

<https://gateoverflow.in/84039>



Match the pairs in the following questions:

(a)	Groups	(p)	Associativity
(b)	Semigroups	(q)	Identity
(c)	Monoids	(r)	Commutativity
(d)	Abelian groups	(s)	Left inverse

gate1990 match-the-following set-theory&algebra group-theory

Answer

**4.4.3 Group Theory: GATE CSE 1992 | Question: 14a** top ↺<https://gateoverflow.in/593>

If  $G$  is a group of even order, then show that there exists an element  $a \neq e$ , the identity in  $G$ , such that  $a^2 = e$ .

[gate1992](#) [set-theory&algebra](#) [group-theory](#) [normal](#) [descriptive](#) [proof](#)

Answer

**4.4.4 Group Theory: GATE CSE 1993 | Question: 28** top ↺<https://gateoverflow.in/2324>

Let  $(\{p, q\}, *)$  be a semigroup where  $p * p = q$ . Show that:

- $p * q = q * p$  and
- $q * q = q$

[gate1993](#) [set-theory&algebra](#) [group-theory](#) [normal](#) [descriptive](#)

Answer

**4.4.5 Group Theory: GATE CSE 1994 | Question: 1.10** top ↺<https://gateoverflow.in/2451>

Some group  $(G, o)$  is known to be abelian. Then, which one of the following is true for  $G$ ?

- $g = g^{-1}$  for every  $g \in G$
- $g = g^2$  for every  $g \in G$
- $(goh)^2 = g^2oh^2$  for every  $g, h \in G$
- $G$  is of finite order

[gate1994](#) [set-theory&algebra](#) [group-theory](#) [normal](#)

Answer

**4.4.6 Group Theory: GATE CSE 1995 | Question: 2.17** top ↺<https://gateoverflow.in/2629>

Let  $A$  be the set of all non-singular matrices over real number and let  $*$  be the matrix multiplication operation. Then

- $A$  is closed under  $*$  but  $\langle A, * \rangle$  is not a semigroup.
- $\langle A, * \rangle$  is a semigroup but not a monoid.
- $\langle A, * \rangle$  is a monoid but not a group.
- $\langle A, * \rangle$  is a group but not an abelian group.

[gate1995](#) [set-theory&algebra](#) [group-theory](#)

Answer

**4.4.7 Group Theory: GATE CSE 1995 | Question: 21** top ↺<https://gateoverflow.in/2659>

Let  $G_1$  and  $G_2$  be subgroups of a group  $G$ .

- Show that  $G_1 \cap G_2$  is also a subgroup of  $G$ .
- Is  $G_1 \cup G_2$  always a subgroup of  $G$ ?

[gate1995](#) [set-theory&algebra](#) [group-theory](#) [normal](#) [descriptive](#) [proof](#)

Answer

**4.4.8 Group Theory: GATE CSE 1996 | Question: 1.4** top ↺<https://gateoverflow.in/2708>

Which of the following statements is FALSE?

- The set of rational numbers is an abelian group under addition
- The set of integers in an abelian group under addition
- The set of rational numbers form an abelian group under multiplication
- The set of real numbers excluding zero is an abelian group under multiplication

[gate1996](#) [set-theory&algebra](#) [group-theory](#) [normal](#)
[Answer](#)
**4.4.9 Group Theory: GATE CSE 1996 | Question: 2.4**
top ↗
<https://gateoverflow.in/2733>


Which one of the following is false?

- A. The set of all bijective functions on a finite set forms a group under function composition
- B. The set  $\{1, 2, \dots, p-1\}$  forms a group under multiplication mod  $p$ , where  $p$  is a prime number
- C. The set of all strings over a finite alphabet forms a group under concatenation
- D. A subset  $S \neq \emptyset$  of  $G$  is a subgroup of the group  $\langle G, * \rangle$  if and only if for any pair of elements  $a, b \in S, a * b^{-1} \in S$

[gate1996](#) [set-theory&algebra](#) [normal](#) [sets](#) [group-theory](#)
[Answer](#)
**4.4.10 Group Theory: GATE CSE 1997 | Question: 3.1**
top ↗
<https://gateoverflow.in/2232>


Let  $(Z, *)$  be an algebraic structure where  $Z$  is the set of integers and the operation  $*$  is defined by  $n * m = \max(n, m)$ . Which of the following statements is true for  $(Z, *)$ ?

- A.  $(Z, *)$  is a monoid
- B.  $(Z, *)$  is an Abelian group
- C.  $(Z, *)$  is a group
- D. None of the above

[gate1997](#) [set-theory&algebra](#) [group-theory](#) [normal](#)
[Answer](#)
**4.4.11 Group Theory: GATE CSE 1998 | Question: 12**
top ↗
<https://gateoverflow.in/1726>


Let  $(A, *)$  be a semigroup. Furthermore, for every  $a$  and  $b$  in  $A$ , if  $a \neq b$ , then  $a * b \neq b * a$ .

- a. Show that for every  $a$  in  $A$ ,  $a * a = a$
- b. Show that for every  $a, b$  in  $A$ ,  $a * b * a = a$
- c. Show that for every  $a, b, c$  in  $A$ ,  $a * b * c = a * c$

[gate1998](#) [set-theory&algebra](#) [group-theory](#) [descriptive](#)
[Answer](#)
**4.4.12 Group Theory: GATE CSE 1999 | Question: 4**
top ↗
<https://gateoverflow.in/1503>


Let  $G$  be a finite group and  $H$  be a subgroup of  $G$ . For  $a \in G$ , define  $aH = \{ah \mid h \in H\}$ .

- a. Show that  $|aH| = |bH|$ .
- b. Show that for every pair of elements  $a, b \in G$ , either  $aH = bH$  or  $aH$  and  $bH$  are disjoint.
- c. Use the above to argue that the order of  $H$  must divide the order of  $G$ .

[gate1999](#) [set-theory&algebra](#) [group-theory](#) [descriptive](#) [proof](#)
[Answer](#)
**4.4.13 Group Theory: GATE CSE 2000 | Question: 4**
top ↗
<https://gateoverflow.in/675>


Let  $S = \{0, 1, 2, 3, 4, 5, 6, 7\}$  and  $\otimes$  denote multiplication modulo 8, that is,  $x \otimes y = (xy) \bmod 8$

- a. Prove that  $(\{0, 1\}, \otimes)$  is not a group.
- b. Write three distinct groups  $(G, \otimes)$  where  $G \subset S$  and  $G$  has 2 elements.

[gate2000-cse](#) [set-theory&algebra](#) [descriptive](#) [group-theory](#)
[Answer](#)

**4.4.14 Group Theory: GATE CSE 2002 | Question: 1.6** top ↺<https://gateoverflow.in/810>

Which of the following is true?

- A. The set of all rational negative numbers forms a group under multiplication.
- B. The set of all non-singular matrices forms a group under multiplication.
- C. The set of all matrices forms a group under multiplication.
- D. Both B and C are true.

[gate2002-cse](#) [set-theory&algebra](#) [group-theory](#) [normal](#)

Answer 

**4.4.15 Group Theory: GATE CSE 2003 | Question: 7** top ↺<https://gateoverflow.in/898>

Consider the set  $\Sigma^*$  of all strings over the alphabet  $\Sigma = \{0, 1\}$ .  $\Sigma^*$  with the concatenation operator for strings

- A. does not form a group
- B. forms a non-commutative group
- C. does not have a right identity element
- D. forms a group if the empty string is removed from  $\Sigma^*$

[gate2003-cse](#) [set-theory&algebra](#) [group-theory](#) [normal](#)

Answer 

**4.4.16 Group Theory: GATE CSE 2004 | Question: 72** top ↺<https://gateoverflow.in/1066>

The following is the incomplete operation table of a 4-element group.

*	e	a	b	c
e	e	a	b	c
a	a	b	c	e
b				
c				

The last row of the table is

- A. c a e b
- B. c b a e
- C. c b e a
- D. c e a b

[gate2004-cse](#) [set-theory&algebra](#) [group-theory](#) [normal](#)

Answer 

**4.4.17 Group Theory: GATE CSE 2005 | Question: 13** top ↺<https://gateoverflow.in/1163>

The set  $\{1, 2, 4, 7, 8, 11, 13, 14\}$  is a group under multiplication modulo 15. The inverses of 4 and 7 are respectively:

- A. 3 and 13
- B. 2 and 11
- C. 4 and 13
- D. 8 and 14

[gate2005-cse](#) [set-theory&algebra](#) [normal](#) [group-theory](#)

Answer 

**4.4.18 Group Theory: GATE CSE 2005 | Question: 46** top ↺<https://gateoverflow.in/1171>

Consider the set  $H$  of all  $3 \times 3$  matrices of the type

$$\begin{pmatrix} a & f & e \\ 0 & b & d \\ 0 & 0 & c \end{pmatrix}$$

where  $a, b, c, d, e$  and  $f$  are real numbers and  $abc \neq 0$ . Under the matrix multiplication operation, the set  $H$  is:

- A. a group
- B. a monoid but not a group
- C. a semi group but not a monoid
- D. neither a group nor a semi group

[gate2005-cse](#) [set-theory&algebra](#) [group-theory](#) [normal](#)

Answer 

#### 4.4.19 Group Theory: GATE CSE 2006 | Question: 3 [top](#)

<https://gateoverflow.in/882>



The set  $\{1, 2, 3, 5, 7, 8, 9\}$  under multiplication modulo 10 is not a group. Given below are four possible reasons. Which one of them is false?

- A. It is not closed
- B. 2 does not have an inverse
- C. 3 does not have an inverse
- D. 8 does not have an inverse

[gate2006-cse](#) [set-theory&algebra](#) [group-theory](#) [normal](#)

Answer 

#### 4.4.20 Group Theory: GATE CSE 2007 | Question: 21 [top](#)

<https://gateoverflow.in/1219>



How many different non-isomorphic Abelian groups of order 4 are there?

- A. 2
- B. 3
- C. 4
- D. 5

[gate2007-cse](#) [group-theory](#) [normal](#)

Answer 

#### 4.4.21 Group Theory: GATE CSE 2009 | Question: 1 [top](#)

<https://gateoverflow.in/795>



Which one of the following is NOT necessarily a property of a Group?

- A. Commutativity
- B. Associativity
- C. Existence of inverse for every element
- D. Existence of identity

[gate2009-cse](#) [set-theory&algebra](#) [easy](#) [group-theory](#)

Answer 

#### 4.4.22 Group Theory: GATE CSE 2009 | Question: 22 [top](#)

<https://gateoverflow.in/799>



For the composition table of a cyclic group shown below:

*	a	b	c	d
a	a	b	c	d
b	b	a	d	c
c	c	d	b	a
d	d	c	a	b

Which one of the following choices is correct?

- A.  $a, b$  are generators
- B.  $b, c$  are generators
- C.  $c, d$  are generators
- D.  $d, a$  are generators

[gate2009-cse](#) [set-theory&algebra](#) [normal](#) [group-theory](#)

Answer 

#### 4.4.23 Group Theory: GATE CSE 2010 | Question: 4 [top](#)

<https://gateoverflow.in/1150>



Consider the set  $S = \{1, \omega, \omega^2\}$ , where  $\omega$  and  $\omega^2$  are cube roots of unity. If  $*$  denotes the multiplication operation, the structure  $(S, *)$  forms

- A. A Group
- B. A Ring
- C. An integral domain
- D. A field

[gate2010-cse](#) [set-theory&algebra](#) [normal](#) [group-theory](#)

Answer 

#### 4.4.24 Group Theory: GATE CSE 2014 Set 3 | Question: 3 [top](#)

<https://gateoverflow.in/2037>



Let  $G$  be a group with 15 elements. Let  $L$  be a subgroup of  $G$ . It is known that  $L \neq G$  and that the size of  $L$  is at least 4. The size of  $L$  is \_\_\_\_\_.

[gate2014-cse-set3](#) [set-theory&algebra](#) [group-theory](#) [numerical-answers](#) [normal](#)

Answer 

#### 4.4.25 Group Theory: GATE CSE 2014 Set 3 | Question: 50 [top](#)

<https://gateoverflow.in/2084>



There are two elements  $x, y$  in a group  $(G, *)$  such that every element in the group can be written as a product of some number of  $x$ 's and  $y$ 's in some order. It is known that

$$x * x = y * y = x * y * x * y = y * x * y * x = e$$

where  $e$  is the identity element. The maximum number of elements in such a group is \_\_\_\_\_.

[gate2014-cse-set3](#) [set-theory&algebra](#) [group-theory](#) [numerical-answers](#) [normal](#)

Answer 

#### 4.4.26 Group Theory: GATE CSE 2018 | Question: 19 [top](#)

<https://gateoverflow.in/204093>



Let  $G$  be a finite group on 84 elements. The size of a largest possible proper subgroup of  $G$  is \_\_\_\_\_.

[gate2018-cse](#) [group-theory](#) [numerical-answers](#) [set-theory&algebra](#)

Answer 

#### 4.4.27 Group Theory: GATE CSE 2019 | Question: 10 [top](#)

<https://gateoverflow.in/302838>



Let  $G$  be an arbitrary group. Consider the following relations on  $G$ :

- $R_1 : \forall a, b \in G, aR_1 b$  if and only if  $\exists g \in G$  such that  $a = g^{-1}bg$
- $R_2 : \forall a, b \in G, aR_2 b$  if and only if  $a = b^{-1}$

Which of the above is/are equivalence relation/relations?

- A.  $R_1$  and  $R_2$
- B.  $R_1$  only
- C.  $R_2$  only

- D. Neither  $R_1$  nor  $R_2$

gate2019-cse engineering-mathematics discrete-mathematics set-theory&algebra group-theory

Answer 

#### 4.4.28 Group Theory: GATE CSE 2020 | Question: 18

 <https://gateoverflow.in/333213>



Let  $G$  be a group of 35 elements. Then the largest possible size of a subgroup of  $G$  other than  $G$  itself is \_\_\_\_\_.

gate2020-cse numerical-answers group-theory easy

Answer 

#### 4.4.29 Group Theory: GATE CSE 2021 Set 1 | Question: 34

 <https://gateoverflow.in/357417>



Let  $G$  be a group of order 6, and  $H$  be a subgroup of  $G$  such that  $1 < |H| < 6$ . Which one of the following options is correct?

- A. Both  $G$  and  $H$  are always cyclic
- B.  $G$  may not be cyclic, but  $H$  is always cyclic
- C.  $G$  is always cyclic, but  $H$  may not be cyclic
- D. Both  $G$  and  $H$  may not be cyclic

gate2021-cse-set1 set-theory&algebra group-theory

Answer 

### Answers: Group Theory

#### 4.4.1 Group Theory: GATE CSE 1988 | Question: 2xviii

 <https://gateoverflow.in/94353>



- ✓ If  $(a * b)^2 = a^2 * b^2 \forall a, b \in G$  (\* is an operator)

$$\text{LHS} \Rightarrow (a * b) * (a * b)$$

$$= a * b * a * b$$

$$\text{RHS} \Rightarrow a * a * b * b$$

Comparing LHS and RHS

$$\implies a * b * a * b = a * a * b * b$$

Applying Cancellation law

$$b * a = a * b \text{ (Commutative law)}$$

So, it is Abelian group. (It is a group and it follows Commutative property)

 10 votes

-- Kushagra Gusain (313 points)



#### 4.4.2 Group Theory: GATE CSE 1990 | Question: 2-x

 <https://gateoverflow.in/84039>



- group  $\rightarrow$  left inverse
- semigroup  $\rightarrow$  associative
- monoid  $\rightarrow$  identity
- abelian group  $\rightarrow$  commutative

 21 votes

-- kunal chalotra (13.6k points)

#### 4.4.3 Group Theory: GATE CSE 1992 | Question: 14a

 <https://gateoverflow.in/593>



- ✓ I will prove it using contradiction. Assuming no element has order 2. i.e.,  $a^2 \neq e$  for any non-identity element  $a$ , means

$a \neq a^{-1}$  for any (non-identity element)  $a$ .

Rewriting the statement: the inverse of any element is not that element itself, it is something else.

But I want to somehow show that at least one element has inverse as its own. I am trying a method lets see if it works :).

I will select each element from the set and will check inverse of each element, and in this process, as soon as I encounter any element having  $a^2 \neq e$  then I am done.

**My Goal:** to show  $G$  has at least 1 element as its own inverse.

Let  $|G| = 2n$ . Then we take out the identity and have  $2n - 1$  elements to choose from.

**Step 1:** Select an element, if it is its own inverse then I am done.

**Step 2 (otherwise):** If inverse of  $a$  is not  $a$  and is  $b$ , throw  $a$  and  $b$  out. ( $\because$  if  $a$  inverse is  $b$  then  $b$  inverse is  $a$ , and inverse of an element is unique)

(Notice we always throw one pair)

In worst case I will end up throwing all but one element, because total number of elements is odd ( $2n - 1$ ) and we always throw a pair of two (even).

Now question is, what is the inverse of that element?

**It has to be its own inverse**, it can not map to inverse of any other element because inverse is unique. And moreover it can not be inverse of identity element because inverse of identity is identity itself.

Finally, I can say there exist one non-identity element  $a$  of order 2.

Yes, it worked !

Hence Proved !

56 votes

-- Sachin Mittal (15.8k points)



#### 4.4.4 Group Theory: GATE CSE 1993 | Question: 28 [top](#)

<https://gateoverflow.in/2324>

✓ a.

$$\begin{aligned} p * p &= q \\ p * p * p &= p * q \quad //\text{left operation with } p \\ (p * p) * p &= p * q \quad //\text{associative property} \\ q * p &= p * q \quad //p * p = q \end{aligned}$$

b.

For a semi-group, two properties are known: associativity and closure. (Identity is not required).

Closure means that  $p * q$  must be a part of the semi-group.

This means, either  $p = p * q$  or  $q = p * q$  as the semi-group is  $(\{p, q\}, *)$

**CASE 1:**  $p = p * q$ .

This means,  $p = p * p * p$  as  $p * p = q \rightarrow (1)$

Then,  $q * q = \text{LHS} = p * p * p * p = p * p = q = \text{RHS}$ . ( From (1)).

**CASE 2:**  $q = p * q$ .

This means,  $q = p * q = p * p * p \rightarrow (2)$

Then,  $q * q = \text{LHS} = p * p * p * p = p * q = q = \text{RHS}$  (based on Case 2's assumption).

30 votes

-- meghashyamc (253 points)



#### 4.4.5 Group Theory: GATE CSE 1994 | Question: 1.10 [top](#)

<https://gateoverflow.in/2451>

✓ Associativity property of Group.

- For all  $a, b$  and  $c$  in  $G$ , the equation  $(aob)oc = ao(boc)$  holds.

For an Abelian group, commutative property also holds.

- For all  $a, b$  in  $G$ , the equation  $aob = boa$

From option C, using these two properties,

$$(goh)^2 = (goh)o(go)h = (hog)o(go)h = ((hog)og)o(h) = (ho(gog))oh = (hog^2)oh = (g^2oh)oh = g^2o(hoh) = g^2oh^2$$

So, C is correct.

Integer addition  $(\mathbb{Z}, +)$  is an Abelian group.

Inverse of 1 is  $-1$  and not 1. So, A is false.

$1^2 = 1 + 1 = 2 \neq 1$ . So B also false.

The order of a group is the number of elements in it. An integer is an infinite set, so D is also false.

References:

- <http://math.stackexchange.com/questions/40996/prove-that-if-abi-aibi-forall-a-b-in-g-for-three-consecutive-integers/41004#41004>
- <http://math.stackexchange.com/questions/423745/a-group-g-is-abelian-iff-abn-an-bn-for-all-a-b-in-g-and-n-in-bb?lq=1>

## References



54 votes

-- Arjun Suresh (328k points)

### 4.4.6 Group Theory: GATE CSE 1995 | Question: 2.17 top ↴

→ <https://gateoverflow.in/2629>



- ✓ Answer: D

As the matrices are non singular so their determinant  $\neq 0$ . Hence, the inverse matrix always exist.

But for a group to be abelian it should follow commutative property. As, matrix multiplication is not commutative,  $\langle A, * \rangle$  is a group but not an abelian group.

Two nonsingular matrix can not give a singular matrix after product. Therefore it satisfies closure property also.

**Proof:** Let  $A$  and  $B$  are nonsingular and  $C$  is singular.

**Claim:** For any  $A$ ,  $B$  and  $C$ :  $AB = C$  is NOT possible.

I will proof using contradiction. Let it be possible to have  $AB = C$ .

$$\begin{aligned} AB &= C \\ \implies \det(AB) &= \det(C) \\ \det(AB) &= 0 \quad [\because \det(C) = 0 \text{ as } C \text{ is singular}] \\ \implies |A| \cdot |B| &= 0 \\ \implies |A| &= 0 \text{ or } |B| = 0 \end{aligned}$$

Which is contradiction as  $A$  and  $B$  both are non singular.

34 votes

-- Rajarshi Sarkar (27.8k points)

### 4.4.7 Group Theory: GATE CSE 1995 | Question: 21 top ↴

→ <https://gateoverflow.in/2659>



- ✓ Let  $G$  with the set  $\{1, 3, 5, 7\}$  be a group with respect to  $\otimes_8$  operation because all elements are less than 8 and co-prime to 8.

Let  $G_1 = \{1, 3\}$ ,  $G_2 = \{1, 5\}$

$G_1$  and  $G_2$  are sub-groups of  $G$  having identity element 1. We can make a composition table and cross verify.

- $G_1 \cap G_2 = \{1\}$  is a subgroup containing only identity element (Trivial Subgroup).
- $G_1 \cup G_2 = \{1, 3, 5\}$  which is not a subgroup.

Reason when we draw composition table  $3 * 5 = 15 \pmod{8} = 7$  which is not present in this subgroup so not satisfying closure property. Hence, not a subgroup.

30 votes

-- Rajesh Pradhan (18.9k points)

### 4.4.8 Group Theory: GATE CSE 1996 | Question: 1.4 top ↴

→ <https://gateoverflow.in/2708>



- ✓ Answer: C

Rational numbers will include 0. As the group should be under multiplication we will not have any inverse element for 0.

Thus, not even satisfying the group property.

24 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.4.9 Group Theory: GATE CSE 1996 | Question: 2.4

<https://gateoverflow.in/2733>



- ✓ (a) Let set = {1, 2, 3, 4}

We can have identity function as {(1, 1), (2, 2), (3, 3), (4, 4)}

Since function is bijective and mapping to same set, we can have an inverse for any function by inverting the relation (changing the mapping  $a \rightarrow b$  to  $b \rightarrow a$ )

Since the function maps to the same set, it must be closed and associative also. So, all four properties of group satisfied. So, (a) is true.

- (b) Let  $p = 5$ . So, set = {1, 2, 3, 4}

Identity element is 1.

*	1	2	3	4
1	1	2	3	4
2	2	4	1	3
3	3	1	4	2
4	4	3	2	1

This forms a group. Similarly for any p, we get a group. So, (b) is also true.

(c) is false as string concatenation operation is a monoid (doesn't have inverse to become a group).

<http://en.wikipedia.org/wiki/Concatenation>

(d) is True.

[http://www.math.niu.edu/~beachy/abstract\\_algebra/study\\_guide/32.html](http://www.math.niu.edu/~beachy/abstract_algebra/study_guide/32.html)

#### References



32 votes

-- Arjun Suresh (328k points)



#### 4.4.10 Group Theory: GATE CSE 1997 | Question: 3.1

<https://gateoverflow.in/2232>

- ✓ Lets follow our checklist one by one to see what property this algebraic structure follows.

Closure -yes ( $m * n = \max(m, n)$ ) Output is either  $m$  or  $n$  whichever is maximum and since  $m, n$  belongs to  $Z$ , the result of the binary operation also belongs to  $Z$ . So closure property is satisfied.

Associative-Yes the output is max among the elements and it is associative

Now for identity, we don't have a single unique element for all the elements which is less than all the elements. ie,  $m * e = m \implies \max(m, e) = m$ . We can't find a single unique  $e$  which is less than all possible integer  $m$ , such that comparison between the two would always give  $m$  itself.

If the set was for Natural numbers we could have had 1 as identity element as it is less than any other natural number and we would have got a monoid.

- Semi-group - Closed and associative
- Monoid - Closed, associative and has an identity
- Group - Monoid with inverse
- Abelian group- Group with commutative property.

Hence, this is just a semigroup- D option.

Ans D)

26 votes

-- Sourav Roy (2.9k points)

**4.4.11 Group Theory: GATE CSE 1998 | Question: 12** top ↺<https://gateoverflow.in/1726>

✓ a. Let  $a * a = b$ .  $(a * a) * a = b * a$ . Since  $(A, *)$  is a semigroup,  $*$  is closed and associative. So,  $(a * a) * a = a * (a * a) \implies a * b = b * a$ , which is possible only if  $a = b$ . Thus we proved  $a * a = a$ .

b. Let  $(a * b) * a = c \implies (a * b) * a * a = c * a \implies a * b * a = c * a \implies c * a = a$ .

Similarly,  $a * (a * b * a) = a * c \implies a * a * (b * a) = a * c \implies a * (b * a) = a * c \implies a * c = a = c * a$ .

So,  $c = a$ .

c. Let

$$(a * b) * c = d \implies (a * b) * c * c = d * c \implies a * b * c = d * c \implies d * c = d.$$

Similarly,

$$a * (a * b * c) = a * d \implies a * a * (b * c) = a * d \implies a * (b * c) = a * d \implies a * d = d.$$

Thus

$$d * c = a * d = d$$

Now

$$c * d * c = c * a * d = c * d \implies c = c * a * d = c * d$$

and

$$d * c * a = a * d * a = d * a \implies d * c * a = a = d * a$$

So,

$$a * c = (d * a) * (c * d) = d * (a * c) * d = d.$$

Thus,

$$a * b * c = a * c.$$

24 votes

-- Arjun Suresh (328k points)

**4.4.12 Group Theory: GATE CSE 1999 | Question: 4** top ↺<https://gateoverflow.in/1503>

✓ Given :

$\langle G, \star \rangle$  is a finite group and  $H$  is a finite subgroup of  $G$ . For  $a \in G$ , define  $aH = \{ah \mid h \in H\}$

i.e.  $aH$  is a left coset.

a.

The order of a coset is defined as its cardinality.

any 2 sets have the same cardinality if and only if there is a bijection between them.

So to show any two left cosets have the same cardinality, it suffices to demonstrate a bijection between them.

Let  $aH$  and  $bH$  are 2 left cosets of  $H$  in  $G$  such that

$$aH = \{ah \mid h \in H\} \text{ and } bH = \{bh \mid h \in H\} \text{ where } a, b \in G$$

Let  $f$  be a mapping defined from  $aH$  to  $bH$  such that

$$f(ah) = bh \quad \forall h \in H$$

Let  $ah_1 = ah_2$  where  $h_1, h_2 \in H$

- $\implies a^{-1}ah_1 = a^{-1}ah_2$
- $\implies h_1 = h_2$
- $\implies bh_1 = bh_2$
- $\implies f(ah_1) = f(ah_2)$

$\therefore f$  is well defined.

Let  $f(ah_1) = f(ah_2)$  where  $h_1, h_2 \in H$

- $\implies bh_1 = bh_2$
- $\implies b^{-1}bh_1 = b^{-1}bh_2$
- $\implies h_1 = h_2$
- $\implies ah_1 = ah_2$

$\therefore f$  is one-one mapping.

Let  $y \in bH$  then  $y = bh$  where  $h \in H$

$\exists ah \in aH$  such that

$$f(ah) = hb = y$$

- $\implies y$  has a pre-image in  $aH$
- $\implies$  Every element of  $bH$  has a pre-image in  $aH$

$\therefore f$  is an onto mapping.

$\because f$  is a well-defined one-one and onto mapping

$\implies f$  is a bijective function

$\implies$  the Cosets  $aH$  and  $bH$  have the same cardinality.

$$\therefore |aH| = |bH|$$


---

### b.

For  $aH$  and  $bH$

**Case 1.**  $aH$  and  $bH$  are disjoint i.e. they have no elements in common. i.e.  $(aH \cap bH) = \phi$

**Case 2.**  $aH = bH$  i.e. all the elements of  $aH$  and  $bH$  are common (they are identical) i.e.  $(aH \cap bH) = (aH \cup bH)$

**Case 3.**  $aH$  and  $bH$  have only some common elements and other elements are not common.

i.e We can have (either **Case 1.** or **Case 2.**) and **Case 3.** should also be satisfied. If Case 1 and Case 2 are TRUE it means Case 3 is false and vice versa. We will now prove that Case 1 and 2 are indeed TRUE.

Let  $aH$  and  $bH$  be two left cosets of  $H$  in  $G$  where  $a, b \in G$

If we get  $aH \cap bH = \phi$

then **Case 1.** is satisfied. ( $\because$  we assumed it )

Now let us check for **Case 2.**

Let  $aH \cap bH \neq \phi$  where  $a, b \in G$

$\implies$  At least one element of  $aH$  must be equal to an element of  $bH$

Let  $\alpha$  be one such common element

$\implies \alpha \in aH \cap bH$  such that  $\alpha = ah_1 = bh_2$  for some  $h_1, h_2 \in H$ .

$\implies ah_1 = bh_2$

$\implies ah_1h_1^{-1} = bh_2h_1^{-1}$

$\implies a = bh_2h_1^{-1}$

$\implies a = bh_2h_1^{-1} \in bH$  ( $\because h_1, h_2 \in H \implies h_1^{-1}, h_2 \in H \implies h_1^{-1}h_2 \in H$  by closure property)

$$\therefore a \in bH$$

So  $a = bh_3$  (where  $h_3 = h_2h_1^{-1} \in H$ )

$\implies aH = bh_3H$

$\implies aH = bH$  ( $\because kH = H$  if  $k \in H$ )

So, for every pair of elements  $a, b \in G$ ,  $aH$  and  $bH$  are either disjoint else if they are not disjoint then they will have all the element same.

---

### c.

From a. and b. we can see that

The cosets partition the entire group  $G$  into mutually disjoint subsets i.e.

$G = a_1H \cup a_2H \cup \dots \cup a_kH$  ( $\because$  2 left cosets are either identical or disjoint)

$\implies o(G) = o(a_1H) + o(a_2H) + \dots + o(a_kH)$

$\implies o(G) = o(H) + o(H) + \dots + k \times$  ( $\because o(aH) = o(bH) = o(H)$ )

$\implies o(G) = k * o(H)$

$\therefore$  the order of

$H$  must divide the order of

$G$ .

This is also known as Lagrange's Theorem.

---

**NOTE :-**

$$kH = H \text{ if } k \in H$$

Proof : -

Suppose  $k \in H$  and  $x \in kH$

$\therefore x = kh$  where  $h \in H$

$$\implies xh^{-1} = k$$

$\because k \in H \implies xh^{-1} \in H \implies x \in H$  (closure property)  $\implies kH \subseteq H \rightarrow I$

Let  $x \in H$  then

$x = ex = kk^{-1}x = k(k^{-1}x) \in kH$  ( $\because k, x \in H \implies k^{-1}, x \in H \implies k^{-1}x \in H$  by closure property)

$$\implies H \subseteq kH \rightarrow II$$

Combining I and II we get  $H = kH$



-- Satbir Singh (20.9k points)

**4.4.13 Group Theory: GATE CSE 2000 | Question: 4**

<https://gateoverflow.in/675>



✓	$\otimes$	0	1
		0	0
		1	0

a. 1 is the identity element. Inverse does not exist for zero. So, it is not a group.

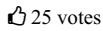
b.	$\otimes$	1	3
		1	5
		3	1

	$\otimes$	1	5
		1	5
		5	1

	$\otimes$	1	7
		1	7
		7	1



-- Anu (4.7k points)

**4.4.14 Group Theory: GATE CSE 2002 | Question: 1.6**

<https://gateoverflow.in/810>



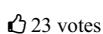
✓ Answer: B

A. False. Multiplication of two negative rational numbers give positive number. So, closure property is not satisfied.

B. True. Matrices have to be non-singular (determinant  $\neq 0$ ) for the inverse to exist.

C. False. Singular matrices do not form a group under multiplication.

D. False as C is false.



-- Rajarshi Sarkar (27.8k points)

**4.4.15 Group Theory: GATE CSE 2003 | Question: 7**

<https://gateoverflow.in/888>



✓ Identity element for concatenation is empty string  $\epsilon$ . Now, we cannot concatenate any string with a given string to get empty string  $\implies$  there is no inverse for string concatenation. Only other 3 group properties -- closure, associative and existence of identity -- are satisfied.

Hence, ans should be (a).



-- Madhur Rawat (2k points)

**4.4.16 Group Theory: GATE CSE 2004 | Question: 72**

<https://gateoverflow.in/1066>



1. Group of order Prime Square ( $p^2$ ) is always abelian. [See here](#)
2. If the group is abelian, then  $x * y = y * x$  for every  $x, y$  in it (Commutative). Therefore, the  $(i, j)$  entry is equal to the  $(j, i)$  entry in the Cayley table making the table is symmetric. (Informally, 1<sup>st</sup> row is same as 1<sup>st</sup> column, 2<sup>nd</sup> row is same as 2<sup>nd</sup> column and so on)

Here, order  $4 = p^2 = 2^2$  ( $p = 2$ ). Hence, it is abelian group.

Now abelian group's Cayley table is symmetric. So, 1<sup>st</sup> row will be same as 1<sup>st</sup> col and 2<sup>nd</sup> row will be same as 2<sup>nd</sup> column.

Matches with **option D** only.

### References



32 votes

-- Rajesh Pradhan (18.9k points)

### 4.4.17 Group Theory: GATE CSE 2005 | Question: 13 top ↗

<https://gateoverflow.in/1163>



✓ Option C.

Identity element here is 1.

$$4 * 4 \bmod 15 = 1$$

$$7 * 13 \bmod 15 = 1.$$

24 votes

-- anshu (2.7k points)

### 4.4.18 Group Theory: GATE CSE 2005 | Question: 46 top ↗

<https://gateoverflow.in/1171>



✓ Given Information: Matrix is upper triangular. Its determinant is multiplication of principle diagonal elements. i.e.,  $abc$ .

It is given that  $abc \neq 0$ . So, Inverse for every such matrix exists.

Now this set is

1. Closed - You can see after multiplication matrix is in same format and  $|AB| = |A||B| \neq 0$  as  $|A|, |B| \neq 0$
2. Associative - Matrix multiplication is associative
3. Existence of Identity - Identity Matrix is present
4. Existence of Inverse - as determinant is non zero there exist inverse for every matrix

So, it is group.

Correct Answer: A

35 votes

-- Akash Kanase (36k points)

### 4.4.19 Group Theory: GATE CSE 2006 | Question: 3 top ↗

<https://gateoverflow.in/882>



✓ Answer: C

3 has an inverse, which is 7.

$$3 * 7 \bmod 10 = 1.$$

26 votes

-- Rajarshi Sarkar (27.8k points)

### 4.4.20 Group Theory: GATE CSE 2007 | Question: 21 top ↗

<https://gateoverflow.in/1219>



✓ The number of Abelian groups of order  $P^k$  ( $P$  is prime) is the number of partitions of  $k$ . Here, order is 4 i.e.  $2^2$ .

Partition of 2 are  $\{1, 1\}, \{2, 0\}$ .

Total 2 partition so no. of different abelian groups are 2.

[http://oeis.org/wiki/Number\\_of\\_groups\\_of\\_order\\_n](http://oeis.org/wiki/Number_of_groups_of_order_n)

1. First, find the prime factorization of  $n$ . For example, 4 has prime factorization as  $2 * 2$ . Also, 600 can be factorized as  $2^3 * 3^1 * 5^2$
2. Now, find the number of partitions of all powers, and then multiply them. Number of Partitions of a number  $k$  is the number of ways  $k$  can be partitioned. For example, number of partitions of 3 is 3, because 3 can be partitioned in 3 different ways:  $\{1 + 1 + 1\}, \{1 + 2\}, \{3\}$ . Similarly, 4 can be partitioned in 5 different ways:  $\{1 + 1 + 1 + 1\}, \{2 + 1 + 1\}, \{2 + 2\}, \{3 + 1\}, \{4\}$ . Note that order of elements in a partition does not matter, for example, partitions  $\{2 + 1 + 1\}$  and  $\{1 + 1 + 2\}$  are the same.
- So for this question, we will find number of partitions of 2, which is 2 :  $\{1 + 1\}, \{2\}$ . There is no other power, so answer is 2 only.
3. Suppose, in question, order given is 600.. Then, different powers are 3, 1, 2. Number of partitions for 3, 1, 2 are 3, 1, 2 respectively and result would have been  $3 * 1 * 2 = 6$ .

4. Group theorists view two isomorphic groups as follows: For every element  $g$  of a group  $G$ , there exists an element  $h$  of group such that  $h$  'behaves in the same way' as  $g$  (operates with other elements of the group in the same way as  $g$ ). For instance, if  $g$  generates  $G$ , then so does  $h$ . This implies in particular that  $G$  and  $H$  are in bijective correspondence. Thus, the definition of an isomorphism is quite natural.

Correct Answer: A

#### References



80 votes

-- Digvijay (44.9k points)

#### 4.4.21 Group Theory: GATE CSE 2009 | Question: 1 [top](#)

<https://gateoverflow.in/795>



- **Groupoid:** closure property.
- **Semigroup:** closure, associative.
- **Monoid-closure:** associative, identity.
- **Group:** closure, associative, identity, inverse.
- **Abelian group:** group properties + commutativity

So, ans should be A.

26 votes

-- sonu (1.9k points)

#### 4.4.22 Group Theory: GATE CSE 2009 | Question: 22 [top](#)

<https://gateoverflow.in/799>



- ✓ An element is a generator for a cyclic group if on repeated applications of it upon itself, it can generate all elements of group.

For example here:  $a * a = a$ , then  $(a * a) * a = a * a = a$ , and so on. Here, we see that no matter how many times we apply  $a$  on itself, we cannot generate any other element except  $a$ . So,  $a$  is not a generator.

Now for  $b$ ,  $b * b = a$ . Then,  $(b * b) * b = a * b = b$ ,  $(b * b * b) * b = b * b = a$ , and so on. Here again, we see that we can only generate  $a$  and  $b$  on repeated application of  $b$  on itself. So,  $b$  is not a generator.

Now for  $c$ ,  $c * c = b$ . Then,  $(c * c) * c = b * c = d$ ,  $(c * c * c) * c = d * c = a$ ,  $(c * c * c * c) * c = a * c = c$ . So, we see that we have generated all elements of group. So,  $c$  is a generator.

For  $d$ ,  $d * d = b$ . Then  $(d * d) * d = b * d = c$ ,  $(d * d * d) * d = c * d = a$ ,  $(d * d * d * d) * d = a * d = d$ . So, we have generated all elements of group from  $d$ . So,  $d$  is a generator.

$c$  and  $d$  are generators.

Option (C) is correct.

[http://www.cse.iitd.ac.in/~mittal/gate/gate\\_math\\_2009.html](http://www.cse.iitd.ac.in/~mittal/gate/gate_math_2009.html)

#### References



37 votes

-- Anu (4.7k points)

#### 4.4.23 Group Theory: GATE CSE 2010 | Question: 4 [top](#)

<https://gateoverflow.in/1150>



- ✓ Answer: A

Cayley Table

	1	$\omega$	$\omega^2$
1	1	$\omega$	$\omega^2$
$\omega$	$\omega$	$\omega^2$	1
$\omega^2$	$\omega^2$	1	$\omega$

The structure  $(S, *)$  satisfies closure property, associativity and commutativity. The structure also has an identity element ( $= 1$ ) and an inverse for each element. So, the structure is an Abelian group.

32 votes

-- Rajarshi Sarkar (27.8k points)

**4.4.24 Group Theory: GATE CSE 2014 Set 3 | Question: 3** <https://gateoverflow.in/2037>

✓ **Lagrange's theorem:** For any finite group  $G$ , the order (number of elements) of every subgroup  $L$  of  $G$  divides the order of  $G$ .

$G$  has 15 elements.

Factors of 15 are 1, 3, 5, and 15.

Since, the given size of  $L$  is at least 4 (1 and 3 eliminated) and not equal to  $G$  (15 eliminated), the only size left is 5.

Size of  $L$  is 5.

75 votes

-- Srinath Jayachandran (2.9k points)

**4.4.25 Group Theory: GATE CSE 2014 Set 3 | Question: 50** <https://gateoverflow.in/2084>

✓ It is given that:

- $x$  is its own inverse.
- $y$  is its own inverse.
- $x * y$  is its own inverse.
- $y * x$  is its own inverse.

Now I will show you that  $x * y$  and  $y * x$  are essentially same.

$$x * y = x * e * y = x * (x * y * x * y) * y = (x * x) * y * x * (y * y) = e * y * x * e = y * x$$

(Group is associative so I do not care about brackets)

This turns out to be abelian group. and  $x * y$  is no different from  $y * x$

Up to this point I have 4 elements -  $x, y, e, x * y$ . ( $G$  is abelian therefore  $x * y$  is same as  $y * x$ )

Now see if you can have a new element. It is given that every element is product of some numbers of  $x$  and  $y$ .

Lets try with  $x$ .

$x * \circ$ , what u would like to put next to  $x$ ?

If you put  $x$  then there is no use and you have to start over again because of  $x * x = e$  now you have to start all over again.

Put  $y$  next to  $x$ :  $x * y$  (this element we already have, we want different element so try multiplying further.)

$x * y * \circ$ , obviously you cannot put  $y$ , next to  $x * y$  because it will be  $x$  again:  $x * y * y = x * e = x$   
(you have to put alternate.)

Put  $x$ , next to  $x * y$ :  $x * y * x$ .

This is equal to  $x * x * y$  because of commutative property.  $x * y * x = x * x * y = y$ .

I showed you that, once you get  $x * y$  using  $x$ , you can not get next element by multiplying into  $x * y$  further. Because of commutative property it will be again  $x$  or  $y$ .

Similarly, if we start with  $y$ , we have the same issue.

This concludes that we can not generate further element and only four element can be there at max.

$\{x, y, x * y, e\}$ .

There is a theorem for abelian group: If every element is its own inverse then Group  $G$  is abelian. I am not sure if proof of that theorem relates to this problem somewhere, You can check it out. :)

118 votes

-- Sachin Mittal (15.8k points)

**4.4.26 Group Theory: GATE CSE 2018 | Question: 19** <https://gateoverflow.in/204093>

✓ Order of a Subgroup always divides the order of Group.

Proper Subgroup of Group having order 84 would have order 1, 2, 4, 21, 42.

So largest order would be 42.

33 votes

-- Digvijay (44.9k points)

**4.4.27 Group Theory: GATE CSE 2019 | Question: 10** <https://gateoverflow.in/302838>

$R_1 : \forall a, b \in G, aR_1 b \text{ iff } \exists g \in G \text{ such that } a = g^{-1}bg$

let g and h are inverse for each other.

Reflexive:

$$aR_1a$$

$$a = g^{-1}ag$$

$ga = gg^{-1}ag$  //Left multiplication by  $g$

$gag^{-1} = agg^{-1}$  //Right multiplication by  $g^{-1}$

$$gag^{-1} = a$$

$$a = gag^{-1}$$

$$a = h^{-1}ah \quad (\exists h \in G)$$

we have  $aR_1a$ . So the relation is reflexive.

Alternative :- in the group, there should exist identity element, So we can take it as some  $g$ .

Symmetric:

let  $(a,b)$  exist, then

$$a = g^{-1}bg$$

$$gag^{-1} = b$$

$$h^{-1}ah = b \quad (\exists h \in G)$$

$\therefore (b,a)$  should be in the relation.

Hence the relation is symmetric.

Transitive:

If  $(a,b)$  and  $(b,c)$  present, then

$$a = x^{-1}bx \text{ and } b = y^{-1}cy$$

$$a = \underline{x^{-1}} \underline{y^{-1}} c \underline{y} \underline{x}$$

What is the inverse of  $x^{-1}y^{-1}$  ?

$$x^{-1}y^{-1} \cdot \underline{\quad} = \text{Identity.}$$

to cancel the term  $y^{-1}$ , we must multiply with its inverse.

to cancel the term  $x^{-1}$ , we must multiply with its inverse.

So, inverse of  $x^{-1}y^{-1}$  is  $y \cdot x$

$$\therefore a = p^{-1}b p, \text{ where } p \text{ is } y \cdot x$$

$\therefore (a,c)$  should be in the relation.

Hence the relation is transitive.

$R_1$  is equivalence relation.

$$R_2 : \forall a, b \in G, aR_2b \text{ iff } a = b^{-1}$$

Reflexive:

for including a pair of  $(a,a)$ , we need to  $a = a^{-1}$ .

For an arbitrary group this may not be true. So the relation is not reflexive.

$R_2$  is not equivalence relation.

**Correct Answer (B).**

32 votes

-- Digvijay (44.9k points)

4.4.28 Group Theory: GATE CSE 2020 | Question: 18 [top](#)

<https://gateoverflow.in/333213>



✓ Lagrange's Theorem :

Order of subgroup must be factor of Order of group.

$G$  is a group with 35 elements. So order of  $G = 35$ .

Factors of 35 : 1, 5, 7, 35

Proper subgroup: order of the subgroup is less than the order of group.

Order of the largest possible proper subgroup = 7.

14 votes

-- Shaik Masthan (50.2k points)

#### 4.4.29 Group Theory: GATE CSE 2021 Set 1 | Question: 34 top ↗

<https://gateoverflow.in/357417>



- Given  $G$  is a group of order 6.

**Lagrange's Theorem:** The order of every subgroup of  $G$  divides the order of  $G$

So, Subgroup ( $H$ ) of  $G$  can be the order of 1, 2, 3, 6 but 6 is not possible as we need a proper sub-group as mentioned in the question.

Now, any Group of prime order is cyclic. If the order is not-prime both cyclic and acyclic groups are possible.

Order of  $G = 6$  – Not a prime number so **G may or may not be cyclic**.

Order of  $H = \{1, 2, 3\} - 2$  and 3 are prime numbers and Group with 1 element is cyclic. So, **H is always cyclic**.

Ans : (B)  $G$  may not be cyclic, but  $H$  is always cyclic

More Read: Exactly 2 non-isomorphic groups of order 6 are there – [cyclic or not?](#)

#### References



1 votes

-- Bhargav D Dave (607 points)

#### 4.5

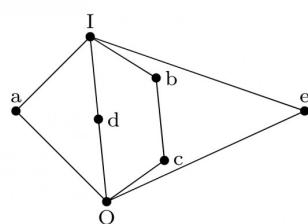
#### Lattice (9) top ↗

<https://gateoverflow.in/91351>



#### 4.5.1 Lattice: GATE CSE 1988 | Question: 1vii top ↗

The complement(s) of the element ' $a'$  in the lattice shown in below figure is (are) \_\_\_\_\_



gate1988 descriptive lattice set-theory&algebra

Answer

#### 4.5.2 Lattice: GATE CSE 1990 | Question: 17c top ↗

<https://gateoverflow.in/86884>



Show that the elements of the lattice  $(N, \leq)$ , where  $N$  is the set of positive integers and  $a \leq b$  if and only if  $a$  divides  $b$ , satisfy the distributive property.

gate1990 descriptive set-theory&algebra lattice

Answer

#### 4.5.3 Lattice: GATE CSE 1994 | Question: 2.9 top ↗

<https://gateoverflow.in/2476>



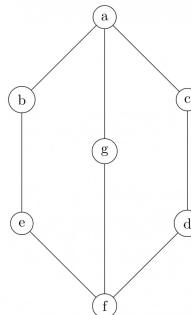
The Hasse diagrams of all the lattices with up to four elements are \_\_\_\_\_ (write all the relevant Hasse diagrams)

gate1994 set-theory&algebra lattice normal Fill-in-the-blanks

Answer

4.5.4 Lattice: GATE CSE 1997 | Question: 3.3 [top ↴](#)<https://gateoverflow.in/2234>

In the lattice defined by the Hasse diagram given in following figure, how many complements does the element ‘e’ have?



- A. 2
- B. 3
- C. 0
- D. 1

[gate1997](#) [set-theory&algebra](#) [lattice](#) [normal](#)

Answer

4.5.5 Lattice: GATE CSE 2002 | Question: 4 [top ↴](#)<https://gateoverflow.in/857>

$S = \{(1, 2), (2, 1)\}$  is binary relation on set  $A = \{1, 2, 3\}$ . Is it irreflexive? Add the minimum number of ordered pairs to  $S$  to make it an equivalence relation. Give the modified  $S$ .

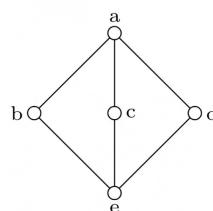
Let  $S = \{a, b\}$  and let  $\square(S)$  be the powerset of  $S$ . Consider the binary relation ' $\subseteq$ ' (set inclusion) on  $\square(S)$ . Draw the Hasse diagram corresponding to the lattice  $(\square(S), \subseteq)$

[gate2002-cse](#) [set-theory&algebra](#) [normal](#) [lattice](#) [descriptive](#)

Answer

4.5.6 Lattice: GATE CSE 2005 | Question: 9 [top ↴](#)<https://gateoverflow.in/1158>

The following is the Hasse diagram of the poset  $[\{a, b, c, d, e\}, \prec]$



The poset is :

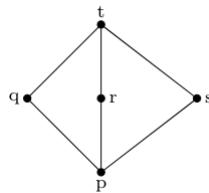
- A. not a lattice
- B. a lattice but not a distributive lattice
- C. a distributive lattice but not a Boolean algebra
- D. a Boolean algebra

[gate2005-cse](#) [set-theory&algebra](#) [lattice](#) [normal](#)

Answer

4.5.7 Lattice: GATE CSE 2015 Set 1 | Question: 34 [top ↴](#)<https://gateoverflow.in/8281>

Suppose  $L = \{p, q, r, s, t\}$  is a lattice represented by the following Hasse diagram:



For any  $x, y \in L$ , not necessarily distinct,  $x \vee y$  and  $x \wedge y$  are join and meet of  $x, y$ , respectively. Let  $L^3 = \{(x, y, z) : x, y, z \in L\}$  be the set of all ordered triplets of the elements of  $L$ . Let  $p_r$  be the probability that an element  $(x, y, z) \in L^3$  chosen equiprobably satisfies  $x \vee (y \wedge z) = (x \vee y) \wedge (x \vee z)$ . Then

- A.  $p_r = 0$
- B.  $p_r = 1$
- C.  $0 < p_r \leq \frac{1}{5}$
- D.  $\frac{1}{5} < p_r < 1$

gate2015-cse-set1 set-theory&algebra normal lattice

Answer

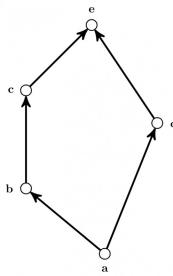
#### 4.5.8 Lattice: GATE CSE 2017 Set 2 | Question: 21

<https://gateoverflow.in/118278>



Consider the set  $X = \{a, b, c, d, e\}$  under partial ordering  $R = \{(a, a), (a, b), (a, c), (a, d), (a, e), (b, b), (b, c), (b, e), (c, c), (c, e), (d, d), (d, e), (e, e)\}$

The Hasse diagram of the partial order  $(X, R)$  is shown below.



The minimum number of ordered pairs that need to be added to  $R$  to make  $(X, R)$  a lattice is \_\_\_\_\_

gate2017-cse-set2 set-theory&algebra lattice numerical-answers normal

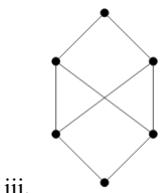
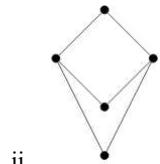
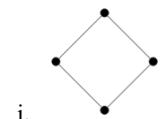
Answer

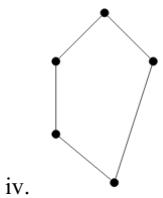
#### 4.5.9 Lattice: GATE IT 2008 | Question: 28

<https://gateoverflow.in/3318>



Consider the following Hasse diagrams.





Which all of the above represent a lattice?

- A. (i) and (iv) only
- B. (ii) and (iii) only
- C. (iii) only
- D. (i), (ii) and (iv) only

[gate2008-it](#) [set-theory&algebra](#) [lattice](#) [normal](#)

Answer

### Answers: Lattice

#### 4.5.1 Lattice: GATE CSE 1988 | Question: 1vii [top](#)

<https://gateoverflow.in/91351>



- ✓ •  $\text{lub}(a, e) = \text{lub}(a, b) = \text{lub}(a, c) = \text{lub}(a, d) = I$  (Upper Bound of Lattice)
- $\text{glb}(a, e) = \text{glb}(a, b) = \text{glb}(a, c) = \text{glb}(a, d) = O$  (Lower Bound of Lattice)

So,  $e, b, c, d$  all are complement of  $a$ .

19 votes

-- Ashwani Kumar (12.8k points)

#### 4.5.2 Lattice: GATE CSE 1990 | Question: 17c [top](#)

<https://gateoverflow.in/86884>



- ✓ Distributive property is as follows:

$$a \wedge (b \vee c) = (a \wedge b) \vee (a \wedge c)$$

For "divides by" lattice the meet ( $\wedge$ ) operation is gcd and the join ( $\vee$ ) operation is lcm. So, we have to prove:

$$\gcd(a, \text{lcm}(b, c)) = \text{lcm}(\gcd(a, b), \gcd(a, c))$$

#### Forward Direction Proof:

Let  $p$  be any prime factor of  $\gcd(a, \text{lcm}(b, c))$  and  $\alpha$  be the largest integer such that  $p^\alpha$  divides  $\gcd(a, \text{lcm}(b, c))$

$\implies p^\alpha$  divides  $a$  and  $p^\alpha$  divides  $\text{lcm}(b, c)$ .

$\implies p^\alpha$  divides  $a$  and ( $p^\alpha$  divides  $b$  OR  $p^\alpha$  divides  $c$ )

$\implies (p^\alpha \text{ divides } a \text{ and } p^\alpha \text{ divides } b) \text{ OR } (p^\alpha \text{ divides } a \text{ AND } p^\alpha \text{ divides } c)$

$\implies (p^\alpha \text{ divides } \gcd(a, b)) \text{ OR } (p^\alpha \text{ divides } \gcd(a, c))$

$\implies p^\alpha$  divides  $\text{lcm}(\gcd(a, b), \gcd(a, c))$

#### Reverse Direction Proof:

Let  $p$  be any prime factor of  $\text{lcm}(\gcd(a, b), \gcd(a, c))$  and  $\alpha$  be the largest integer such that  $p^\alpha$  divides  $\gcd(a, b)$  or  $\gcd(a, c)$ . So,  $p^\alpha$  divides  $a$  and either  $b$  or  $c$

$\implies p^\alpha$  divides both  $a$  and  $\text{lcm}(b, c)$ .

$\implies p^\alpha$  divides  $\gcd(a, \text{lcm}(b, c))$

Hence,  $\gcd(a, \text{lcm}(b, c)) = \text{lcm}(\gcd(a, b), \gcd(a, c))$

5 votes

-- Arjun Suresh (328k points)

#### 4.5.3 Lattice: GATE CSE 1994 | Question: 2.9 [top](#)

<https://gateoverflow.in/2476>



1. Diamond structure

## 2. Straight line structure

24 votes

-- Digvijay (44.9k points)

**4.5.4 Lattice: GATE CSE 1997 | Question: 3.3** [www.gateoverflow.in/2234](https://gateoverflow.in/2234)

✓ Answer: B

Complement of an element  $a$  is  $a'$  if:

- $a \wedge a' = 0$  (lowest vertex in the Hasse diagram)
- $a \vee a' = 1$  (highest vertex in the Hasse diagram)

 $g, c$  and  $d$  are the complements of  $e$ .

23 votes

-- Rajarshi Sarkar (27.8k points)

**4.5.5 Lattice: GATE CSE 2002 | Question: 4** [www.gateoverflow.in/857](https://gateoverflow.in/857)✓  $S = \{(1, 2), (2, 1)\}$  : This relation is Irreflexive, Symmetric, Not Transitive, Not Reflexive, Not Asymmetric, Not antisymmetric.Equivalence Relation  $\implies$  Symmetric, Transitive, Reflexive.

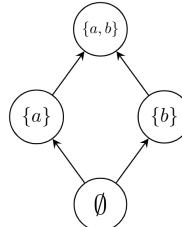
It is not transitive &amp; Reflexive.

Reflexive closure of  $S = \{(1, 1), (2, 2), (3, 3), (1, 2), (2, 1)\}$ 

After taking transitive closure relation does not change.

Answer:  $S = \{(1, 1), (2, 2), (3, 3), (1, 2), (2, 1)\}$  $S = \{a, b\}$  $P(S) = \{\emptyset, a, b, a, b\}$ 

Related Hasse Diagram



20 votes

-- Akash Kanase (36k points)

**4.5.6 Lattice: GATE CSE 2005 | Question: 9** [www.gateoverflow.in/1158](https://gateoverflow.in/1158)

✓ Option B.

A lattice has lub and glb but to be distributive it should also have a unique complement.

26 votes

-- anshu (2.7k points)

**4.5.7 Lattice: GATE CSE 2015 Set 1 | Question: 34** [www.gateoverflow.in/8281](https://gateoverflow.in/8281)✓ Number of elements in  $L^3$  = Number of ways in which we can choose 3 elements from 5 with repetition  
 $= 5 * 5 * 5 = 125$ .Now, when we take  $x = t$ , then the given condition for  $L$  is satisfied for any  $y$  and  $z$ . Here,  $y$  and  $z$  can be taken in  $5 * 5 = 25$  ways.Take  $x = r, y = p, z = p$ . Here also, the given condition is satisfied.When  $x = t$ , we have  $5 * 5 = 25$  cases (for any  $y$  and  $z$ ) where the given conditions are satisfied. Now, with  $x = r, y = p, z = p$ , we have one more case. So,  $26/125$  which means strictly greater than  $1/5$ .So, this makes  $p_r > \frac{25}{125}$ 

Also,

for  $x = q, y = r, z = s$ , the given condition is **not satisfied** as  $q \vee (r \wedge s) = q \vee p = q$ , while  $(q \vee r) \wedge (q \vee s) = t \wedge t = t$ . So,  $p_r \neq 1$ .

These findings make option A, B, C as FALSE.

Hence, answer = **option D**

68 votes

-- Arjun Suresh (328k points)

#### 4.5.8 Lattice: GATE CSE 2017 Set 2 | Question: 21 [top](#)

<https://gateoverflow.in/118278>

- ✓ A Hasse Diagram is called a Lattice, if for every pair of elements there exists a LUB and GLB.

In the above Hasse Diagram, LUB and GLB exist for every two elements taken from  $\{a, b, c, d, e\}$ . So, it is already a Lattice.

Hence, Minimum number of ordered pairs that need to be added = 0

57 votes

-- Prashant Singh (47.2k points)

#### 4.5.9 Lattice: GATE IT 2008 | Question: 28 [top](#)

<https://gateoverflow.in/3318>

- ✓ Answer is (A)

Hasse diagram is lattice when every pair of elements have a least upper bound and a greatest lower bound. In figures (ii) and (iii), every element is not having a least upper bound and a greatest lower bound (these if exist will be unique as per their definitions). So, they are not lattices.

36 votes

-- neha pawar (3.3k points)

## 4.6

### Mathematical Induction (2) [top](#)

#### 4.6.1 Mathematical Induction: GATE CSE 1995 | Question: 23 [top](#)

<https://gateoverflow.in/2661>

Prove using mathematical induction for  $n \geq 5, 2^n > n^2$

[gate1995](#) [set-theory&algebra](#) [proof](#) [mathematical-induction](#) [descriptive](#)

Answer

#### 4.6.2 Mathematical Induction: GATE CSE 2000 | Question: 3 [top](#)

<https://gateoverflow.in/674>

Consider the following sequence:

$s_1 = s_2 = 1$  and  $s_i = 1 + \min(s_{i-1}, s_{i-2})$  for  $i > 2$ .

Prove by induction on  $n$  that  $s_n = \lceil \frac{n}{2} \rceil$ .

[gate2000-cse](#) [set-theory&algebra](#) [mathematical-induction](#) [descriptive](#)

Answer

### Answers: Mathematical Induction

#### 4.6.1 Mathematical Induction: GATE CSE 1995 | Question: 23 [top](#)

<https://gateoverflow.in/2661>

- ✓ Base case:  $n = 1, 2^1 = 2 > 1^2$

Induction hypothesis:  $2^n > n^2$

To prove:  $2^{n+1} > (n+1)^2$

LHS =  $2 \cdot 2^n > 2 \cdot n^2$  (Induction hypothesis)

RHS =  $(n+1)^2 = n^2 + 2n + 1 < \text{LHS}$ , hence proved.

12 votes

-- Arjun Suresh (328k points)

**4.6.2 Mathematical Induction: GATE CSE 2000 | Question: 3** [top](#)<https://gateoverflow.in/674>

✓  $s_3 = 1 + \min(s_1, s_2) = 1 + \min(1, 1) = 2 = \lceil \frac{3}{2} \rceil$ .

So, base condition of induction satisfied.

Assume,  $s_{n-2} = \lceil \frac{n-2}{2} \rceil$  and  $s_{n-1} = \lceil \frac{n-1}{2} \rceil$  (Induction hypothesis)

Now, we have to prove,

$$s_n = \lceil \frac{n}{2} \rceil$$

$$s_n = 1 + \min(s_{n-1}, s_{n-2}) = 1 + \lceil \frac{n-2}{2} \rceil = 1 + \lceil \frac{n}{2} \rceil - 1 = \lceil \frac{n}{2} \rceil$$

(Hence, proved)

15 votes

-- Arjun Suresh (328k points)

**4.7****Number Theory (7)** [top](#)**4.7.1 Number Theory: GATE CSE 1991 | Question: 15,a** [top](#)<https://gateoverflow.in/542>

Show that the product of the least common multiple and the greatest common divisor of two positive integers  $a$  and  $b$  is  $a \times b$ .

[gate1991](#) [set-theory&algebra](#) [normal](#) [number-theory](#) [proof](#) [descriptive](#)

Answer

**4.7.2 Number Theory: GATE CSE 1995 | Question: 7(A)** [top](#)<https://gateoverflow.in/2642>

Determine the number of divisors of 600.

[gate1995](#) [set-theory&algebra](#) [number-theory](#) [numerical-answers](#)

Answer

**4.7.3 Number Theory: GATE CSE 2014 Set 2 | Question: 49** [top](#)<https://gateoverflow.in/2015>

The number of distinct positive integral factors of 2014 is \_\_\_\_\_

[gate2014-cse-set2](#) [set-theory&algebra](#) [easy](#) [numerical-answers](#) [number-theory](#)

Answer

**4.7.4 Number Theory: GATE CSE 2015 Set 2 | Question: 9** [top](#)<https://gateoverflow.in/8058>

The number of divisors of 2100 is \_\_\_\_\_.

[gate2015-cse-set2](#) [set-theory&algebra](#) [number-theory](#) [easy](#) [numerical-answers](#)

Answer

**4.7.5 Number Theory: GATE IT 2005 | Question: 34** [top](#)<https://gateoverflow.in/3780>

Let  $n = p^2q$ , where  $p$  and  $q$  are distinct prime numbers. How many numbers  $m$  satisfy  $1 \leq m \leq n$  and  $\gcd(m, n) = 1$ ? Note that  $\gcd(m, n)$  is the greatest common divisor of  $m$  and  $n$ .

- A.  $p(q-1)$
- B.  $pq$
- C.  $(p^2-1)(q-1)$
- D.  $p(p-1)(q-1)$

[gate2005-it](#) [set-theory&algebra](#) [normal](#) [number-theory](#)

Answer

**4.7.6 Number Theory: GATE IT 2007 | Question: 16** [top](#)<https://gateoverflow.in/3449>

The minimum positive integer  $p$  such that  $3^p \pmod{17} = 1$  is

- A. 5
- B. 8

- C. 12  
D. 16

gate2007-it set-theory&algebra normal number-theory

Answer 

#### 4.7.7 Number Theory: GATE IT 2008 | Question: 24

 <https://gateoverflow.in/3285>



The exponent of 11 in the prime factorization of  $300!$  is

- A. 27  
B. 28  
C. 29  
D. 30

gate2008-it set-theory&algebra normal number-theory

Answer 

### Answers: Number Theory

#### 4.7.1 Number Theory: GATE CSE 1991 | Question: 15,a

 <https://gateoverflow.in/542>



- ✓  $x$  and  $y$  can be expressed as

- $x = 2^{a_1} \cdot 3^{a_2} \dots P^{a_n}$ .
- $y = 2^{b_1} \cdot 3^{b_2} \dots P^{b_n}$ .

where,  $a_i \& b_i \geq 0$  for  $1 \leq i \leq n$ , and  $P$  is a prime number.

$$x * y = 2^{a_1+b_1} \cdot 3^{a_2+b_2} \dots P^{a_n+b_n}$$

- $\text{LCM}(x, y) = 2^{\max(a_1+b_1)} \cdot 3^{\max(a_2+b_2)} \dots P^{\max(a_n+b_n)}$
- $\text{HCF}(x, y) = 2^{\min(a_1+b_1)} \cdot 3^{\min(a_2+b_2)} \dots P^{\min(a_n+b_n)}$

Since,  $\max(a_i + b_i) + \min(a_i + b_i) = a_i + b_i$

$$\text{So, } \text{LCM}(x, y) * \text{HCF}(x, y) = 2^{a_1+b_1} \cdot 3^{a_2+b_2} \dots P^{a_n+b_n} = x * y.$$

Hence proved.

 13 votes

-- ZAHID WAKEEL (1,6k points)

#### 4.7.2 Number Theory: GATE CSE 1995 | Question: 7(A)

 <https://gateoverflow.in/2642>



- ✓ Prime factorization of  $600 = 2^3 \times 3 \times 5^2$ .

Total no of divisors  $= (3+1)(1+1)(2+1) = 4 \times 2 \times 3 = 24$  divisors

Here, we are choosing either 0, 1, 2 or 3, 2's so  $3+1 = 4$  choices for 2 and so on for all.

In case we do not choose any of the above factors, we get 1 as divisor!

 13 votes

-- Akash Kanase (36k points)

#### 4.7.3 Number Theory: GATE CSE 2014 Set 2 | Question: 49

 <https://gateoverflow.in/2015>



- ✓ First do prime factorization of  $2014 - 2^1 \times 19^1 \times 53^1$

Now to get a factor of 2014, we can choose any combination of the prime factors including 0. i.e;  $2^0$  and  $2^1$  are possible and similarly for other prime factors also, there are 2 possibilities. So, total number of positive integral factors

$$= 2 \times 2 \times 2 = 8$$

(When all the powers of prime factors are 0, we get 1 and when all the powers are maximum, we get the given number.)

 37 votes

-- Arjun Suresh (328k points)

**4.7.4 Number Theory: GATE CSE 2015 Set 2 | Question: 9**<https://gateoverflow.in/8058>

- ✓ Answer: 36

$$2100 = 7 \times 3 \times 2^2 \times 5^2$$

Hence, total number of factors will be  $(1+1) \times (1+1) \times (2+1) \times (2+1) = 2 \times 2 \times 3 \times 3 = 36$ ,

because any factor is obtained by multiplying the prime factors zero or more times. (one extra for zero)

36 votes

-- Rajarshi Sarkar (27.8k points)

**4.7.5 Number Theory: GATE IT 2005 | Question: 34**<https://gateoverflow.in/3780>

- ✓  $n = p^2q$ , where  $p$  and  $q$  are prime.

So, number of multiples of  $p$  in  $n = pq$

Number of multiples of  $q$  in  $n = p^2$

Number of multiples of  $pq$  in  $n = p$

Since, prime factorization of  $n$  consists of only  $p$  and  $q$ ,  $\gcd(m, n)$  will be a multiple of these or 1. So, number of possible  $m$  such that  $\gcd(m, n)$  is 1 will be  $n - \text{number of multiples of either } p \text{ or } q$

$$\begin{aligned} &= n - p^2 - pq + p \\ &= p^2q - p^2 - pq + p \\ &= p(pq - p - q + 1) \\ &= p(p-1)(q-1) \end{aligned}$$

Correct Answer: D

46 votes

-- Arjun Suresh (328k points)

Euler's totient function  $\phi(n)$  is being asked here :

Euler's totient function  $\phi(n) = \text{Number of positive integers which are } \leq n \text{ and relatively prime or co-prime to } n$ . (ie. co-prime means if  $\gcd(a, b) = 1$ )

It is given by  $\phi(n) = n \times \left( \frac{(P_1-1)(P_2-1)\dots(P_k-1)}{P_1 P_2 \dots P_k} \right)$

where  $P_1 P_2 \dots P_k$  distinct prime divisors of  $n$

We have  $n = p^2q$ .

Therefore,

$$\begin{aligned} \phi(n) &= n \left( \frac{(p-1)(q-1)}{pq} \right) \\ &= p^2q \left( \frac{(p-1)(q-1)}{pq} \right) \\ &= p(p-1)(q-1) \end{aligned}$$

### References



49 votes

-- Akhil Nadh PC (16.6k points)

**4.7.6 Number Theory: GATE IT 2007 | Question: 16**<https://gateoverflow.in/3449>

- ✓ Fermat's Little Theorem :

$$a^p \equiv a \pmod{p}$$

According to Modular Arithmetic  $a \equiv b \pmod{n}$  if their difference  $(a - b)$  is an integral multiple of  $n$  ( $n$  divides  $(a - b)$ )

So,  $(a^p - a)$  is an integral multiple of  $p$ . Now as  $a$  is not divisible by  $p$  so definitely,  $(a^{p-1} - 1)$  is an integral multiple of  $p$ . This simply means if we divide  $a^{p-1}$  by  $p$ , the remainder would be 1. i.e.,  $a^{p-1} \pmod{p} = 1$ .

Put the values in the formula.

$p = 17$

So,  $p - 1 = 16$ .

Correct Answer: D

120 votes

-- Rupie\_C (607 points)

#### 4.7.7 Number Theory: GATE IT 2008 | Question: 24 [top](#)

<https://gateoverflow.in/3285>



✓ Simple Method:

$$\lfloor 300/11 \rfloor = 27$$

$$\lfloor 27/11 \rfloor = 2$$

$$\lfloor 2/11 \rfloor = 0$$

Repeat this and when get 0 stop and sum all the results.

Ans:  $27 + 2 + 0 = 29$ .

Correct Answer: C

121 votes

-- papesh (18k points)

$300!$  is  $1*2*3*...*300$

Now there are 27 multiples of 11 from 1 to 300, so they will include 11 as a prime factor atleast once.

121 and 242 will contain an extra 11, all other will contain 11 as a factor only once.

So, total number of 11's =  $27+2 = 29$ .

So, exponent of 11 is 29 i.e. option C.

122 votes

-- Happy Mittal (8.2k points)

#### 4.8

#### Partial Order (10) [top](#)

##### 4.8.1 Partial Order: GATE CSE 1991 | Question: 01,xiv [top](#)

<https://gateoverflow.in/509>



If the longest chain in a partial order is of length  $n$ , then the partial order can be written as a \_\_\_\_\_ of  $n$  antichains.

[gate1991](#) [set-theory&algebra](#) [partial-order](#) [normal](#) [fill-in-the-blanks](#)

Answer

##### 4.8.2 Partial Order: GATE CSE 1992 | Question: 14b [top](#)

<https://gateoverflow.in/43580>



Consider the set of integers  $\{1, 2, 3, 4, 6, 8, 12, 24\}$  together with the two binary operations LCM (lowest common multiple) and GCD (greatest common divisor). Which of the following algebraic structures does this represent?

- A. group
- B. ring
- C. field
- D. lattice

[gate1992](#) [set-theory&algebra](#) [partial-order](#) [lattice](#) [normal](#)

Answer

**4.8.3 Partial Order: GATE CSE 1993 | Question: 8.5** [top](#)<https://gateoverflow.in/2303>

The less-than relation,  $<$ , on reals is

- A. a partial ordering since it is asymmetric and reflexive
- B. a partial ordering since it is antisymmetric and reflexive
- C. not a partial ordering because it is not asymmetric and not reflexive
- D. not a partial ordering because it is not antisymmetric and reflexive
- E. none of the above

[gate1993](#) [set-theory&algebra](#) [partial-order](#) [easy](#)

Answer

**4.8.4 Partial Order: GATE CSE 1996 | Question: 1.2** [top](#)<https://gateoverflow.in/2706>

Let  $X = \{2, 3, 6, 12, 24\}$ . Let  $\leq$  be the partial order defined by  $X \leq Y$  if  $x$  divides  $y$ . Number of edges in the Hasse diagram of  $(X, \leq)$  is

- A. 3
- B. 4
- C. 9
- D. None of the above

[gate1996](#) [set-theory&algebra](#) [partial-order](#) [normal](#)

Answer

**4.8.5 Partial Order: GATE CSE 1997 | Question: 6.1** [top](#)<https://gateoverflow.in/2257>

A partial order  $\leq$  is defined on the set  $S = \{x, a_1, a_2, \dots, a_n, y\}$  as  $x \leq_i a_i$  for all  $i$  and  $a_i \leq y$  for all  $i$ , where  $n \geq 1$ . The number of total orders on the set  $S$  which contain the partial order  $\leq$  is

- A.  $n!$
- B.  $n + 2$
- C.  $n$
- D. 1

[gate1997](#) [set-theory&algebra](#) [partial-order](#) [normal](#)

Answer

**4.8.6 Partial Order: GATE CSE 1998 | Question: 11** [top](#)<https://gateoverflow.in/1725>

Suppose  $A = \{a, b, c, d\}$  and  $\Pi_1$  is the following partition of A

$$\Pi_1 = \{\{a, b, c\}, \{d\}\}$$

- a. List the ordered pairs of the equivalence relations induced by  $\Pi_1$ .
- b. Draw the graph of the above equivalence relation.
- c. Let  $\Pi_2 = \{\{a\}, \{b\}, \{c\}, \{d\}\}$

$$\Pi_3 = \{\{a, b, c, d\}\}$$

$$\text{and } \Pi_4 = \{\{a, b\}, \{c, d\}\}$$

Draw a Poset diagram of the poset,  $\langle \{\Pi_1, \Pi_2, \Pi_3, \Pi_4\}, \text{refines} \rangle$ .

[gate1998](#) [set-theory&algebra](#) [normal](#) [partial-order](#) [descriptive](#)

Answer

**4.8.7 Partial Order: GATE CSE 2003 | Question: 31** [top](#)<https://gateoverflow.in/921>

Let  $(S, \leq)$  be a partial order with two minimal elements  $a$  and  $b$ , and a maximum element  $c$ . Let  $P: S \rightarrow \{\text{True}, \text{False}\}$  be a predicate defined on  $S$ . Suppose that  $P(a) = \text{True}$ ,  $P(b) = \text{False}$  and  $P(x) \implies P(y)$  for all  $x, y \in S$  satisfying  $x \leq y$ , where  $\implies$  stands for logical implication. Which of the following statements CANNOT be true?

- A.  $P(x) = \text{True}$  for all  $x \in S$  such that  $x \neq b$
- B.  $P(x) = \text{False}$  for all  $x \in S$  such that  $x \neq a$  and  $x \neq c$
- C.  $P(x) = \text{False}$  for all  $x \in S$  such that  $b \leq x$  and  $x \neq c$
- D.  $P(x) = \text{False}$  for all  $x \in S$  such that  $a \leq x$  and  $b \leq x$

[gate2003-cse](#) [set-theory&algebra](#) [partial-order](#) [normal](#) [propositional-logic](#)

Answer 

#### 4.8.8 Partial Order: GATE CSE 2004 | Question: 73 [top](#)

<https://gateoverflow.in/1067>



The inclusion of which of the following sets into

$$S = \{\{1, 2\}, \{1, 2, 3\}, \{1, 3, 5\}, \{1, 2, 4\}, \{1, 2, 3, 4, 5\}\}$$

is necessary and sufficient to make  $S$  a complete lattice under the partial order defined by set containment?

- A.  $\{1\}$
- B.  $\{1\}, \{2, 3\}$
- C.  $\{1\}, \{1, 3\}$
- D.  $\{1\}, \{1, 3\}, \{1, 2, 3, 4\}, \{1, 2, 3, 5\}$

[gate2004-cse](#) [set-theory&algebra](#) [partial-order](#) [normal](#)

Answer 

#### 4.8.9 Partial Order: GATE CSE 2007 | Question: 26 [top](#)

<https://gateoverflow.in/1224>

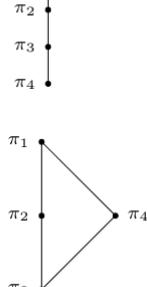


Consider the set  $S = \{a, b, c, d\}$ . Consider the following 4 partitions  $\pi_1, \pi_2, \pi_3, \pi_4$  on

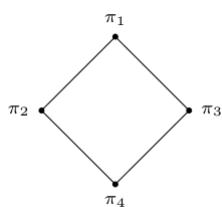
$$S : \pi_1 = \{\overline{abcd}\}, \quad \pi_2 = \{\overline{ab}, \overline{cd}\}, \quad \pi_3 = \{\overline{abc}, \overline{d}\}, \quad \pi_4 = \{\overline{a}, \overline{b}, \overline{c}, \overline{d}\}.$$

Let  $\prec$  be the partial order on the set of partitions  $S' = \{\pi_1, \pi_2, \pi_3, \pi_4\}$  defined as follows:  $\pi_i \prec \pi_j$  if and only if  $\pi_i$  refines  $\pi_j$ . The poset diagram for  $(S', \prec)$  is:

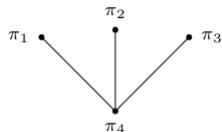
A.



B.



C.



D.

[gate2007-cse](#) [set-theory&algebra](#) [normal](#) [partial-order](#) [descriptive](#)

Answer 

**4.8.10 Partial Order: GATE IT 2007 | Question: 23** [top](#)<https://gateoverflow.in/3456>

A partial order  $P$  is defined on the set of natural numbers as follows. Here  $\frac{x}{y}$  denotes integer division.

- $(0, 0) \in P$ .
- $(a, b) \in P$  if and only if  $(a \% 10) \leq (b \% 10)$  and  $(\frac{a}{10}, \frac{b}{10}) \in P$ .

Consider the following ordered pairs:

- $(101, 22)$
- $(22, 101)$
- $(145, 265)$
- $(0, 153)$

Which of these ordered pairs of natural numbers are contained in  $P$ ?

- A. (i) and (iii)
- B. (ii) and (iv)
- C. (i) and (iv)
- D. (iii) and (iv)

[gate2007-it](#) [set-theory&algebra](#) [partial-order](#) [normal](#)

Answer

**Answers: Partial Order****4.8.1 Partial Order: GATE CSE 1991 | Question: 01,xiv** [top](#)<https://gateoverflow.in/509>

- ✓ Suppose the length of the longest chain in a partial order is  $n$ . Then the elements in the poset can be partitioned into  $n$  disjoint antichains.

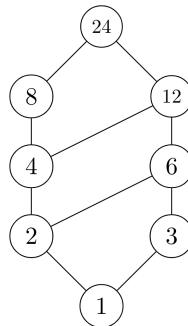
17 votes

-- Rajarshi Sarkar (27.8k points)

**4.8.2 Partial Order: GATE CSE 1992 | Question: 14b** [top](#)<https://gateoverflow.in/43580>

- ✓ Ans is lattice (D).

For LCM and GCD:



27 votes

-- Prashant Singh (47.2k points)

**4.8.3 Partial Order: GATE CSE 1993 | Question: 8.5** [top](#)<https://gateoverflow.in/2303>

- ✓ Relation  $<$  is :

- Not reflexive
- Irreflexive
- Not symmetric
- Asymmetric
- Anti symmetric

The relation is not POSET because it is irreflexive. Check AntiSymmetry:  $aRb \neq bRa$  unless  $a = b$ .

A relation may be 'not Asymmetric and not reflexive' but still Antisymmetric. As  $\{(1, 1), (1, 2)\}$

Not Asymmetric and Irreflexive = Antisymmetric

Option E.

19 votes

-- Digvijay (44.9k points)

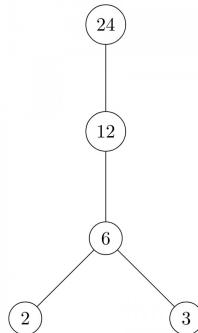
#### 4.8.4 Partial Order: GATE CSE 1996 | Question: 1.2 [top](#)

<https://gateoverflow.in/2706>



- ✓ Answer: B

Hasse Diagram is:



25 votes

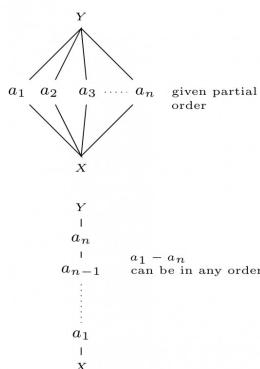
-- Rajarshi Sarkar (27.8k points)

#### 4.8.5 Partial Order: GATE CSE 1997 | Question: 6.1 [top](#)

<https://gateoverflow.in/2257>



- ✓ To make this partial order a total order, we need the relation to hold for every two elements of the partial order. Currently between any  $a_i$  and  $a_j$ , there is no relation. So, for every  $a_i, a_j$ , we have to add either  $(a_i, a_j)$  or  $(a_j, a_i)$  in total order. So, this translates to giving an ordering for  $n$  elements between  $x$  and  $y$ , which can be done in  $n!$  ways. So, answer is (a).



The bottom figure is for a total order. We can permute the  $a_i$  from  $i = 1$  to  $n$ , and each permutation will also be a total order containing the given partial order.

45 votes

-- Arjun Suresh (328k points)

#### 4.8.6 Partial Order: GATE CSE 1998 | Question: 11 [top](#)

<https://gateoverflow.in/1725>



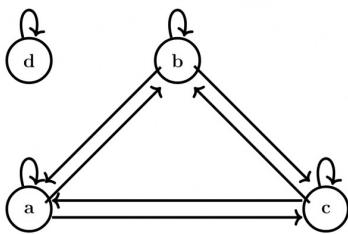
- ✓ a. For Calculating Ordered Pairs Just multiply the partition with itself.

$$\{a, b, c\} * \{a, b, c\} = \{(a, a), (a, b), (a, c), (b, a), (b, b), (b, c), (c, a), (c, b), (c, c)\}$$

$$\{d\} * \{d\} = \{(d, d)\}$$

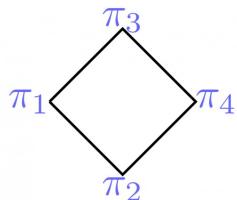
∴ The ordered pairs of the equivalence relations are  
 $= \{(a, a), (a, b), (a, c), (b, a), (b, b), (b, c), (c, a), (c, b), (c, c), (d, d)\}$

- b. For each ordered pair  $(a, b)$  in the equivalence relation just make a directed edge from  $a$  towards  $b$ .



c. Suppose we have two partitions of a set  $S : P_1 = A_1, A_2, A_3 \dots$  and  $P_2 = B_1, B_2, B_3 \dots$

We say that  $P_1$  is a refinement of  $P_2$  if every  $A_i$  is a subset of some  $B_j$ . Or We can say that  $P_1$  refines  $P_2$



#### Additional Note :-

First read definition of refinement given above then relate it to this example.

Refinement means refining/filtering elements.

Suppose like we have { water, ice, sugar, rasna }

now someone told you to make sugarfree rasna so you keep sugar aside like { {water,ice,rasna}, {sugar} }

now someone told you to not to put ice in rasna so you do keep ice aside like { {water,rasna,sugar}, {ice} }

i.e. { {water,ice,rasna}, {sugar} } and { {water,rasna,sugar}, {ice} } are refined versions of { water, ice, sugar, rasna } in one you have refined sugar and in other you refined ice.

now someone told you to make sugarfree rasna and also not add ice then you do like { {water,rasna}, {ice,sugar} }.

Now this is another refined version of { water, ice, sugar, rasna } and not refined version of { {water,ice,rasna}, {sugar} } or { {water,rasna,sugar}, {ice} }. why ?

because {ice,sugar} is not a subset of {water,ice,rasna} or {water,rasna,sugar} but it is a subset of { water, ice, sugar, rasna }

17 votes

-- Satbir Singh (20.9k points)

#### 4.8.7 Partial Order: GATE CSE 2003 | Question: 31 [top](#)

<https://gateoverflow.in/921>



✓ Maximum element is  $c$ : So,  $c$  is of higher order than any other element in  $S$

Minimal elements are  $a$  and  $b$ : No other element in  $S$  is of lower order than either  $a$  or  $b$ .

We are given  $P(a) = \text{TRUE}$ . So, for all  $x$  such that  $a \leq x$ ,  $P(x)$  must be TRUE. We do have at least one such  $x$ , which is  $c$  as it is the maximum element. So, D **CANNOT** be true.

- A can be TRUE as all elements mapped to TRUE doesn't violate the given implication.
- B can be TRUE if  $a$  is related only to  $c$ .
- C can be TRUE as  $b \leq x$  ensures  $x \neq a$  and for all other elements  $P(x)$  can be FALSE without violating the given implication.

Ref: [https://en.wikipedia.org/wiki/Partially\\_ordered\\_set](https://en.wikipedia.org/wiki/Partially_ordered_set)

Correct Answer: **D**

#### References



35 votes

-- Arjun Suresh (328k points)

**4.8.8 Partial Order: GATE CSE 2004 | Question: 73**<https://gateoverflow.in/1067>

- ✓ Answer: A

**A lattice is complete if every subset of partial order set has a supremum and infimum element .**

For example, here we are given a partial order set  $S$ . Now it will be a complete lattice if whatever be the subset we choose, it has a supremum and infimum element. Here relation given is set containment, so supremum element will be just union of all sets in the subset we choose. Similarly, infimum element will be just intersection of all the sets in the subset we choose.

Now as we can see,  $S$  now is not complete lattice, because although it has a supremum for every subset we choose, but some subsets have no infimum. For example: if we take subset  $\{1, 3, 5\}$  and  $\{1, 2, 4\}$  then intersection of sets in this is  $\{1\}$ , which is not present in  $S$ . So clearly, if we add set  $\{1\}$  in  $S$ , we will solve the problem. So, adding  $\{1\}$  is necessary and sufficient condition for  $S$  to be complete lattice. Thus, option (A) is correct.

27 votes

-- Rajarshi Sarkar (27.8k points)

**4.8.9 Partial Order: GATE CSE 2007 | Question: 26**<https://gateoverflow.in/1224>

- ✓ Answer is option C.

Suppose we have two partitions of a set  $S$ :  $P_1 = \{A_1, A_2, \dots\}$  and  $P_2 = \{B_1, B_2, \dots\}$ .

- We say that  $P_1$  is a refinement of  $P_2$  if every  $A_i$  is a subset of some  $B_j$ .

Refer <https://www.cs.sfu.ca/~ggbaker/zju/math/equiv-rel.html>

$\pi_4$  refines all of them.

1.  $\pi_4$  refining  $\pi_2, \pi_3$ .
2.  $\pi_4$  &  $\pi_2$  refining  $\pi_1$ .  $\pi_4$  &  $\pi_3$  refining  $\pi_1$ . ( $\pi_2$  refines  $\pi_1$ , i.e.,  $(ab)$  and  $(cd)$  in  $\pi_2$  are joined as  $(abcd)$  in  $\pi_1$ . And  $\pi_3$  refining  $\pi_1$  i.e.,  $(abc)(d)$  in  $\pi_3$  are joined as  $(abcd)$  in  $\pi_1$ )

That symbol  $(\bar{x})$  represents a **partition** ...  $\bar{x}$  means  $(x)$ .

As it is poset we are not showing transitive dependency.

Partition concept :- [https://en.wikipedia.org/wiki/Partition\\_of\\_a\\_set](https://en.wikipedia.org/wiki/Partition_of_a_set)

### References



44 votes

-- Akash Kanase (36k points)

**4.8.10 Partial Order: GATE IT 2007 | Question: 23**<https://gateoverflow.in/3456>

- ✓ Ans. D

For ordered pair  $(a, b)$ , to be in  $P$ , each digit in a starting from unit place must not be larger than the corresponding digit in  $b$ .

This condition is satisfied by options

- (iii)  $(145, 265) \rightarrow 5 \leq 5, 4 < 6$  and  $1 < 2$
- (iv)  $(0, 153) \rightarrow 0 < 3$  and no need to examine further

36 votes

-- Vikrant Singh (11.2k points)

**4.9****Polynomials (4)**<https://gateoverflow.in/2245>**4.9.1 Polynomials: GATE CSE 1997 | Question: 4.4**<https://gateoverflow.in/2245>

A polynomial  $p(x)$  is such that  $p(0) = 5, p(1) = 4, p(2) = 9$  and  $p(3) = 20$ . The minimum degree it should have is

- 1
- 2
- 3
- 4

gate1997 set-theory&algebra normal polynomials

Answer 

#### 4.9.2 Polynomials: GATE CSE 2000 | Question: 2.4

<https://gateoverflow.in/651>



A polynomial  $p(x)$  satisfies the following:

- $p(1) = p(3) = p(5) = 1$
- $p(2) = p(4) = -1$

The minimum degree of such a polynomial is

- A. 1
- B. 2
- C. 3
- D. 4

gate2000-cse set-theory&algebra normal polynomials

Answer 

#### 4.9.3 Polynomials: GATE CSE 2014 Set 2 | Question: 5

<https://gateoverflow.in/1957>



A non-zero polynomial  $f(x)$  of degree 3 has roots at  $x = 1$ ,  $x = 2$  and  $x = 3$ . Which one of the following must be TRUE?

- A.  $f(0)f(4) < 0$
- B.  $f(0)f(4) > 0$
- C.  $f(0) + f(4) > 0$
- D.  $f(0) + f(4) < 0$

gate2014-cse-set2 set-theory&algebra polynomials normal

Answer 

#### 4.9.4 Polynomials: GATE CSE 2017 Set 2 | Question: 24

<https://gateoverflow.in/118185>



Consider the quadratic equation  $x^2 - 13x + 36 = 0$  with coefficients in a base  $b$ . The solutions of this equation in the same base  $b$  are  $x = 5$  and  $x = 6$ . Then  $b = \underline{\hspace{2cm}}$

gate2017-cse-set2 polynomials numerical-answers set-theory&algebra

Answer 

### Answers: Polynomials

#### 4.9.1 Polynomials: GATE CSE 1997 | Question: 4.4

<https://gateoverflow.in/2245>



✓ Lets take  $p(x) = ax + b$   
Now,  $p(0) = 5 \implies b = 5$ .

$$p(1) = 4 \implies a + b = 4, a = -1$$

$p(2) = 9 \implies 2a + b = 9 \implies -2 + 5 = 9$ , which is false. So, degree 1 is not possible.

Let  $p(x) = ax^2 + bx + c$

$$p(0) = 5 \implies c = 5$$

$$p(1) = 4 \implies a + b + c = 4 \implies a + b = -1 \rightarrow (1)$$

$$p(2) = 9 \implies 4a + 2b + c = 9 \implies 2a + b = 2 \rightarrow (2)$$

$$(2) - (1) \implies a = 3, b = -1 - 3 = -4$$

$p(3) = 20 \implies 9a + 3b + c = 20, 27 - 12 + 5 = 20$ , equation holds.  
So, degree 2 also will suffice.

Correct Answer: *B*

42 votes

-- Arjun Suresh (328k points)

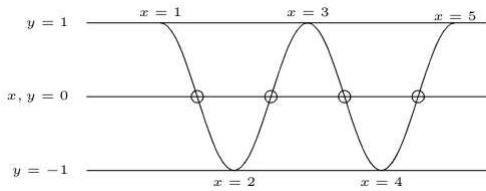
#### 4.9.2 Polynomials: GATE CSE 2000 | Question: 2.4

<https://gateoverflow.in/651>



- ✓ yes, option *D* is the correct answer.

Here is how  $p(x)$  should look like:



Value of  $P(x)$  will be zero at circled (*O*) points, so they will be the roots of the polynomial  $P(x)$ . Hence, the minimum degree of  $P(x)$  will be 4.

44 votes

-- Anurag Pandey (10.5k points)

#### 4.9.3 Polynomials: GATE CSE 2014 Set 2 | Question: 5

<https://gateoverflow.in/1957>



- ✓ The roots are  $x = 1, x = 2$ , and  $x = 3$ .

So, polynomial is  $f(x) = (x - 1)(x - 2)(x - 3)$

$$f(0) = -6, f(4) = 6$$

So,  $f(0)f(4) < 0$ .

Correct Answer: *A*

79 votes

-- Happy Mittal (8.2k points)

#### 4.9.4 Polynomials: GATE CSE 2017 Set 2 | Question: 24

<https://gateoverflow.in/118185>



- ✓ Let  $ax^2 + bx + c = 0$  be a quadratic equation, then

$$\text{Sum of roots} = \frac{-b}{a} \text{ and product of roots} = \frac{c}{a}$$

$$(5)_b + (6)_b = (13)_b \Rightarrow b = 8$$

and  $(5)_b * (6)_b = (36)_b$  means  $30 = 3b + 6$ . So,  $b = 8$

61 votes

-- Manish Joshi (20.5k points)

## 4.10

### Relations (36)

#### 4.10.1 Relations: GATE CSE 1987 | Question: 2d

<https://gateoverflow.in/80583>



State whether the following statements are TRUE or FALSE:

The union of two equivalence relations is also an equivalence relation.

[gate1987](#) [set-theory&algebra](#) [relations](#) [true-false](#)

Answer

#### 4.10.2 Relations: GATE CSE 1987 | Question: 9a

<https://gateoverflow.in/82436>



How many binary relations are there on a set  $A$  with  $n$  elements?

[gate1987](#) [set-theory&algebra](#) [relations](#) [descriptive](#)

Answer

**4.10.3 Relations: GATE CSE 1987 | Question: 9e** top ↴<https://gateoverflow.in/82446>

How many true inclusion relations are there of the form  $A \subseteq B$ , where  $A$  and  $B$  are subsets of a set  $S$  with  $n$  elements?

[gate1987](#) [set-theory&algebra](#) [relations](#) [descriptive](#)

Answer

**4.10.4 Relations: GATE CSE 1989 | Question: 1-iv** top ↴<https://gateoverflow.in/87048>

The transitive closure of the relation  $\{(1, 2), (2, 3), (3, 4), (5, 4)\}$  on the set  $\{1, 2, 3, 4, 5\}$  is \_\_\_\_\_.

[gate1989](#) [set-theory&algebra](#) [relations](#) [descriptive](#)

Answer

**4.10.5 Relations: GATE CSE 1992 | Question: 15.b** top ↴<https://gateoverflow.in/43579>

Let  $S$  be the set of all integers and let  $n > 1$  be a fixed integer. Define for  $a, b \in S$ ,  $aRb$  iff  $a - b$  is a multiple of  $n$ . Show that  $R$  is an equivalence relation and find its equivalence classes for  $n = 5$ .

[gate1992](#) [set-theory&algebra](#) [normal](#) [relations](#) [descriptive](#)

Answer

**4.10.6 Relations: GATE CSE 1994 | Question: 2.3** top ↴<https://gateoverflow.in/2470>

Amongst the properties {reflexivity, symmetry, anti-symmetry, transitivity} the relation  $R = \{(x, y) \in N^2 \mid x \neq y\}$  satisfies \_\_\_\_\_

[gate1994](#) [set-theory&algebra](#) [normal](#) [relations](#) [fill-in-the-blanks](#)

Answer

**4.10.7 Relations: GATE CSE 1995 | Question: 1.19** top ↴<https://gateoverflow.in/2606>

Let  $R$  be a symmetric and transitive relation on a set  $A$ . Then

- A.  $R$  is reflexive and hence an equivalence relation
- B.  $R$  is reflexive and hence a partial order
- C.  $R$  is reflexive and hence not an equivalence relation
- D. None of the above

[gate1995](#) [set-theory&algebra](#) [relations](#) [normal](#)

Answer

**4.10.8 Relations: GATE CSE 1996 | Question: 2.2** top ↴<https://gateoverflow.in/2731>

Let  $R$  be a non-empty relation on a collection of sets defined by  $_A R_B$  if and only if  $A \cap B = \emptyset$ . Then, (pick the true statement)

- A.  $R$  is reflexive and transitive
- B.  $R$  is symmetric and not transitive
- C.  $R$  is an equivalence relation
- D.  $R$  is not reflexive and not symmetric

[gate1996](#) [set-theory&algebra](#) [relations](#) [normal](#)

Answer

**4.10.9 Relations: GATE CSE 1996 | Question: 8** top ↴<https://gateoverflow.in/2760>

Let  $F$  be the collection of all functions  $f : \{1, 2, 3\} \rightarrow \{1, 2, 3\}$ . If  $f$  and  $g \in F$ , define an equivalence relation  $\sim$  by  $f \sim g$  if and only if  $f(3) = g(3)$ .

- a. Find the number of equivalence classes defined by  $\sim$ .
- b. Find the number of elements in each equivalence class.

[gate1996](#) [set-theory&algebra](#) [relations](#) [functions](#) [normal](#) [descriptive](#)
[Answer](#)
**4.10.10 Relations: GATE CSE 1997 | Question: 14**
<https://gateoverflow.in/2274>


Let  $R$  be a reflexive and transitive relation on a set  $A$ . Define a new relation  $E$  on  $A$  as

$$E = \{(a, b) \mid (a, b) \in R \text{ and } (b, a) \in R\}$$

Prove that  $E$  is an equivalence relation on  $A$ .

Define a relation  $\leq$  on the equivalence classes of  $E$  as  $E_1 \leq E_2$  if  $\exists a, b$  such that  $a \in E_1, b \in E_2$  and  $(a, b) \in R$ . Prove that  $\leq$  is a partial order.

[gate1997](#) [set-theory&algebra](#) [relations](#) [normal](#) [proof](#) [descriptive](#)
[Answer](#)
**4.10.11 Relations: GATE CSE 1997 | Question: 6.3**
<https://gateoverflow.in/2259>


The number of equivalence relations of the set  $\{1, 2, 3, 4\}$  is

- A. 15
- B. 16
- C. 24
- D. 4

[gate1997](#) [set-theory&algebra](#) [relations](#) [normal](#)
[Answer](#)
**4.10.12 Relations: GATE CSE 1998 | Question: 1.6**
<https://gateoverflow.in/1643>


Suppose  $A$  is a finite set with  $n$  elements. The number of elements in the largest equivalence relation of  $A$  is

- A.  $n$
- B.  $n^2$
- C. 1
- D.  $n + 1$

[gate1998](#) [set-theory&algebra](#) [relations](#) [easy](#)
[Answer](#)
**4.10.13 Relations: GATE CSE 1998 | Question: 1.7**
<https://gateoverflow.in/1644>


Let  $R_1$  and  $R_2$  be two equivalence relations on a set. Consider the following assertions:

- i.  $R_1 \cup R_2$  is an equivalence relation
- ii.  $R_1 \cap R_2$  is an equivalence relation

Which of the following is correct?

- A. Both assertions are true
- B. Assertions (i) is true but assertions (ii) is not true
- C. Assertions (ii) is true but assertions (i) is not true
- D. Neither (i) nor (ii) is true

[gate1998](#) [set-theory&algebra](#) [relations](#) [normal](#)
[Answer](#)
**4.10.14 Relations: GATE CSE 1998 | Question: 10a**
<https://gateoverflow.in/1724>


Prove by induction that the expression for the number of diagonals in a polygon of  $n$  sides is  $\frac{n(n-3)}{2}$

gate1998 set-theory&algebra descriptive relations

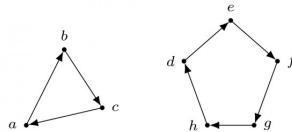
Answer 

#### 4.10.15 Relations: GATE CSE 1998 | Question: 10b

<https://gateoverflow.in/232729>



Let  $R$  be a binary relation on  $A = \{a, b, c, d, e, f, g, h\}$  represented by the following two component digraph. Find the smallest integers  $m$  and  $n$  such that  $m < n$  and  $R^m = R^n$ .



gate1998 descriptive set-theory&algebra relations

Answer 

#### 4.10.16 Relations: GATE CSE 1998 | Question: 2.3

<https://gateoverflow.in/1675>



The binary relation  $R = \{(1,1), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (3,4)\}$  on the set  $A = \{1, 2, 3, 4\}$  is

- A. reflexive, symmetric and transitive
- B. neither reflexive, nor irreflexive but transitive
- C. irreflexive, symmetric and transitive
- D. irreflexive and antisymmetric

gate1998 set-theory&algebra easy relations

Answer 

#### 4.10.17 Relations: GATE CSE 1999 | Question: 1.2

<https://gateoverflow.in/1456>



The number of binary relations on a set with  $n$  elements is:

- A.  $n^2$
- B.  $2^n$
- C.  $2^{n^2}$
- D. None of the above

gate1999 set-theory&algebra relations combinatorics easy

Answer 

#### 4.10.18 Relations: GATE CSE 1999 | Question: 2.3

<https://gateoverflow.in/1481>



Let  $L$  be a set with a relation  $R$  which is transitive, anti-symmetric and reflexive and for any two elements  $a, b \in L$ , let the least upper bound  $\text{lub}(a, b)$  and the greatest lower bound  $\text{glb}(a, b)$  exist. Which of the following is/are true?

- A.  $L$  is a poset
- B.  $L$  is a Boolean algebra
- C.  $L$  is a lattice
- D. None of the above

gate1999 set-theory&algebra normal relations multiple-selects

Answer 

#### 4.10.19 Relations: GATE CSE 1999 | Question: 3

<https://gateoverflow.in/1522>



- a. Mr. X claims the following:

If a relation  $R$  is both symmetric and transitive, then  $R$  is reflexive. For this, Mr. X offers the following proof:

“From  $xRy$ , using symmetry we get  $yRx$ . Now because  $R$  is transitive  $xRy$  and  $yRx$  together imply  $xRx$ . Therefore,  $R$  is reflexive”.

- Give an example of a relation  $R$  which is symmetric and transitive but not reflexive.

gate1999 | set-theory&algebra | relations | normal | descriptive

Answer 

#### 4.10.20 Relations: GATE CSE 2000 | Question: 2.5

<https://gateoverflow.in/652>



A relation  $R$  is defined on the set of integers as  $xRy$  iff  $(x + y)$  is even. Which of the following statements is true?

- $R$  is not an equivalence relation
- $R$  is an equivalence relation having 1 equivalence class
- $R$  is an equivalence relation having 2 equivalence classes
- $R$  is an equivalence relation having 3 equivalence classes

gate2000-cse | set-theory&algebra | relations | normal

Answer 

#### 4.10.21 Relations: GATE CSE 2001 | Question: 1.2

<https://gateoverflow.in/695>



Consider the following relations:

- $R_1(a, b)$  iff  $(a + b)$  is even over the set of integers
- $R_2(a, b)$  iff  $(a + b)$  is odd over the set of integers
- $R_3(a, b)$  iff  $a \cdot b > 0$  over the set of non-zero rational numbers
- $R_4(a, b)$  iff  $|a - b| \leq 2$  over the set of natural numbers

Which of the following statements is correct?

- $R_1$  and  $R_2$  are equivalence relations,  $R_3$  and  $R_4$  are not
- $R_1$  and  $R_3$  are equivalence relations,  $R_2$  and  $R_4$  are not
- $R_1$  and  $R_4$  are equivalence relations,  $R_2$  and  $R_3$  are not
- $R_1, R_2, R_3$  and  $R_4$  all are equivalence relations

gate2001-cse | set-theory&algebra | normal | relations

Answer 

#### 4.10.22 Relations: GATE CSE 2002 | Question: 2.17

<https://gateoverflow.in/847>



The binary relation  $S = \phi$  (empty set) on a set  $A = \{1, 2, 3\}$  is

- Neither reflexive nor symmetric
- Symmetric and reflexive
- Transitive and reflexive
- Transitive and symmetric

gate2002-cse | set-theory&algebra | normal | relations

Answer 

#### 4.10.23 Relations: GATE CSE 2002 | Question: 3

<https://gateoverflow.in/856>



Let  $A$  be a set of  $n (> 0)$  elements. Let  $N_r$  be the number of binary relations on  $A$  and let  $N_f$  be the number of functions from  $A$  to  $A$

- Give the expression for  $N_r$ , in terms of  $n$ .
- Give the expression for  $N_f$ , terms of  $n$ .
- Which is larger for all possible  $n$ ,  $N_r$  or  $N_f$

[gate2002-cse](#) [set-theory&algebra](#) [normal](#) [descriptive](#) [relations](#)

Answer 

#### 4.10.24 Relations: GATE CSE 2004 | Question: 24 [top](#)

<https://gateoverflow.in/1021>



Consider the binary relation:

$$S = \{(x, y) \mid y = x + 1 \text{ and } x, y \in \{0, 1, 2\}\}$$

The reflexive transitive closure is  $S$  is

- A.  $\{(x, y) \mid y > x \text{ and } x, y \in \{0, 1, 2\}\}$
- B.  $\{(x, y) \mid y \geq x \text{ and } x, y \in \{0, 1, 2\}\}$
- C.  $\{(x, y) \mid y < x \text{ and } x, y \in \{0, 1, 2\}\}$
- D.  $\{(x, y) \mid y \leq x \text{ and } x, y \in \{0, 1, 2\}\}$

[gate2004-cse](#) [set-theory&algebra](#) [easy](#) [relations](#)

Answer 

#### 4.10.25 Relations: GATE CSE 2005 | Question: 42 [top](#)

<https://gateoverflow.in/1167>



Let  $R$  and  $S$  be any two equivalence relations on a non-empty set  $A$ . Which one of the following statements is TRUE?

- A.  $R \cup S, R \cap S$  are both equivalence relations
- B.  $R \cup S$  is an equivalence relation
- C.  $R \cap S$  is an equivalence relation
- D. Neither  $R \cup S$  nor  $R \cap S$  are equivalence relations

[gate2005-cse](#) [set-theory&algebra](#) [normal](#) [relations](#)

Answer 

#### 4.10.26 Relations: GATE CSE 2005 | Question: 7 [top](#)

<https://gateoverflow.in/1349>



The time complexity of computing the transitive closure of a binary relation on a set of  $n$  elements is known to be:

- A.  $O(n)$
- B.  $O(n \log n)$
- C.  $O\left(n^{\frac{3}{2}}\right)$
- D.  $O(n^3)$

[gate2005-cse](#) [set-theory&algebra](#) [normal](#) [relations](#)

Answer 

#### 4.10.27 Relations: GATE CSE 2006 | Question: 4 [top](#)

<https://gateoverflow.in/883>



A relation  $R$  is defined on ordered pairs of integers as follows:

$$(x, y)R(u, v) \text{ if } x < u \text{ and } y > v$$

Then  $R$  is:

- A. Neither a Partial Order nor an Equivalence Relation
- B. A Partial Order but not a Total Order
- C. A total Order
- D. An Equivalence Relation

[gate2006-cse](#) [set-theory&algebra](#) [normal](#) [relations](#)

Answer 

**4.10.28 Relations: GATE CSE 2007 | Question: 2** top ↗<https://gateoverflow.in/1201>

Let  $S$  be a set of  $n$  elements. The number of ordered pairs in the largest and the smallest equivalence relations on  $S$  are:

- A.  $n$  and  $n$
- B.  $n^2$  and  $n$
- C.  $n^2$  and 0
- D.  $n$  and 1

[gate2007-cse](#) [set-theory&algebra](#) [normal](#) [relations](#)

Answer

**4.10.29 Relations: GATE CSE 2009 | Question: 4** top ↗<https://gateoverflow.in/797>

Consider the binary relation  $R = \{(x,y), (x,z), (z,x), (z,y)\}$  on the set  $\{x, y, z\}$ . Which one of the following is TRUE?

- A.  $R$  is symmetric but NOT antisymmetric
- B.  $R$  is NOT symmetric but antisymmetric
- C.  $R$  is both symmetric and antisymmetric
- D.  $R$  is neither symmetric nor antisymmetric

[gate2009-cse](#) [set-theory&algebra](#) [easy](#) [relations](#)

Answer

**4.10.30 Relations: GATE CSE 2010 | Question: 3** top ↗<https://gateoverflow.in/1149>

What is the possible number of reflexive relations on a set of 5 elements?

- A.  $2^{10}$
- B.  $2^{15}$
- C.  $2^{20}$
- D.  $2^{25}$

[gate2010-cse](#) [set-theory&algebra](#) [easy](#) [relations](#)

Answer

**4.10.31 Relations: GATE CSE 2015 Set 2 | Question: 16** top ↗<https://gateoverflow.in/8089>

Let  $R$  be the relation on the set of positive integers such that  $aRb$  if and only if  $a$  and  $b$  are distinct and have a common divisor other than 1. Which one of the following statements about  $R$  is true?

- A.  $R$  is symmetric and reflexive but not transitive
- B.  $R$  is reflexive but not symmetric nor transitive
- C.  $R$  is transitive but not reflexive and not symmetric
- D.  $R$  is symmetric but not reflexive and not transitive

[gate2015-cse-set2](#) [set-theory&algebra](#) [relations](#) [normal](#)

Answer

**4.10.32 Relations: GATE CSE 2015 Set 3 | Question: 41** top ↗<https://gateoverflow.in/8500>

Let  $R$  be a relation on the set of ordered pairs of positive integers such that  $((p,q), (r,s)) \in R$  if and only if  $p-s = q-r$ . Which one of the following is true about  $R$ ?

- A. Both reflexive and symmetric
- B. Reflexive but not symmetric
- C. Not reflexive but symmetric
- D. Neither reflexive nor symmetric

[gate2015-cse-set3](#) [set-theory&algebra](#) [relations](#) [normal](#)

[Answer](#)**4.10.33 Relations: GATE CSE 2016 Set 2 | Question: 26** [top](#)<https://gateoverflow.in/39603>

A binary relation  $R$  on  $\mathbb{N} \times \mathbb{N}$  is defined as follows:  $(a, b)R(c, d)$  if  $a \leq c$  or  $b \leq d$ . Consider the following propositions:

- $P : R$  is reflexive.
- $Q : R$  is transitive.

Which one of the following statements is **TRUE**?

- A. Both  $P$  and  $Q$  are true.
- B.  $P$  is true and  $Q$  is false.
- C.  $P$  is false and  $Q$  is true.
- D. Both  $P$  and  $Q$  are false.

[gate2016-cse-set2](#) [set-theory&algebra](#) [relations](#) [normal](#)[Answer](#)**4.10.34 Relations: GATE CSE 2020 | Question: 17** [top](#)<https://gateoverflow.in/333214>

Let  $\mathcal{R}$  be the set of all binary relations on the set  $\{1, 2, 3\}$ . Suppose a relation is chosen from  $\mathcal{R}$  at random. The probability that the chosen relation is reflexive (round off to 3 decimal places) is \_\_\_\_\_.

[gate2020-cse](#) [numerical-answers](#) [probability](#) [relations](#)[Answer](#)**4.10.35 Relations: GATE CSE 2021 Set 1 | Question: 43** [top](#)<https://gateoverflow.in/357408>

A relation  $R$  is said to be circular if  $aRb$  and  $bRc$  together imply  $cRa$ .

Which of the following options is/are correct?

- A. If a relation  $S$  is reflexive and symmetric, then  $S$  is an equivalence relation.
- B. If a relation  $S$  is circular and symmetric, then  $S$  is an equivalence relation.
- C. If a relation  $S$  is reflexive and circular, then  $S$  is an equivalence relation.
- D. If a relation  $S$  is transitive and circular, then  $S$  is an equivalence relation.

[gate2021-cse-set1](#) [multiple-selects](#) [set-theory&algebra](#) [relations](#)[Answer](#)**4.10.36 Relations: GATE IT 2004 | Question: 4** [top](#)<https://gateoverflow.in/3645>

Let  $R_1$  be a relation from  $A = \{1, 3, 5, 7\}$  to  $B = \{2, 4, 6, 8\}$  and  $R_2$  be another relation from  $B$  to  $C = \{1, 2, 3, 4\}$  as defined below:

- i. An element  $x$  in  $A$  is related to an element  $y$  in  $B$  (under  $R_1$ ) if  $x + y$  is divisible by 3.
- ii. An element  $x$  in  $B$  is related to an element  $y$  in  $C$  (under  $R_2$ ) if  $x + y$  is even but not divisible by 3.

Which is the composite relation  $R_1 R_2$  from  $A$  to  $C$ ?

- A.  $R_1 R_2 = \{(1, 2), (1, 4), (3, 3), (5, 4), (7, 3)\}$
- B.  $R_1 R_2 = \{(1, 2), (1, 3), (3, 2), (5, 2), (7, 3)\}$
- C.  $R_1 R_2 = \{(1, 2), (3, 2), (3, 4), (5, 4), (7, 2)\}$
- D.  $R_1 R_2 = \{(3, 2), (3, 4), (5, 1), (5, 3), (7, 1)\}$

[gate2004-it](#) [set-theory&algebra](#) [relations](#) [normal](#)[Answer](#)**Answers: Relations**

**4.10.1 Relations: GATE CSE 1987 | Question: 2d** [top](#)<https://gateoverflow.in/80583>

- ✓ No union of two equivalence relations may not be an equivalence relation because of transitive dependency.

Equivalence relation: satisfy Reflexive, symmetric, and transitive property

- Reflexive  $\cup$  Reflexive = Reflexive
- Symmetric  $\cup$  Symmetric = Symmetric
- Transitive  $\cup$  Transitive  $\neq$  Transitive why

Example :  $R = \{(1, 2), (3, 4), (1, 4)\}$ ,  $S = (2, 3)$

Union =  $\{(1, 2), (3, 4), (1, 4), (2, 3)\}$  which is not transitive i.e.  $(1, 3)$  and  $(2, 4)$  is missing.

So, False is the answer.

21 votes

-- Prashant Singh (47.2k points)

**4.10.2 Relations: GATE CSE 1987 | Question: 9a** [top](#)<https://gateoverflow.in/82436>

- ✓ The total number of binary relation from  $n$  element set to itself is  $2^{n^2}$  i.e.  $n^2$  entries with two choices take it or not.

29 votes

-- Prashant Singh (47.2k points)

**4.10.3 Relations: GATE CSE 1987 | Question: 9e** [top](#)<https://gateoverflow.in/82446>

- ✓ Number of subsets of a set of  $n$  elements =  $2^n$

$$= {}^nC_0 + {}^nC_1 + \dots + {}^nC_n$$

Each of these terms  ${}^nC_k$  denotes the number of possible subsets of size  $k$ .

Now given a subset of size  $k$ , how many subsets can it have?  $\implies 2^k$ .

So, in this way number of inclusive relations on subsets of a set with  $n$  elements

$$= 2^0 \times {}^nC_0 + 2^1 \times {}^nC_1 + \dots + 2^n \times {}^nC_n = 3^n$$

PS:  $3^n = (2 + 1)^n = {}^nC_0 \times 2^0 \times 1^n + {}^nC_1 \times 2^1 \times 1^{n-1} \dots {}^nC_n \times 2^n \times 1^0$

14 votes

-- Arjun Suresh (328k points)

**4.10.4 Relations: GATE CSE 1989 | Question: 1-iv** [top](#)<https://gateoverflow.in/87048>

- ✓ Transitive closure of  $R$

1. It is transitive.
2. It contains  $R$ .
3. It is minimal satisfies 1 and 2.

$$R = (1, 2), (2, 3), (3, 4), (5, 4)$$

The transitive closure of the relation  $R = \{(1, 2), (2, 3), (3, 4), (5, 4)\}$

18 votes

-- Hemant Parihar (11.8k points)

**4.10.5 Relations: GATE CSE 1992 | Question: 15.b** [top](#)<https://gateoverflow.in/43579>

- ✓ Let  $\mathbb{Z}$  be the set of integers, and define a relation  $R$  on  $\mathbb{Z}$  by  $aRb$  whenever the difference between  $a$  and  $b$  are multiples of 5. That is  $(a, b) \in R$  if and only if  $b - a = 5k$  for some integer  $k$ . Let us show that  $R$  is an equivalence relation: If  $a \in \mathbb{Z}$ , then  $a - a = 0 = 5 * 0$ , so  $aRa$ . Thus  $R$  is **Reflexive**.

If  $a, b \in \mathbb{Z}$  with  $aRb$ , then  $b - a = 5k$  for some integer  $k$ . Thus  $a - b = -(b - a) = 5 - 5k = (-k)$ . Since  $-k$  is also an integer, this shows that  $bRa$  and  $R$  is **Symmetric**.

If  $a, b, c \in \mathbb{Z}$  with  $aRb$  and  $bRc$ , then  $b - a = 5k$  and  $c - b = 5m$  for some integers  $k$  and  $m$ . Then  $c - a = (c - b) + (b - a) = 5m + 5k = 5(m + k)$ . Since  $m + k$  is an integer, this shows that  $aRc$  and  $R$  is **Transitive**.

Therefore,  $R$  is an Equivalence relation.

For  $n = 5$  the equivalence relation is called *congruence modulo 5*.

Equivalence classes will be

1.  $\{a \mid a \in \mathbb{Z}, a \bmod 5 = 0\}$
2.  $\{a \mid a \in \mathbb{Z}, a \bmod 5 = 1\}$
3.  $\{a \mid a \in \mathbb{Z}, a \bmod 5 = 2\}$
4.  $\{a \mid a \in \mathbb{Z}, a \bmod 5 = 3\}$
5.  $\{a \mid a \in \mathbb{Z}, a \bmod 5 = 4\}$

6 votes

-- Arpit Dhuriya (2.9k points)

#### 4.10.6 Relations: GATE CSE 1994 | Question: 2.3 [top](#)



- It is not reflexive as  $xRx$  is not possible.
- It is symmetric as if  $xRy$  then  $yRx$ .
- It is not antisymmetric as  $xRy$  and  $yRx$  are possible and we can have  $x \neq y$ .
- It is not transitive as if  $xRy$  and  $yRz$  then  $xRz$  need not be true. This is violated when  $z = x$ .

So, symmetry is the answer.

31 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.10.7 Relations: GATE CSE 1995 | Question: 1.19 [top](#)



- ✓ The answer is  $D$ .

Let  $A = \{1, 2, 3\}$  and relation  $R = \{(1, 2), (2, 1), (1, 1), (2, 2)\}$ .  $R$  is symmetric and transitive but not reflexive. Because  $(3, 3)$  is not there.

25 votes

-- Anu (4.7k points)

#### 4.10.8 Relations: GATE CSE 1996 | Question: 2.2 [top](#)



- ✓ Let  $A = \{1, 2, 3\}$  and  $B = \{4, 5\}$  and  $C = \{1, 6, 7\}$

now  $A \cap B = \emptyset$  and  $B \cap C = \emptyset$  but  $A \cap C \neq \emptyset$ , so  $R$  is not transitive.

$A \cap A = A$ , so  $R$  is not reflexive.

$A \cap B = B \cap A$ , so  $R$  is symmetric

So,  $A$  is false as  $R$  is not reflexive or transitive

$B$  is true.

$C$  is false because  $R$  is not transitive or reflexive

$D$  is false because  $R$  is symmetric

34 votes

-- akash (799 points)

#### 4.10.9 Relations: GATE CSE 1996 | Question: 8 [top](#)



- ✓ Total number of functions =  $3 * 3 * 3 = 27$  as each of 1, 2, and 3 has 3 choice to map to.

Now, for the equivalence relation, we need the mapping of 3 to be fixed. i.e., two functions  $f$  and  $g$  are related if and only if  $f(3) = g(3)$ . So, with  $3 \rightarrow 1$ , we can get  $3 * 3 = 9$  functions as 2 and 3 have 3 choices to map to each, and similarly 9 each for  $3 \rightarrow 2$  and  $3 \rightarrow 3$ .

a. So, total number of equivalence classes = 3, one each for  $3 \rightarrow 1, 3 \rightarrow 2$ , and  $3 \rightarrow 3$ .

b. Number of elements (elements here are functions) in each equivalence class = 9.

31 votes

-- Arjun Suresh (328k points)

**4.10.10 Relations: GATE CSE 1997 | Question: 14**<https://gateoverflow.in/2274>

1. Since it is given that relation  $R$  is reflexive and transitive, the new defined relation (definition of symmetric) is equivalence.
2. **Partial order** is a binary relation " $\leq$ " over a set  $P$  which is reflexive, antisymmetric, and transitive.
  - $a \leq a$  (reflexivity);
  - if  $a \leq b$  and  $b \leq a$ , then  $a = b$  (antisymmetry);
  - if  

$$\begin{aligned} &a \leq b \text{ and} \\ &b \leq c, \text{ then} \\ &a \leq c \text{ (transitivity)}. \end{aligned}$$

**References**

6 votes

-- asutosh kumar Biswal (8.1k points)

**4.10.11 Relations: GATE CSE 1997 | Question: 6.3**<https://gateoverflow.in/2259>

- ✓ No. of Equivalence Relations on a set of  $n$  elements is given by the  $n^{th}$  BELL number  $B_n$ .

$B_n$  is also equal to the number of different ways to partition a set that has exactly  $n$  elements, or equivalently, the number of equivalence relations on it.

Ref: [https://en.wikipedia.org/wiki/Bell\\_number](https://en.wikipedia.org/wiki/Bell_number)

$n^{th}$  Bell number can be found easily from the Bell triangle as follows:

Here,  $E_{(i,j)} = E_{(i-1,j-1)} + E_{(i,j-1)}$ ;  $i, j > 1$ ,

$$E_{(1,1)} = 1, E_{(i,1)} = E_{(i-1,i-1)}$$

1	— No. of partitions for 1 element set
1	2 — No. of partitions for 2 element set
2	3 5 — No. of partitions for 3 element set
5	7 10 15 — No. of partitions for 4 element set

So, answer is (A) 15.

**References**

43 votes

-- Akash Kanase (36k points)

**4.10.12 Relations: GATE CSE 1998 | Question: 1.6**<https://gateoverflow.in/1643>

- ✓ Answer is  $B$ .

The largest equivalence relation will be when every element is related to every other element. So,  $n \times n = n^2$  possible ordered pairs.

16 votes

-- Keith Kr (4.6k points)

**4.10.13 Relations: GATE CSE 1998 | Question: 1.7**<https://gateoverflow.in/1644>

- ✓ Answer:  $C$

$R_1$  intersection  $R_2$  is equivalence relation..

$R_1$  union  $R_2$  is not equivalence relation because transitivity needn't hold. For example,  $(a,b)$  can be in  $R_1$  and  $(b,c)$  be in  $R_2$  and  $(a,c)$  not in either  $R_1$  or  $R_2$ .

24 votes

-- Digvijay (44.9k points)

**4.10.14 Relations: GATE CSE 1998 | Question: 10a**<https://gateoverflow.in/1724>**✓ Statement:**

No. of diagonals :  $D(n) = \frac{n*(n-3)}{2}$

**Step 1: Basis :** for  $n = 4$ ,  $\frac{4*(4-3)}{2} = 2$  is true.

**Step 2: Inductive Step :**

If  $D(k)$  is true. we need to prove  $D(k + 1)$  is also true.

We add one more vertex to the set of  $k$  vertices. Assume added vertex is  $C$ .

Further assume  $C$  will connects vertex  $A$  and  $B$  to close the polygon. ( $A$  and  $B$  already exists in  $k$  sided polygon)

From  $C$ , no of pairs to each  $k$  vertices =  $k$ , out of these two will be used to close the polygon, i.e. used as sides of new  $(k + 1)$  sided polygon. Further more, initial connection (edge or side) between  $A$  and  $B$  is now becomes a diagonal.

No. of Diagonals in for  $(k + 1)$  sided polygon = diagonal from  $k$  sided polygon +  $k - 2 + 1$

$$\frac{k*(k-3)}{3} + k - 1 = \frac{k^2 - k - 2}{2} = \frac{(k+1)(k-2)}{2} \frac{(k+1)((k+1)-3)}{2}$$

$\implies D(k + 1)$  holds.

Since, both the basis and the inductive step have been performed, by mathematical induction, the statement  $D(n)$  holds for all natural numbers  $n > 3$ .

15 votes

-- Debashish Deka (40.7k points)

**4.10.15 Relations: GATE CSE 1998 | Question: 10b**<https://gateoverflow.in/232729>**✓ For every non-empty set  $A$ , if  $R$  is a binary relation on  $A$  then-**

$R^0$  is an identity relation on  $A$  which is defined as -  $R^0 = \{(x, x) \mid x \in A\}$

Also, if a relation has a cycle of length  $n$  then its  $n^{th}$  power is reflexive and identity relation. So for first component,  $R_3$  is reflexive and hence  $R_0 = R_3$ .

Similarly, for second component  $R_0 = R_5$ . LCM of 3 and 5 is 15.  
So  $m = 1$  and  $n = 12$ .

LCM of 3 and 5 is 15. So,  $m = 0$  and  $n = 15$ .

[Check this](#) for having some intuition behind  $R^0$ .

PS: Here,  $R_1 = R_4$ ;  $R_2 = R_6$  and we get  $m = 1, n = 12$ . But question asks for smallest  $m, n$ .

**References**

8 votes

-- Soumya Jain (12.4k points)

**4.10.16 Relations: GATE CSE 1998 | Question: 2.3**<https://gateoverflow.in/1675>**✓ Not reflexive -  $(4, 4)$  not present.**

Not irreflexive -  $(1, 1)$  is present.

Not symmetric -  $(2, 1)$  is present but not  $(1, 2)$ .

Not antisymmetric -  $(2, 3)$  and  $(3, 2)$  are present.

Not Asymmetric - asymmetry requires both antisymmetry and irreflexivity.

It is transitive.

So, the correct option is *B*.  
transitive.

25 votes

-- Digvijay (44.9k points)

#### 4.10.17 Relations: GATE CSE 1999 | Question: 1.2 top ↗

<https://gateoverflow.in/1456>



- ✓ Answer: *C*

In a binary relation two elements are chosen from the set. So, with  $n$  elements  $n^2$  pairings are possible. Now, a relation can be any subset of these  $n^2$  pairings and thus we get  $2^{n^2}$  binary relations.

22 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.10.18 Relations: GATE CSE 1999 | Question: 2.3 top ↗

<https://gateoverflow.in/1481>



- ✓ Which of the following **is/are** true? This is question with Multiple answers.

As our Relation *R* on Set *L* is Reflexive , anti symmetric & Transitive it is poset.

Since LUB & GLB exists for any two elements it is lattice.

Answer: *A & C*.

*B* is not guaranteed to be true.

Ref: <http://uosis.mif.vu.lt/~valdas/PhD/Kursinis2/Sasao99/Chapter2.pdf>

#### References



11 votes

-- Akash Kanase (36k points)

#### 4.10.19 Relations: GATE CSE 1999 | Question: 3 top ↗

<https://gateoverflow.in/1522>



- ✓ Let set *A* be  $1, 2, 3$ , and let a relation *R* on *A* be

$$\{(1,1), (1,2), (2,1), (2,2)\}$$

*R* is both symmetric and transitive, but not reflexive. The key point here is that there may be some element in set *A* which is not related to any of the element in *R*, but to be reflexive, all elements must be related to themselves.

25 votes

-- Happy Mittal (8.2k points)

#### 4.10.20 Relations: GATE CSE 2000 | Question: 2.5 top ↗

<https://gateoverflow.in/652>



- ✓ *R* is reflexive as  $(x + x)$  is even for any integer.

*R* is symmetric as if  $(x + y)$  is even  $(y + x)$  is also even.

*R* is transitive as if  $(x + (y + z))$  is even, then  $((x + y) + z)$  is also even.

So, *R* is an equivalence relation.

For set of natural numbers, sum of even numbers always give even, sum of odd numbers always give even and sum of any even and any odd number always give odd. So, *R* must have two equivalence classes -one for even and one for odd.

$$\{\dots, -4, -2, 0, 2, 4, \dots\}, \{\dots, -3, -1, 1, 3, \dots\}$$

Correct Answer: *C*.

38 votes

-- Anu (4.7k points)

#### 4.10.21 Relations: GATE CSE 2001 | Question: 1.2 top ↗

<https://gateoverflow.in/695>



- ✓ *R1*) Reflexive :  $a + a = 2a$  always even

Symmetric: either  $(a, b)$  both must be odd or both must be even to have sum as even

Therefore, if  $(a, b)$  then definitely  $(b, a)$

Transitive: if  $(a, b)$  and  $(b, c)$ , then both of them must be even pairs or odd pairs and therefore  $(a, c)$  is even

R2) Reflexive :  $a + a = 2a$  cant be odd ever

R3) Reflexive:  $a \cdot a > 0$

Symmetric: if  $a, b > 0$  then both must be +ve or -ve, which means  $b \cdot a > 0$  also exists

Transitive : if  $a \cdot b > 0$  and  $b \cdot c > 0$  then to have  $b$  as same number, both pairs must be +ve or -ve which implies  $a \cdot c > 0$

R4) Reflexive:  $|a - a| \leq 2$

Symmetric: if  $|a - b| \leq 2$  definitely  $|b - a| \leq 2$  when  $a, b$  are natural numbers

Transitive:  $|a - b| \leq 2$  and  $|b - c| \leq 2$ , does not imply  $|a - c| \leq 2$

Ex:  $|4 - 2| \leq 2$  and  $|2 - 0| \leq 2$ , but  $|4 - 0| > 2$ ,

Hence, R2 and R4 are not equivalence.

Answer is B.

122 votes

-- confused\_luck (741 points)

#### 4.10.22 Relations: GATE CSE 2002 | Question: 2.17 top

→ <https://gateoverflow.in/847>



✓ Answer is D.

$S = \emptyset$  (empty set) on a set  $A = \{1, 2, 3\}$  is Irreflexive, Symmetric, Anti Symmetric, Asymmetric, Transitive. But it is not Reflexive.

133 votes

-- Digvijay (44.9k points)

#### 4.10.23 Relations: GATE CSE 2002 | Question: 3 top

→ <https://gateoverflow.in/856>



✓ A. Consider a 2D matrix of  $n \times n$  size where each dimension represent the  $n$  elements of  $A$ . So, we get  $n^2$  elements where each one can be viewed as an ordered pair  $(i, j), 1 \leq i, j \leq n$ . Now if we consider a set with these  $n^2$  elements, any subset of it will be a binary relation from  $A$  to  $A$ .

So, no. of binary relations,  $N_r = 2^{n^2}$

For a function from a set of  $n$  elements to a set of  $m$  elements we have  $m$  choice for each of the  $n$  elements of the domain. Thus, we get  $m^n$  possibilities. Here,  $m = n$ . So,

No. of functions,  $N_f = n^n$

Now, number of functions must be smaller than the number of relations because every function is also a relation. We can prove this formally as follows:

$$\lim_{n \rightarrow \infty} \frac{2^{n^2}}{n^n}$$

$\infty$  form. So, applying L'Hopital's rule (Limit remains same after taking derivative of both numerator and denominator)

$$= \lim_{n \rightarrow \infty} \frac{2n \cdot \log 2 \cdot 2^{n^2}}{nn^{n-1}}$$

We can continue like this applying L'Hopital's rule and we should eventually get 1 in the denominator (as after each derivation power of  $n$  decreases by 1) which gives the limit value as  $\infty$ . So,  $2^{n^2}$  is faster growing than  $n^n$ .

So, for sufficiently large  $n$ ,  $N_r > N_f$

#### References



27 votes

-- Digvijay (44.9k points)

**4.10.24 Relations: GATE CSE 2004 | Question: 24** [w https://gateoverflow.in/1021](https://gateoverflow.in/1021)

- ✓ Option b. Transitive means,  $x$  is related to all greater  $y$  (as every  $x$  is related to  $x + 1$ ) and reflexive means  $x$  is related to  $x$ .

16 votes

-- anshu (2.7k points)

**4.10.25 Relations: GATE CSE 2005 | Question: 42** [w https://gateoverflow.in/1167](https://gateoverflow.in/1167)

- ✓  $R \cup S$  might not be transitive. Say,  $(a, b)$  be present in  $R$  and  $(b, c)$  be present in  $S$  and  $(a, c)$  not present in either,  $R \cup S$  will contain,  $(a, b)$  and  $(b, c)$  but not  $(a, c)$  and hence, not transitive.

Correct Answer: C.

21 votes

-- anshu (2.7k points)

**4.10.26 Relations: GATE CSE 2005 | Question: 7** [w https://gateoverflow.in/1349](https://gateoverflow.in/1349)

- ✓ Answer D

Calculating Transitive Closure boils down to Matrix Multiplication.

We can do Matrix Multiplication in  $O(n^3)$ . There are better algo that do less than cubic time, but we can not surely do matrix multiplication in

- (A)  $O(n)$
- (B)  $O(n \log n)$
- (C)  $O(n^{1.5})$

34 votes

-- Akash Kanase (36k points)

**4.10.27 Relations: GATE CSE 2006 | Question: 4** [w https://gateoverflow.in/883](https://gateoverflow.in/883)

- ✓ Answer is (A). Because the relation is not reflexive which is a necessary condition for both partial order and equivalence relation..!!

PS: For a relation to be reflexive  $R(a, a)$  must hold for all possible  $a$ .

29 votes

-- Vicky Bajoria (4.1k points)

**4.10.28 Relations: GATE CSE 2007 | Question: 2** [w https://gateoverflow.in/1201](https://gateoverflow.in/1201)

- ✓ Answer is B.

equivalence relation means it is reflexive, symmetric and transitive

and if the relation is reflexive then it must have all the pairs of diagonal elements. and relation with only diagonal elements is also symmetric and transitive. therefore smallest is of size  $n$ .

with diagonal elements we can include all the elements therefore largest is  $n^2$

25 votes

-- jayendra (6.7k points)

**4.10.29 Relations: GATE CSE 2009 | Question: 4** [w https://gateoverflow.in/797](https://gateoverflow.in/797)

- ✓ Answer is D.

A binary relation  $R$  over a set  $X$  is symmetric if it holds for all  $a$  and  $b$  in  $X$  that if  $a$  is related to  $a$ .

$$\forall_{a,b} \in X, aRb \Rightarrow bRa.$$

Here  $(x, y)$  is there in  $R$  but  $(y, x)$  is not there.

$\therefore$  Not Symmetric.

For Antisymmetric Relations:  $\forall_{a,b} \in X, R(a, b) \& R(b, a) \Rightarrow a = b$ .

Here  $(x, z)$  is there in  $R$  also  $(z, x)$  is there violating the antisymmetric rule.

$\therefore$  Not AntiSymmetric.

125 votes

-- Sona Praneeth Akula (3.4k points)

#### 4.10.30 Relations: GATE CSE 2010 | Question: 3 [top](#)

<https://gateoverflow.in/1149>



- ✓ A relation consists of set of ordered pairs  $(a, b)$ . Here,  $a$  can be chosen in  $n$  ways and similarly,  $b$  can be chosen in  $n$  ways. So, totally  $n^2$  possible ordered pairs are possible for a relation. Now each of these ordered pair can either be present in the relation or not- 2 possibilities for each of the  $n^2$  pair. So, total number of possible relations =

$$2^{(n^2)}$$

Now, for a relation  $R$  to be reflexive, ordered pairs  $\{(a, a) \mid a \in S\}$ , must be present in  $R$ . i.e.; the relation set  $R$  must have  $n$  ordered pairs fixed. So, number of ordered pairs possible is  $n^2 - n$  and hence total number of reflexive relations is equal to

$$2^{(n^2 - n)}$$

for  $n = 5$ , answer will be,  $2^{5^2 - 5} = 2^{20}$

Therefore, **option C** is correct

134 votes

-- Arjun Suresh (328k points)

#### 4.10.31 Relations: GATE CSE 2015 Set 2 | Question: 16 [top](#)

<https://gateoverflow.in/8089>



- ✓ Answer: D

Take  $(3, 6)$  and  $(6, 2)$  elements of  $R$ . For transitivity  $(3, 2)$  must be element of  $R$ , but 3 and 2 don't have a common divisor and hence not in  $R$ .

For any positive integer  $n$ ,  $(n, n)$  is not element of  $R$  as only distinct  $m$  and  $n$  are allowed for  $(m, n)$  in  $R$ . So, not reflexive also.

154 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.10.32 Relations: GATE CSE 2015 Set 3 | Question: 41 [top](#)

<https://gateoverflow.in/8500>



- ✓ The key trick here is to realize that the relation is of the form :

**{ordered pair, ordered pair} and not simply ordered pair .**

Ok, so for reflexive

$\forall_{a,b} if((a,b),(a,b)) \in R \rightarrow$  reflexive

$((a,b),(a,b)) \in R \leftrightarrow (a - b = b - a)$  (not possible for any postive integers b and a)

**But that is a contradiction hence it is not reflexive.**

Now, for symmetric

$((a,b),(c,d)) \in R \rightarrow ((c,d),(a,b)) \in R$

$((a,b),(c,d)) \in R \rightarrow (a - d = b - c)$

$((c,d),(a,b)) \in R$

$\because (c - b = d - a) \leftrightarrow (d - a = c - b) \leftrightarrow (-(a - d) = -(b - c)) \leftrightarrow (a - d = b - c)$

**So, it is symmetric.**

Hence, **C is the correct option.**

75 votes

-- Tamojit Chatterjee (1.9k points)

#### 4.10.33 Relations: GATE CSE 2016 Set 2 | Question: 26 [top](#)

<https://gateoverflow.in/39603>



- ✓ (B) Reflexive, but not transitive.

it is " $a \leq c$  OR  $b \leq d$ ",

**NOT**

" $a \leq c$  AND  $b \leq d$ "

$(2,5)R(6,3), (6,3)R(1,4)$ , but  $(2,5)R(1,4)$

75 votes

-- Ashish Deshmukh (1.3k points)

**4.10.34 Relations: GATE CSE 2020 | Question: 17** <https://gateoverflow.in/333214>

- ✓ No. of relations on set  $A$  with  $n$  elements =  $2^{n \times n}$

There are  $n$  reflexive pairs, and  $n^2 - n$  non-reflexive pairs

For a relation which is reflexive, all reflexive pairs must present and are no-restrictions on the non-reflexive pairs.

So, there are two possibilities for non-reflexive pairs- present or absent.

$$\therefore \text{No.of reflexive relations} = 1 \cdot 2^{(n^2-n)}$$

$$\text{Probability that a chosen relation is reflexive} = \frac{2^{(n^2-n)}}{2^{n^2}} = \frac{2^6}{2^9} = 0.125$$

18 votes

-- Shaik Masthan (50.2k points)

	1	2	3
1	(1, 1)	(1, 2)	(1, 3)
2	(2, 1)	(2, 2)	(2, 3)
3	(3, 1)	(3, 2)	(3, 3)

Now each of the cells have 2 possibility i.e.

1. it can be in a relation
2. it cannot appear in the relation

Hence total number of relations possible =  $2 * 2 * 2 * 2 * 2 * 2 * 2 * 2 * 2 = 2^9$

For any relation to be reflexive the relation should contain all the daigonal elements of the table so we need to select (1, 1), (2, 2), (3, 3) in every reflexive relation.

Now 6 remaining cells(non-daigonal cells) can have 2 possibilities

1. it can be in a relation
2. it cannot appear in the relation

Hence total number of reflexive relations possible =  $1 * 1 * 1 * 2 * 2 * 2 * 2 * 2 = 2^6$  (1 is possibility for selecting daigonal elements)

$$\therefore \text{Probability} = \frac{\text{Total number of reflexive relation}}{\text{total number of relations}} = \frac{2^6}{2^9} = \frac{64}{512} = 0.125$$

12 votes

-- Satbir Singh (20.9k points)

**4.10.35 Relations: GATE CSE 2021 Set 1 | Question: 43** <https://gateoverflow.in/357408>

- ✓ Let  $S$  be an empty relation

Empty relation is all **symmetric, transitive and circular** (as all these three are conditional)

But it is not reflexive.

**equivalence relation : reflexive, symmetric and transitive**

$S$  is both circular and symmetric but not reflexive, hence B is false

$S$  is both transitive and circular but not reflexive, hence D is false

option A clearly does not follow the definition of equivalence relation,

so only option left is C

and **C indeed is the correct answer as proved below**

**Let S be both reflexive and circular,**

**case 1: x has only diagonal elements (  $aSa$  exists for all a)**

Then  $S$  is all reflexive, symmetric, transitive and circular (hence equivalence )

**case 2: let for some 3 different elements a,b,c  $aSb$  exists but  $bSc$  does not exist**

Both  $aSa, bSb$  also exist (it is given reflexive)

$(aSa \text{ and } aSb) \rightarrow bSa$  (from circular property),

so,  $aSb \rightarrow bSa$ , hence it is symmetric

And transitive as well (because if  $aSb$  exists then no  $bSc$  exists for any three different elements  $a, b, c$ )

Hence this case will also be equivalence

**case 3: let for some 3 different elements a,b,c both  $aSb, bSc$  exists**

$aSa, bSb, cSc$  (exists from reflexive property)

$bSb \text{ and } bSc \rightarrow cSb$  (from circular property) (**Hence it is symmetric**)

$aSb \text{ and } bSc \rightarrow cSa$  (from circular property)

$cSa \rightarrow aSc$  (from symmetric property) (already proved symmetric 2 steps above)

so, we can conclude,

$aSb \text{ and } bSc \rightarrow aSc$  (**hence it is transitive as well**)

as we just proved it as both symmetric and transitive, it is definitely equivalence relation

In all three cases we proved that if  $S$  is both reflexive and circular then it is an equivalence relation.

**C is correct ans.**

6 votes

-- Nikhil Dhamla (2.3k points)

### If a relation R is reflexive and circular then it is symmetric : True

Proof : Assume  $aRb$ . Then since  $R$  is reflexive, we have  $bRb$ . Since  $R$  is circular, so,  $aRb, bRb$  will mean that we have  $bRa$ . So,  $R$  is symmetric.

### If R is reflexive and circular then it is transitive : True

Proof : Assume  $aRb, bRc$ . Since  $R$  is circular, so,  $cRa$ , and since  $R$  is symmetric (we proved above) so  $aRc$  so  $R$  is transitive.

**So, option C is correct.**

Option B is false. For counter example, take a set  $A = \{a, b, c\}$ , define relation  $R$  on  $A$  as follows :  $R = \{(a, a)\}$ ,  $R$  is symmetric and circular but not equivalence relation.

Option A is false. For counter example, take a set  $A = \{a, b, c\}$ , define relation  $R$  on  $A$  as follows:

$R = \{(a, a), (b, b), (c, c), (a, b), (b, a), (a, c), (c, a)\}$ ,  $R$  is symmetric and reflexive but not transitive so not equivalence relation.

Option D is false. For counter example, take a set  $A = \{a, b, c\}$ , define relation  $R$  on  $A$  as follows:  $R = \{(a, a)\}$ ,  $R$  is transitive and circular but not equivalence relation.

### Some more variations :

1. Converse of Statement in option C is also true. i.e.

**Theorem : If R is an equivalence relation then R is reflexive and circular.**

Proof :

Reflexive: As, the relation  $R$  is an equivalence relation. So, reflexivity is the property of an equivalence relation. Hence,  $R$  is reflexive.

Circular: Let  $(a, b) \in R$  and  $(b, c) \in R$

$$\Rightarrow (a, c) \in R \quad (\because R \text{ is transitive})$$

$$\Rightarrow (c, a) \in R \quad (\because R \text{ is symmetric})$$

Thus,  $R$  is Circular.

So, we can say that

**"A relation S is reflexive and circular if and only if S is an equivalence relation."**

2. If a relation  $R$  is transitive and circular then it is symmetric : False.

3. If a relation  $R$  is transitive and circular then it is reflexive : False.

Counter example(for both above statements) :  $R = \{(a, b)\}$

PS : Similarly you can try to prove or disprove more similar statements and their converses.

5 votes

-- Deepak Poonia (2.3k points)

**4.10.36 Relations: GATE IT 2004 | Question: 4** [top](#)<https://gateoverflow.in/3645>

- ✓ Answer is C.

Explanation:

$$R1 = (1, 2), (1, 8), (3, 6), (5, 4), (7, 2), (7, 8)$$

$$R2 = (2, 2), (4, 4), (6, 2), (6, 4), (8, 2)$$

$$\text{So, } R1R2 = (1, 2), (3, 2), (3, 4), (5, 4), (7, 2)$$

24 votes

-- chetna (297 points)

**4.11****Sets (27)** [top](#)**4.11.1 Sets: GATE CSE 1993 | Question: 17** [top](#)<https://gateoverflow.in/2314>

Out of a group of 21 persons, 9 eat vegetables, 10 eat fish and 7 eat eggs. 5 persons eat all three. How many persons eat at least two out of the three dishes?

[gate1993](#) [set-theory&algebra](#) [easy](#) [sets](#) [descriptive](#)

Answer

**4.11.2 Sets: GATE CSE 1993 | Question: 8.3** [top](#)<https://gateoverflow.in/2301>

Let  $S$  be an infinite set and  $S_1, \dots, S_n$  be sets such that  $S_1 \cup S_2 \cup \dots \cup S_n = S$ . Then

- A. at least one of the sets  $S_i$  is a finite set
- B. not more than one of the sets  $S_i$  can be finite
- C. at least one of the sets  $S_i$  is an infinite
- D. not more than one of the sets  $S_i$  can be infinite
- E. None of the above

[gate1993](#) [set-theory&algebra](#) [normal](#) [sets](#)

Answer

**4.11.3 Sets: GATE CSE 1993 | Question: 8.4** [top](#)<https://gateoverflow.in/2302>

Let  $A$  be a finite set of size  $n$ . The number of elements in the power set of  $A \times A$  is:

- A.  $2^{2^n}$
- B.  $2^{n^2}$
- C.  $(2^n)^2$
- D.  $(2^2)^n$
- E. None of the above

[gate1993](#) [set-theory&algebra](#) [easy](#) [sets](#)

Answer

**4.11.4 Sets: GATE CSE 1994 | Question: 2.4** [top](#)<https://gateoverflow.in/2471>

The number of subsets  $\{1, 2, \dots, n\}$  with odd cardinality is \_\_\_\_\_

[gate1994](#) [set-theory&algebra](#) [easy](#) [sets](#) [fill-in-the-blanks](#)

Answer

**4.11.5 Sets: GATE CSE 1995 | Question: 1.20** [top](#)<https://gateoverflow.in/2607>

The number of elements in the power set  $P(S)$  of the set  $S = \{\{\emptyset\}, 1, \{2, 3\}\}$  is:

- A. 2
- B. 4
- C. 8

- D. None of the above

gate1995 set-theory&algebra normal sets

Answer 

#### 4.11.6 Sets: GATE CSE 1995 | Question: 25b top ↗

<https://gateoverflow.in/314348>



Determine the number of positive integers ( $\leq 720$ ) which are not divisible by any of 2, 3 or 5.

gate1995 set-theory&algebra sets numerical-answers

Answer 

#### 4.11.7 Sets: GATE CSE 1996 | Question: 1.1 top ↗

<https://gateoverflow.in/2705>



Let  $A$  and  $B$  be sets and let  $A^c$  and  $B^c$  denote the complements of the sets  $A$  and  $B$ . The set  $(A - B) \cup (B - A) \cup (A \cap B)$  is equal to

- A.  $A \cup B$
- B.  $A^c \cup B^c$
- C.  $A \cap B$
- D.  $A^c \cap B^c$

gate1996 set-theory&algebra easy sets

Answer 

#### 4.11.8 Sets: GATE CSE 1998 | Question: 2.4 top ↗

<https://gateoverflow.in/1676>



In a room containing 28 people, there are 18 people who speak English, 15 people who speak Hindi and 22 people who speak Kannada. 9 persons speak both English and Hindi, 11 persons speak both Hindi and Kannada whereas 13 persons speak both Kannada and English. How many speak all three languages?

- A. 9
- B. 8
- C. 7
- D. 6

gate1998 set-theory&algebra easy sets

Answer 

#### 4.11.9 Sets: GATE CSE 2000 | Question: 2.6 top ↗

<https://gateoverflow.in/653>



Let  $P(S)$  denotes the power set of set  $S$ . Which of the following is always true?

- A.  $P(P(S)) = P(S)$
- B.  $P(S) \cap P(P(S)) = \{\emptyset\}$
- C.  $P(S) \cap S = P(S)$
- D.  $S \notin P(S)$

gate2000-cse set-theory&algebra easy sets

Answer 

#### 4.11.10 Sets: GATE CSE 2000 | Question: 6 top ↗

<https://gateoverflow.in/677>



Let  $S$  be a set of  $n$  elements  $\{1, 2, \dots, n\}$  and  $G$  a graph with  $2^n$  vertices, each vertex corresponding to a distinct subset of  $S$ . Two vertices are adjacent iff the symmetric difference of the corresponding sets has exactly 2 elements. Note: The symmetric difference of two sets  $R_1$  and  $R_2$  is defined as  $(R_1 \setminus R_2) \cup (R_2 \setminus R_1)$

Every vertex in  $G$  has the same degree. What is the degree of a vertex in  $G$ ?

How many connected components does  $G$  have?

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[set-theory&algebra](#)
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[descriptive](#)
[sets](#)
[Answer](#)
**4.11.11 Sets: GATE CSE 2001 | Question: 2.2**
top ↗
<https://gateoverflow.in/720>


Consider the following statements:

- $S_1$  : There exists infinite sets  $A, B, C$  such that  $A \cap (B \cup C)$  is finite.
- $S_2$  : There exists two irrational numbers  $x$  and  $y$  such that  $(x + y)$  is rational.

Which of the following is true about  $S_1$  and  $S_2$ ?

A. Only  $S_1$  is correct  
 B. Only  $S_2$  is correct  
 C. Both  $S_1$  and  $S_2$  are correct  
 D. None of  $S_1$  and  $S_2$  is correct

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[Answer](#)
**4.11.12 Sets: GATE CSE 2001 | Question: 3**
top ↗
<https://gateoverflow.in/744>


- a. Prove that powerset  $(A \cap B) = \text{powerset}(A) \cap \text{powerset}(B)$
- b. Let  $\text{sum}(n) = 0 + 1 + 2 + \dots + n$  for all natural numbers  $n$ . Give an induction proof to show that the following equation is true for all natural numbers  $m$  and  $n$ :

$$\text{sum}(m + n) = \text{sum}(m) + \text{sum}(n) + mn$$

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[Answer](#)
**4.11.13 Sets: GATE CSE 2005 | Question: 8**
top ↗
<https://gateoverflow.in/1157>


Let  $A, B$  and  $C$  be non-empty sets and let  $X = (A - B) - C$  and  $Y = (A - C) - (B - C)$ . Which one of the following is TRUE?

- A.  $X = Y$   
 B.  $X \subset Y$   
 C.  $Y \subset X$   
 D. None of these

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[easy](#)
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**4.11.14 Sets: GATE CSE 2006 | Question: 22**
top ↗
<https://gateoverflow.in/983>


Let  $E, F$  and  $G$  be finite sets. Let

- $X = (E \cap F) - (F \cap G)$  and
- $Y = (E - (E \cap G)) - (E - F)$ .

Which one of the following is true?

- A.  $X \subset Y$   
 B.  $X \supset Y$   
 C.  $X = Y$   
 D.  $X - Y \neq \emptyset$  and  $Y - X \neq \emptyset$

[gate2006-cse](#)
[set-theory&algebra](#)
[normal](#)
[sets](#)
[Answer](#)

**4.11.15 Sets: GATE CSE 2006 | Question: 24** top ↺<https://gateoverflow.in/987>

Given a set of elements  $N = 1, 2, \dots, n$  and two arbitrary subsets  $A \subseteq N$  and  $B \subseteq N$ , how many of the  $n!$  permutations  $\pi$  from  $N$  to  $N$  satisfy  $\min(\pi(A)) = \min(\pi(B))$ , where  $\min(S)$  is the smallest integer in the set of integers  $S$ , and  $\pi(S)$  is the set of integers obtained by applying permutation  $\pi$  to each element of  $S$ ?

- A.  $(n - |A \cup B|)|A||B|$
- B.  $(|A|^2 + |B|^2)n^2$
- C.  $n! \frac{|A \cap B|}{|A \cup B|}$
- D.  $\frac{|A \cap B|^2}{nC_{|A \cup B|}}$

[gate2006-cse](#) [set-theory&algebra](#) [normal](#) [sets](#)

Answer

**4.11.16 Sets: GATE CSE 2008 | Question: 2** top ↺<https://gateoverflow.in/400>

If  $P, Q, R$  are subsets of the universal set  $U$ , then

$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c$$

is

- A.  $Q^c \cup R^c$
- B.  $P \cup Q^c \cup R^c$
- C.  $P^c \cup Q^c \cup R^c$
- D.  $U$

[gate2008-cse](#) [normal](#) [set-theory&algebra](#) [sets](#)

Answer

**4.11.17 Sets: GATE CSE 2014 Set 2 | Question: 50** top ↺<https://gateoverflow.in/2016>

Consider the following relation on subsets of the set  $S$  of integers between 1 and 2014. For two distinct subsets  $U$  and  $V$  of  $S$  we say  $U < V$  if the minimum element in the symmetric difference of the two sets is in  $U$ .

Consider the following two statements:

- S1: There is a subset of  $S$  that is larger than every other subset.
- S2: There is a subset of  $S$  that is smaller than every other subset.

Which one of the following is CORRECT?

- A. Both S1 and S2 are true
- B. S1 is true and S2 is false
- C. S2 is true and S1 is false
- D. Neither S1 nor S2 is true

[gate2014-cse-set2](#) [set-theory&algebra](#) [normal](#) [sets](#)

Answer

**4.11.18 Sets: GATE CSE 2015 Set 1 | Question: 16** top ↺<https://gateoverflow.in/8238>

For a set  $A$ , the power set of  $A$  is denoted by  $2^A$ . If  $A = \{5, \{6\}, \{7\}\}$ , which of the following options are TRUE?

- I.  $\emptyset \in 2^A$
- II.  $\emptyset \subseteq 2^A$
- III.  $\{5, \{6\}\} \in 2^A$
- IV.  $\{5, \{6\}\} \subseteq 2^A$

- A. I and III only
- B. II and III only
- C. I, II and III only

- D. I, II and IV only

gate2015-cse-set1 set-theory&algebra sets normal

Answer 

#### 4.11.19 Sets: GATE CSE 2015 Set 2 | Question: 18 top ↗

<https://gateoverflow.in/8092>



The cardinality of the power set of  $\{0, 1, 2, \dots, 10\}$  is \_\_\_\_\_

gate2015-cse-set2 set-theory&algebra sets easy numerical-answers

Answer 

#### 4.11.20 Sets: GATE CSE 2015 Set 3 | Question: 23 top ↗

<https://gateoverflow.in/8426>



Suppose  $U$  is the power set of the set  $S = \{1, 2, 3, 4, 5, 6\}$ . For any  $T \in U$ , let  $|T|$  denote the number of elements in  $T$  and  $T'$  denote the complement of  $T$ . For any  $T, R \in U$  let  $T \setminus R$  be the set of all elements in  $T$  which are not in  $R$ . Which one of the following is true?

- A.  $\forall X \in U, (|X| = |X'|)$
- B.  $\exists X \in U, \exists Y \in U, (|X| = 5, |Y| = 5 \text{ and } X \cap Y = \emptyset)$
- C.  $\forall X \in U, \forall Y \in U, (|X| = 2, |Y| = 3 \text{ and } X \setminus Y = \emptyset)$
- D.  $\forall X \in U, \forall Y \in U, (X \setminus Y = Y' \setminus X')$

gate2015-cse-set3 set-theory&algebra sets normal

Answer 

#### 4.11.21 Sets: GATE CSE 2016 Set 2 | Question: 28 top ↗

<https://gateoverflow.in/39595>



Consider a set  $U$  of 23 different compounds in a chemistry lab. There is a subset  $S$  of  $U$  of 9 compounds, each of which reacts with exactly 3 compounds of  $U$ . Consider the following statements:

- I. Each compound in  $U \setminus S$  reacts with an odd number of compounds.
- II. At least one compound in  $U \setminus S$  reacts with an odd number of compounds.
- III. Each compound in  $U \setminus S$  reacts with an even number of compounds.

Which one of the above statements is **ALWAYS TRUE**?

A. Only I  
B. Only II  
C. Only III  
D. None.

gate2016-cse-set2 set-theory&algebra difficult sets

Answer 

#### 4.11.22 Sets: GATE CSE 2017 Set 1 | Question: 47 top ↗

<https://gateoverflow.in/118330>



The number of integers between 1 and 500 (both inclusive) that are divisible by 3 or 5 or 7 is \_\_\_\_\_.

gate2017-cse-set1 set-theory&algebra normal numerical-answers sets

Answer 

#### 4.11.23 Sets: GATE CSE 2021 Set 2 | Question: 37 top ↗

<https://gateoverflow.in/357503>



For two  $n$ -dimensional real vectors  $P$  and  $Q$ , the operation  $s(P, Q)$  is defined as follows:

$$s(P, Q) = \sum_{i=1}^n (P[i] \cdot Q[i])$$

Let  $\mathcal{L}$  be a set of 10-dimensional non-zero real vectors such that for every pair of distinct vectors  $P, Q \in \mathcal{L}$ ,  $s(P, Q) = 0$ . What is the maximum cardinality possible for the set  $\mathcal{L}$ ?

- A. 9
- B. 10
- C. 11
- D. 100

[gate2021-cse-set2](#) [set-theory&algebra](#) [sets](#)

Answer 

#### 4.11.24 Sets: GATE IT 2004 | Question: 2

<https://gateoverflow.in/3643>



In a class of 200 students, 125 students have taken Programming Language course, 85 students have taken Data Structures course, 65 students have taken Computer Organization course; 50 students have taken both Programming Language and Data Structures, 35 students have taken both Programming Language and Computer Organization; 30 students have taken both Data Structures and Computer Organization, 15 students have taken all the three courses.

How many students have not taken any of the three courses?

- A. 15
- B. 20
- C. 25
- D. 30

[gate2004-it](#) [set-theory&algebra](#) [easy](#) [sets](#)

Answer 

#### 4.11.25 Sets: GATE IT 2005 | Question: 33

<https://gateoverflow.in/3779>



Let  $A$  be a set with  $n$  elements. Let  $C$  be a collection of distinct subsets of  $A$  such that for any two subsets  $S_1$  and  $S_2$  in  $C$ , either  $S_1 \subset S_2$  or  $S_2 \subset S_1$ . What is the maximum cardinality of  $C$ ?

- A.  $n$
- B.  $n + 1$
- C.  $2^{n-1} + 1$
- D.  $n!$

[gate2005-it](#) [set-theory&algebra](#) [normal](#) [sets](#)

Answer 

#### 4.11.26 Sets: GATE IT 2006 | Question: 23

<https://gateoverflow.in/3562>



Let  $P$ ,  $Q$  and  $R$  be sets let  $\Delta$  denote the symmetric difference operator defined as  $P\Delta Q = (P \cup Q) - (P \cap Q)$ . Using Venn diagrams, determine which of the following is/are TRUE?

- I.  $P\Delta(Q \cap R) = (P\Delta Q) \cap (P\Delta R)$
- II.  $P \cap (Q \cap R) = (P \cap Q)\Delta(P\Delta R)$

- A. I only
- B. II only
- C. Neither I nor II
- D. Both I and II

[gate2006-it](#) [set-theory&algebra](#) [normal](#) [sets](#)

Answer 

#### 4.11.27 Sets: GATE IT 2006 | Question: 24

<https://gateoverflow.in/3563>



What is the cardinality of the set of integers  $X$  defined below?

$$X = \{n \mid 1 \leq n \leq 123, n \text{ is not divisible by either } 2, 3 \text{ or } 5\}$$

- A. 28
- B. 33
- C. 37
- D. 44

[gate2006-it](#) [set-theory&algebra](#) [normal](#) [sets](#)
[Answer](#)

### Answers: Sets

**4.11.1 Sets: GATE CSE 1993 | Question: 17** [top](#)
<https://gateoverflow.in/2314>


- ✓  $N(A \cup B \cup C) = N(A) + N(B) + N(C) - N(A \cap B) - N(A \cap C) - N(B \cap C) + N(A \cap B \cap C)$

Let  $Y$  be the no. of persons who eat at least one item.  $21 - Y$  people do not eat anything.

$$Y = 9 + 10 + 7 - [N(A \cap B) + N(A \cap C) + N(B \cap C)] + 5$$

$$[N(A \cap B) + N(A \cap C) + N(B \cap C)] = 31 - Y.$$

Now, these include the no. of persons who eat all 3 items thrice. So, excluding those, we get, no. of persons who eat at least two items (by adding the no. of persons eating EXACTLY 2 dishes and the number of persons eating all 3 dishes) as

$$31 - Y - 2 * 5 = 21 - Y.$$

The minimum value of  $Y$  is 10 as 10 people eat fish. Is this possible? Yes.

The maximum value of  $Y$  is 21. Is this possible? No. Because 5 people eat all three items. So, the no. of persons eating at most 2 items  $= (9 - 5) + (10 - 5) + (7 - 5) = 11$ . And adding 5 we get 16 people who eat at least one item.

So, our required answer is  $21 - 10 \geq X \geq 21 - 16 \implies 5 \leq X \leq 11$ .

28 votes

-- Rajarshi Sarkar (27.8k points)

**4.11.2 Sets: GATE CSE 1993 | Question: 8.3** [top](#)
<https://gateoverflow.in/2301>


- A. At least one of the set  $S_i$  is a finite set. Well, it is not said that  $S_1, S_2 \dots S_n$  whether they are finite or infinite. It is possible to break down infinite sets into few sets (Some of which can be finite). This seems true, but I'm not able to prove it. **Please Give a suitable counterexample here, if you think this is false.**

Ex- :  $a^*$ , this is infinite set. I can write it as  $\{\} \cup \{a^*\}$ , where  $\{a^*\}$  is infinite.

- B. Not more than one of the sets can be finite. This is false.

Ex :  $a^*b^* \Rightarrow \{ab\} \cup \{\} \cup \{aa^+bb^+\}$ .

- C. At least one of the sets is Infinite. This must be True. As this is a finite union of sets, one of the sets must be infinite to make the whole thing infinite. True.

- D. Not more than one of the sets  $S_i$  can be infinite. This is false.

Ex :  $a^*b^* = \{a^pb^q | p = q\} \cup \{a^mb^n | m \neq n\}$  such that  $p, q, m, n \geq 0$ .

Answer C is surely true.

29 votes

-- Akash Kanase (36k points)

**4.11.3 Sets: GATE CSE 1993 | Question: 8.4** [top](#)
<https://gateoverflow.in/2302>


- ✓ Cardinality of  $A \times A = n^2$

Cardinality of power set of  $A \times A = 2^{n^2}$

Correct Answer: B

32 votes

-- Digvijay (44.9k points)

**4.11.4 Sets: GATE CSE 1994 | Question: 2.4** [top](#)
<https://gateoverflow.in/2471>


- ✓ Answer:  $2^{n-1}$

No. of subsets with cardinality  $i = {}^nC_i$

So, no. of subsets with odd cardinality =  $\sum_{i=1,3,\dots,n-1} {}^n C_i = 2^{n-1}$  (Proof given below)

We have,

$${}^n C_0 + {}^n C_1 + {}^n C_2 + \dots + {}^n C_n = 2^n$$

$${}^n C_0 + {}^n C_1 + {}^n C_2 + \dots + {}^n C_n = \begin{cases} {}^{n+1} C_1 + {}^{n+1} C_3 + \dots + {}^{n+1} C_n, & n \text{ is even} \\ {}^{n+1} C_1 + {}^{n+1} C_3 + \dots + {}^{n+1} C_{n-1} + {}^n C_n, & n \text{ is odd} \end{cases}$$

$$(\because {}^n C_r + {}^n C_{r-1} = {}^{n+1} C_r) = 2^n$$

$$\Rightarrow \left. \begin{array}{l} {}^n C_1 + {}^n C_3 + \dots + {}^n C_{n-1}, n \text{ is even} \\ {}^n C_1 + {}^n C_3 + \dots + {}^n C_n, n \text{ is odd} \end{array} \right\} = 2^{n-1} (\text{replacing } n \text{ by } n-1, {}^n C_n = {}^{n-1} C_{n-1})$$

Proof for  ${}^n C_r + {}^n C_{r-1} = {}^{n+1} C_r$

$${}^n C_r + {}^n C_{r-1} = \frac{n!}{r!(n-r)!} + \frac{n!}{(r-1)!(n-r+1)!}$$

$$= \frac{n!(n-r+1)+n!r}{r!(n-r+1)!}$$

$$= \frac{n!(n+1)}{r!(n-r+1)!}$$

$$= \frac{(n+1)!}{r!(n-r+1)!} = {}^{n+1} C_r$$

21 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.11.5 Sets: GATE CSE 1995 | Question: 1.20 top ↴

<https://gateoverflow.in/2607>



- ✓ Number of elements in power set =  $2^{(\text{no of elements in the set})} = 2^3 = 8$

Elements are  $\{\emptyset, \{\{\emptyset\}\}, \{1\}, \{\{2, 3\}\}, \{\{\emptyset\}, 1\}, \{1, \{2, 3\}\}, \{\{\emptyset\}, \{2, 3\}\}, \{\{\emptyset\}, 1, \{2, 3\}\}\}$

Hence, Option is (C) : 8.

27 votes

-- jayendra (6.7k points)

#### 4.11.6 Sets: GATE CSE 1995 | Question: 25b top ↴

<https://gateoverflow.in/314348>



- ✓ Numbers divisible by 5 =  $\lfloor \frac{720}{5} \rfloor = 144$ .

Numbers divisible by 2 =  $\lfloor \frac{720}{2} \rfloor = 360$ .

Numbers divisible by 3 =  $\lfloor \frac{720}{3} \rfloor = 240$ .

Numbers divisible by either 5, 2 or 3 =  $144 + 360 + 240$

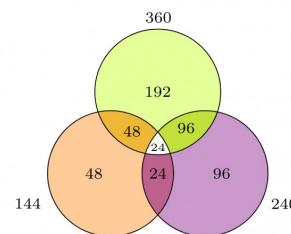
- Numbers divisible by 2 and 3
- Numbers divisible by 2 and 5
- Numbers divisible by 3 and 5
- + Numbers divisible by 2, 3 and 5.

Since, all 2, 3, 5 are prime numbers,

- Numbers divisible by 2 and 3 = Numbers divisible by  $(2 \times 3) = \lfloor \frac{720}{6} \rfloor = 120$
- Numbers divisible by 2 and 5 = Numbers divisible by  $(2 \times 5) = \lfloor \frac{720}{10} \rfloor = 72$
- Numbers divisible by 3 and 5 = Numbers divisible by  $(3 \times 5) = \lfloor \frac{720}{15} \rfloor = 48$
- Numbers divisible by 2, 3 and 5 = Numbers divisible by  $(2 \times 3 \times 5) = \lfloor \frac{720}{30} \rfloor = 24$

So, numbers divisible by either 5, 2 or 3 =  $144 + 360 + 240 - 120 - 72 - 48 + 24 = 528$ .

So, numbers which are not divisible by any of 2, 3 or 5 =  $720 - 528 = 192$ .



Correct Answer: 192.

14 votes

-- Arjun Suresh (328k points)

#### 4.11.7 Sets: GATE CSE 1996 | Question: 1.1 top ↴

<https://gateoverflow.in/2705>



✓  $(A - B) \cup (B - A) \cup (A \cap B)$

$A - B$  is A but not B. i.e. only A

$B - A$  is B but not A. i.e. only B

$A \cap B$  is A and B both

Union of all is (only A) U (only B) U (both A and B)  
 $= A \cup B$

Correct Answer: A

24 votes

-- Digvijay (44.9k points)

#### 4.11.8 Sets: GATE CSE 1998 | Question: 2.4 top ↴

<https://gateoverflow.in/1676>



✓ Apply set formula of A union B union C

$$28 = (18 + 15 + 22) - (9 + 11 + 13) + x$$

$$28 = 55 - 33 + x$$

$$x = 6$$

Correct Answer: D

19 votes

-- Digvijay (44.9k points)

#### 4.11.9 Sets: GATE CSE 2000 | Question: 2.6 top ↴

<https://gateoverflow.in/653>



✓  $S = \{1\}$

$$P(S) = \{\{\}, \{1\}\}$$

$$P(P(S)) = \{\{\}, \{\{\}\}, \{\{1\}\}, \{\{\}, \{1\}\}\}$$

- (A)  $P(P(S)) = P(S)$  – This is false. Counterexample given above.
- (C)  $P(S) \cap S = P(S)$  – This is false. This intersection is usually Empty set.
- (D)  $S \notin P(S)$  – This is false. S belongs to  $P(S)$ .

Edit:-

B. It seems like B is true, but there is counter-example for B too. (Given By @Pragy Below)

$$S = \{\emptyset\}$$

$$P(S) = \{\emptyset, \{\emptyset\}\}$$

$$P(P(S)) = \{\emptyset, \{\emptyset\}, \{\{\emptyset\}\}, \{\emptyset, \{\emptyset\}\}\}$$

$$P(S) \cap P(P(S)) = \{\emptyset, \{\emptyset\}\} \neq \{\emptyset\}$$

So, answer is none of the above, all options are false.

But if we consider Simple sets(Except Empty Set) only then best option is B among the given Options.

57 votes

-- Akash Kanase (36k points)

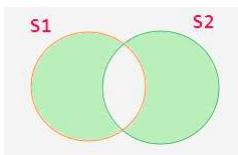
#### 4.11.10 Sets: GATE CSE 2000 | Question: 6 top ↴

<https://gateoverflow.in/677>

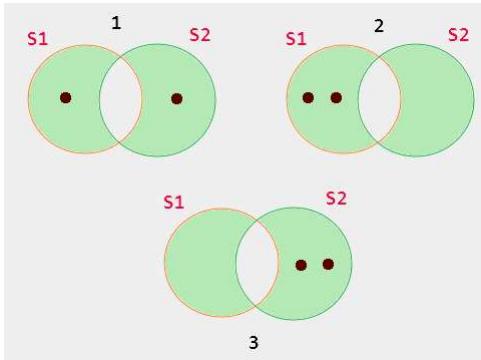


✓  $S = 1, 2, 3, 4, 5, 6, \dots, n$

Let us assume any two subset  $S_1$  and  $S_2$ . We can simply assume  $n(S_1 \cap S_2) = 0$  to consider the disconnected sets if we want.

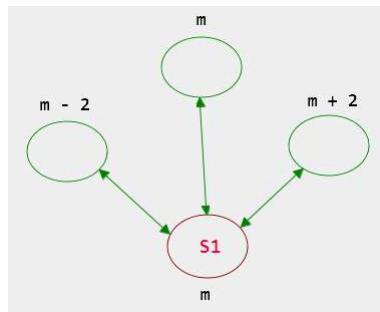


Now there are three cases in which  $(S_1 \setminus S_2) \cup (S_2 \setminus S_1)$  Or,  $(S_1 \oplus S_2)$  has only 2 element.



1. Both green shaded area has one element each and in this case sizes of  $S_1$  and  $S_2$  are same.
2. The green area of  $S_1$  contains 2 element and the green area of  $S_2$  contains none. In this case size of  $S_1$  is 2 more than that of  $S_2$ .
3. The green area of  $S_2$  contains 2 element and the green area of  $S_1$  contains none. In this case size of  $S_2$  is 2 more than that of  $S_1$ .

So, if we are only interested in a **particular set vertex** corresponding to set  $S_1$  of size =  $m$ , then  $S_1$  is connected to **three types** of set vertices as shown below. We will use the words "set" and "vertices" synonymously.



In this above image, we have considered  $m \geq 2$ . The cases for  $m = 1$  and  $m = 0$  will be **discussed later**.

Now, what we need to find is the **no of set vertices** in each of the **above** three types and sum them up to get the **degree** of the vertex corresponding to the set  $S_1$ .

For simplicity let us assume  $S = \{1, 2, 3, 4, 5, 6, 7\}$  and set  $S_1 = \{1, 2, 3, 4\}$ . Our interest will be to find  $S_2$  such that vertices corresponding to  $S_1$  and  $S_2$  are connected.

1. **CASE 1 :** If we try to find another set  $S_2$  having 4 elements and satisfying constraint  $n(S_1 \oplus S_2) = 2$ , then we will see that no of such set  $S_2$  is  $4 \cdot (7 - 4)$ . Or in general if  $S_1$  is an  $m$  element set then no of such  $S_2$  sets with constraint  $n(S_1 \oplus S_2) = 2$  will be equal to  $m \cdot (n - m)$ .
2. **CASE 2 :**  $S_1$  contains 4 element and If we try to find  $S_2$  where  $S_2$  contains 2 elements and satisfying constraint  $n(S_1 \oplus S_2) = 2$ , then no of such  $S_2$  will be  $4C2$  or in general, for  $m$  element set  $S_1$ , we have  $mC2$  no of  $S_2$  type sets all with  $(m - 2)$  size.
3. **CASE 3:**  $S_1$  contains 4 element and If we try to find  $S_2$  where  $S_2$  contains 6 element and satisfying constraint  $n(S_1 \oplus S_2) = 2$ , then no of such  $S_2$  sets will be  $3C2$  or  $(7 - 4)C2$ . In general, with  $S_1$  being  $m$  element set, then  $(n - m)C2$  no of  $S_2$  sets will be possible.

Therefore, summing all three cases :

Degree of vertex  $S_1$  ( assuming general case of  $n(S_1) = m$  )

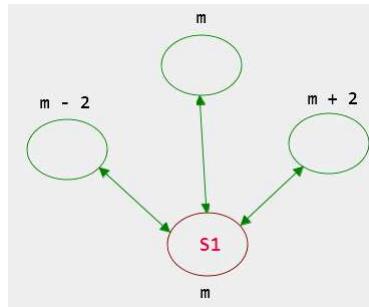
$$\begin{aligned}
&= m \cdot (n - m) + \binom{m}{2} + \binom{n-m}{2} \\
&= m \cdot n - m^2 + \frac{m^2}{2} - \frac{m}{2} + \frac{(n-m) \cdot (n-m-1)}{2} \\
&= m \cdot n - m^2 + \frac{m^2}{2} - \frac{m}{2} + \frac{n \cdot (n-1)}{2} \\
&\quad - \frac{n \cdot m}{2} - \frac{n \cdot m}{2} + \frac{m^2}{2} + \frac{m}{2} \\
&= \frac{n \cdot (n-1)}{2} \\
&= \binom{n}{2}
\end{aligned}$$

This result is independent of  $m$  for  $m \geq 2$  and  $m \leq n$ .

For  $m = 0$  and  $m = 1$  also we can show that degree of 0 and 1 size set vertices is nothing but  $nC2$  only. (fairly straight forward cases).

So we can conclude that every vertex has the same degree and the degree is  $nC2$ .

Now we can guess one thing by looking at the following image:



i.e. for  $m \geq 2$  if  $m$  is even the  $S_1$  is connected to only even cardinality type of sets (**at least one**) or if  $m$  is odd then  $S_1$  is connected to only odd cardinality type of sets (**at least one**). By this, we can almost say that there are two connected components in the graph.

But there is little more argument before we can proceed and have a valid proof.

if  $m = 0$  then  $S_1 = \phi$ , Then  $S_1$  will be connected to all  $m = 2$  type of sets or 2 cardinality sets.

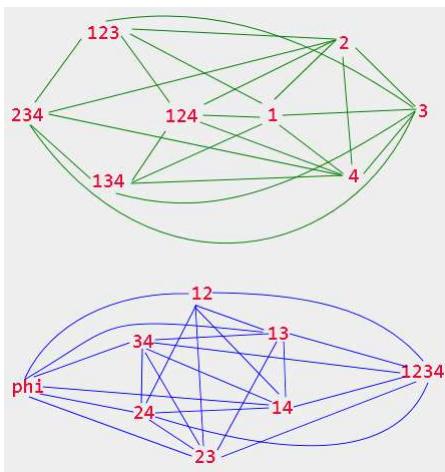
if  $m = 1$  then  $S_1$  will be one of all 1 element sets, Then  $S_1$  will be connected to all other 1 cardinality sets and at least one 3 cardinality set.

We can argue that, one  $m$  (even) cardinality set is at least connected to one  $(m - 2)$  cardinality set. That particular  $(m - 2)$  cardinality set is at least connected to one  $(m - 4)$  cardinality set and so on till  $\phi$  set vertex. There for all even cardinality sets are connected to  $\phi$  directly or indirectly.

A similar argument holds for odd cardinality set vertices till we reach some 1 cardinality set. **Moreover all 1 cardinality sets are connected.**

Therefore we have a situation now that all even cardinality sets form one connected component and all odd cardinality set form another component.

For example :  $n = 4$  :



38 votes

-- Debashish Deka (40,7k points)

#### 4.11.11 Sets: GATE CSE 2001 | Question: 2.2 top ↴

<https://gateoverflow.in/720>



- ✓  $S_1$  : Counter Example :  $a^* \cap (b^* \cup c^*)$ , Here  $a^*, b^*, c^*$  all are infinite, Result is finite language =  $\{\epsilon\}$ .  
So  $S_1$  is True.

$S_2$  : Counter Example :  $x = 1 + \sqrt{2}, y = 1 - \sqrt{2}$   
 $\implies x + y = 2$ .

So  $S_2$  is True.

Answer: C

67 votes

-- Akash Kanase (36k points)

#### 4.11.12 Sets: GATE CSE 2001 | Question: 3 top ↴

<https://gateoverflow.in/744>



- ✓ For question (a):

To prove  $P(A \cap B) = P(A) \cap P(B)$  we should show that  $P(A \cap B) \subseteq P(A) \cap P(B)$  and  $P(A) \cap P(B) \subseteq P(A \cap B)$ .

For first part:

Lets take some subset  $X \subseteq A \cap B$  then  $X \in P(A \cap B)$ . Also  $X \subseteq A \wedge X \subseteq B$ , means  $X \in P(A) \wedge X \in P(B)$ . Again this proves that  $X \in P(A) \cap P(B)$ . This proves  $P(A \cap B) \subseteq P(A) \cap P(B) \rightarrow (1)$

For second part:

Take any  $X$  such that  $X \subseteq A$  and  $X \subseteq B$ . This is  $X \in P(A) \wedge X \in P(B)$ . That means  $X \in P(A) \cap P(B)$ . Now also  $X \subseteq (A \cap B)$ . This also means that  $X \in P(A \cap B)$ . This proves  $P(A) \cap P(B) \subseteq P(A \cap B) \rightarrow (2)$

From results (1) and (2),

$$P(A) \cap P(B) = P(A \cap B)$$

For question (b):

$$\text{Sum}(n) = \frac{n(n+1)}{2}$$

So, for  $n = 1$   $\text{Sum}(1) = 1$

For  $n = 2$ ,  $\text{Sum}(2) = 1 + 2 = 3$

$$\text{Sum}(1 + 1) = \text{Sum}(1) + \text{Sum}(1) + 1 \times 1 = 1 + 1 + 1 = 3$$

So, base case of the formula holds true.

Lets assume the formula holds true for  $n + m$

$$\implies \text{Sum}(m + n) = \text{Sum}(m) + \text{Sum}(n) + mn$$

$$= \frac{m(m+1)}{2} + \frac{n(n+1)}{2} + mn$$

$$= \frac{(m+n)(m+n+1)}{2}$$

Now, we get for

$$\begin{aligned} \text{Sum}(m + n + 1) &= \frac{(m+n+1)(m+n+2)}{2} \\ &= \frac{(m+n)(m+n+2)}{2} + \frac{(m+n+2)}{2} \\ &= \frac{(m+n)(m+n+1)}{2} + \frac{(m+n+2)}{2} + \frac{m+n}{2} \\ &= \frac{(m+n)(m+n+1)}{2} + \frac{(m+n)}{2} + 1 + \frac{m+n}{2} \\ &= \text{Sum}(m + n) + \text{Sum}(1) + (m + n) \times 1 \end{aligned}$$

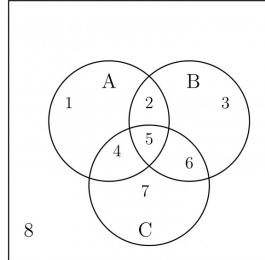
Hence, proved by mathematical induction.

10 votes

-- Sheshang M. Ajwalia (2.6k points)

#### 4.11.13 Sets: GATE CSE 2005 | Question: 8 top

<https://gateoverflow.in/1157>



$$X = (A - B) - C = 1, 4 - 4, 5, 6, 7 = 1$$

$$Y = (A - C) - (B - C) = 1, 2 - 2, 3 = 1$$

So,  $X = Y$ .

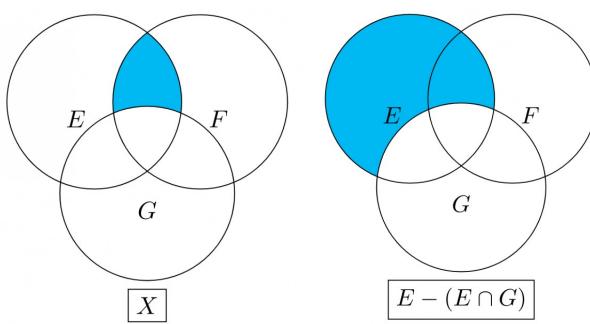
Answer A

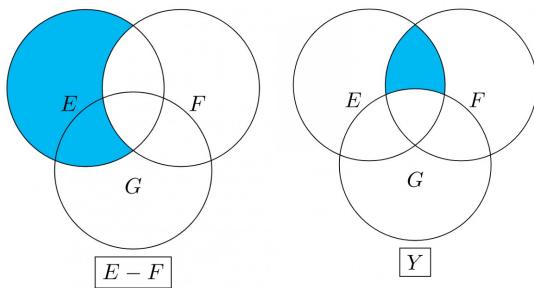
25 votes

-- Akash Kanase (36k points)

#### 4.11.14 Sets: GATE CSE 2006 | Question: 22 top

<https://gateoverflow.in/983>





$$X = Y$$

**Option C** is answer.

21 votes

-- Ayush Upadhyaya (28.2k points)

#### 4.11.15 Sets: GATE CSE 2006 | Question: 24 top ↗

→ <https://gateoverflow.in/987>



- ✓  $\min(\pi(N)) = 1$ , since in a permutation of  $n$  elements from  $1 \dots n$ , some element must get 1.

Similarly, in any subsets  $A$  and  $B$ ,  $\min(\pi(A)) = \min(\pi(B))$  only if  $A$  and  $B$  has a common element and it is the smallest of all the other elements in  $A$  and  $B$ .

(With this understanding itself we can eliminate options  $A$  and  $B$ )

Now we have  $n!$  total permutations and we have to see the number of permutations satisfying the given condition. If  $A = B$ , all of the  $n!$  permutations satisfy the given condition. (This is enough to get the answer as  $C$ ). Otherwise, the fraction of the  $n!$  permutations satisfying the given condition

$$= |A \cap B| / |A \cup B|$$

This is because without the given restriction, the smallest element (among the  $|A \cap B|$  elements) can be any one of the  $|A \cup B|$  elements, and with the restriction, the smallest element must be one of the  $|A \cap B|$  elements.

So, answer is  $C$ .

34 votes

-- Arjun Suresh (328k points)

#### 4.11.16 Sets: GATE CSE 2008 | Question: 2 top ↗

→ <https://gateoverflow.in/400>



- ✓ Answer D

$$\begin{aligned} & (P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c \\ &= (P \cup P^c) \cap (Q \cap R) \cup Q^c \cup R^c \\ &= (Q \cap R) \cup Q^c \cup R^c \\ &= (Q \cap R) \cup (Q \cap R)^C \\ &= U. \end{aligned}$$

35 votes

-- Anu (4.7k points)

#### 4.11.17 Sets: GATE CSE 2014 Set 2 | Question: 50 top ↗

→ <https://gateoverflow.in/2016>



- ✓ Symmetric difference (SD) - suppose  $A$  and  $B$  are 2 sets then symmetric difference of  $A$  and  $B$  is  $(A - B) \cup (B - A) = (A \cup B) - (A \cap B)$ .

In question :  $U < V$  if the minimum element in the symmetric difference of the two sets is in  $U$ . Example:  
 $\{1, 2, 3\} < \{2, 3, 4, 5, 6\}$

Symmetric difference is  $\{1\} \cup \{4, 5, 6\}$ .

**Now Consider a smaller set.** Suppose  $S = \{1, 2, 3, 4\}$

Now the given 2 statements are about smallest and largest subset. So, considering set  $S$  and  $\emptyset$  (empty set) will be helpful.

First take  $U = \{1, 2, 3, 4\}$  and  $V = \{1, 2\}$  (we can take any set other than  $\emptyset$  and S)

$SD = \{3, 4\}$  (just exclude the elements which are common in the 2 sets)

Minimum element of  $SD$  is 3 which is in  $U$  and if we observe carefully minimum element will always be in  $U$ . Whatever the  $V$  is.

So, according to the question  $\{1, 2, 3, 4\}$  is smaller than any other subset of  $S$ . **S2 is true.**

Now consider

$U = \emptyset$  and  $V = \{1, 2\}$  (we can take any subset of S)

$SD = \{1, 2\}$

The symmetric difference will always be equal to  $V$ . So minimum element of  $SD$  will always exist in  $V$  when  $U$  is  $\emptyset$ .

So, according to the que,  $\emptyset$  is greater than any other subset of  $S$ . **S1 is also true.**

This is true even when  $S = \{1, 2, 3, \dots, 2014\}$ .

**So, answer is A. Both S1 and S2 are true**

74 votes

-- Soumya Jain (12.4k points)

#### 4.11.18 Sets: GATE CSE 2015 Set 1 | Question: 16 [top](#)

<https://gateoverflow.in/8238>



- ✓ Power set of  $A$  consists of all subsets of  $A$  and from the definition of a subset,  $\emptyset$  is a subset of any set. So, I and II are TRUE.

5 and  $\{6\}$  are elements of  $A$  and hence  $\{5, \{6\}\}$  is a subset of  $A$  and hence an element of  $2^A$ . An element of a set is never a subset of the set. For that the element must be inside a set- i.e., a singleton set containing the element is a subset of the set, but the element itself is not. Here, option IV is false. To make IV true we have to do as follows:

$\{5, \{6\}\}$  is an element of  $2^A$ . So,  $\{\{5, \{6\}\}\} \subseteq 2^A$ .

So, option C.

87 votes

-- Arjun Suresh (328k points)

#### 4.11.19 Sets: GATE CSE 2015 Set 2 | Question: 18 [top](#)

<https://gateoverflow.in/8092>



- ✓ Answer: 2048

Number of elements in set = 11.

Therefore, cardinality of power set =  $2^{11} = 2048$ .

31 votes

-- Rajarshi Sarkar (27.8k points)

#### 4.11.20 Sets: GATE CSE 2015 Set 3 | Question: 23 [top](#)

<https://gateoverflow.in/8426>



- ✓ Answer is D.

As  $X$  and  $Y$  elements of  $U$ ,  $X$  and  $Y$  are subsets of  $S$ .

Option A is wrong consider  $X = \{1, 2\}$  therefore  $X' = \{3, 4, 5, 6\}$ ,  $|X| = 2$  and  $|X'| = 4$ .

Option B is wrong as any two possible subsets of  $S$  with 5 elements should have atleast 4 elements in common (Pigeonhole principle). Hence,  $X$  intersection  $Y$  cannot be null.

Option C is wrong,  $X$  and  $Y$  can have any number of elements from 0 to 5. Even for the given constraint, consider  $X = \{1, 2\}$ ,  $Y = \{3, 4, 5\}$  and  $X \setminus Y = \{1, 2\}$  which is not null.

49 votes

-- overtomana (945 points)

#### 4.11.21 Sets: GATE CSE 2016 Set 2 | Question: 28 [top](#)

<https://gateoverflow.in/39595>



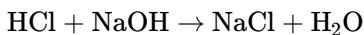
- ✓ Option B should be the correct answer.

It is given that the number of compounds in  $U = 23$  and the number of compounds in  $S = 9$ , so the number of compounds in  $U \setminus S = 23 - 9 = 14$ .

Considering each of these compounds as nodes of a graph  $G$ . So, vertex set of  $G$  is  $U$  and  $S$  is a subset of vertices of  $G$ .

The relation " $A$  reacts with  $B$ " is a symmetric relation, that is  $A$  reacts with  $B$  is same as  $B$  reacts with  $A$ .

For example, consider the following reaction:



Here, we can say either HCl reacts with NaOH to produce NaCl + H<sub>2</sub>O or we can say that NaOH reacts with HCl to produce NaCl + H<sub>2</sub>O, so both of these statements are equivalent.

Since, the relation based on which we are going to draw the edges is symmetric, we can use an undirected edge  $(A, B)$  between any two compounds to represent the fact that  $A$  reacts with  $B$  as well as  $B$  reacts with  $A$ .

Each compound in  $S$  reacts with exactly 3 compounds in  $U$ .

It means that the degree of every node(or compound) in  $S$  is 3.

So, sum of all the degree in  $S$  = number of nodes in  $S$  × degree of each node =  $9 \times 3 = 27$ .

Now in  $U \setminus S$  we have 14 nodes(or compounds), thus clearly  $U \setminus S$  contains an even number of compounds.

Now if each compound in  $U \setminus S$  reacts with an even number of compounds, the sum of degrees of all the node in  $U \setminus S$  would be even, and consequently, the sum of degrees of all the nodes in our graph  $G$  would be odd as the sum of degrees of all the nodes in  $S$  is odd, and an odd number added with an even number produces an odd number.

But since in a graph, every edge corresponds to two degrees and the number of edges in a graph must be a (non-negative)integral value & not fractional value hence the sum of the degrees all the nodes of a graph must be even. (This is Handshaking Lemma).

So, statement III should be false(always).

Also, adding fourteen odd numbers gives an even number.

Hence, if each compound in  $U \setminus S$  reacts with an odd number of compounds, the sum of degrees of all the node in  $U \setminus S$  would be even, and consequently, the sum of degrees of all the nodes in our graph  $G$  would be odd as the sum of degrees of all the nodes in  $S$  is odd, and an odd number added with an even number produces an odd number.

Again by using Handshaking Lemma, this is not possible.

So, statement I should also be false(always).

Thus, from the previous two cases, it can be observed that to satisfy the Handshaking Lemma for  $G$ , the sum of the degrees of all the nodes  $U \setminus S$  must be odd. To make this happen, we must assign at least one node of  $U \setminus S$ , an odd degree.

If at least, one node(or compound) in  $U \setminus S$  would have an odd degree( or reacts with odd numbers of compounds) then we can assign degrees in such a way that the sum of the degrees of all the nodes  $U \setminus S$  will be odd, & thus the Handshaking Lemma would be satisfied.

Hence, statement II is the only statement which is guaranteed to be true always.

Moreover, we can also make some stronger claims from the given information like,  
always an odd number of compounds in  $U \setminus S$  reacts with an odd number of compounds and  
at least, one compound in  $S$  reacts with a compound in  $U \setminus S$  and so on.

109 votes

-- Anurag Pandey (10.5k points)



#### 4.11.22 Sets: GATE CSE 2017 Set 1 | Question: 47 [top](#)

<https://gateoverflow.in/118330>

- ✓ Here, we can apply the property of set. Let  $D_n$  denote divisibility by  $n$ ,  $D_{n_1, n_2}$  denote divisibility by both  $n_1$  and  $n_2$  and so on.

$$\begin{aligned} N(D_3 \cup D_5 \cup D_7) &= N(D_3) + N(D_5) + N(D_7) - N(D_{3,5}) - N(D_{5,7}) - N(D_{3,7}) + N(D_{3,5,7}) \\ &= 166 + 100 + 71 - 33 - 14 - 23 + 4 \\ &= 271 \end{aligned}$$

27 votes

-- sriv\_shubham (2.8k points)



#### 4.11.23 Sets: GATE CSE 2021 Set 2 | Question: 37 [top](#)

<https://gateoverflow.in/357503>

- ✓  $S(P, Q)$  is nothing but the dot product of two vectors.

The dot product of two vectors is zero when they are perpendicular, as we are dealing with 10 dimensional vectors the maximum number of mutually-perpendicular vectors can be 10.

So option B.

3 votes

-- zxy123 (2.5k points)

#### 4.11.24 Sets: GATE IT 2004 | Question: 2 top

<https://gateoverflow.in/3643>

- ✓ The question has a slight misprint. It should be what Bhagirathi says in the comments.

Nevertheless,

$$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$$

- $A \equiv$  Students who have taken Programming.
- $B \equiv$  Students who have taken Data Structures.
- $C \equiv$  Students who have taken Computer Organisation.

So, the number of students who have taken any of the 3 courses is given by:

$$\begin{aligned} |A \cup B \cup C| &= |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C| \\ &= 125 + 85 + 65 - 50 - 35 - 30 + 15 = 175 \end{aligned}$$

Therefore, the number of students who haven't taken any of the 3 courses is:  $200 - 175 = 25$

Hence, the answer is Option C.

34 votes

-- Pragy Agarwal (18.3k points)

#### 4.11.25 Sets: GATE IT 2005 | Question: 33 top

<https://gateoverflow.in/3779>

- ✓ Let's take an example set  $a, b, c$ .

Now lets try to create the required set of subsets, say  $S$ .

Let's start by adding sets of size 1 to  $S$ . We can only add one of the sets  $\{a\}, \{b\}, \{c\}$

Lets say we add  $\{a\}$ , so  $S$  now becomes  $\{\{a\}\}$ .

Now lets add sets of size 2 to  $S$ . Again we see that we can only add one of  $\{a, b\}, \{a, c\}$  or  $\{b, c\}$ , and we cannot add  $\{b, c\}$  since we already added  $\{a\}$ .

Continuing this way we see we can add only one set for a all size till n.

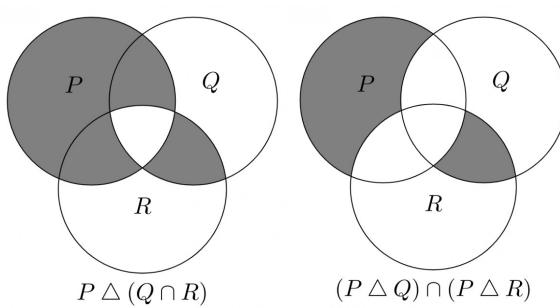
So, the answer should be (B)  $n + 1$  (include the empty set).

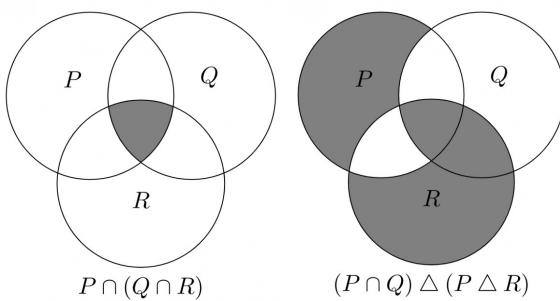
52 votes

-- Omesh Pandita (1.9k points)

#### 4.11.26 Sets: GATE IT 2006 | Question: 23 top

<https://gateoverflow.in/3562>





Answer C.

4 29 votes

-- Anu (4.7k points)

**4.11.27 Sets: GATE IT 2006 | Question: 24** top ↗

↗ <https://gateoverflow.in/3563>



✓ Number's divisible by 2 in  $X = 61$  [= integer(123/2)]

Number's divisible by 3 in  $X = 41$

Number's divisible by 5 in  $X = 24$

Number's divisible by 2 and 3 i.e. by 6 = 20

Number's divisible by 2 and 5 i.e by 10 = 12

Number's divisible by 3 and 5 i.e by 15 = 8

Number's divisible by 2 and 3 and 5 i.e by 30 = 4

Number's divisible by either 2 or 3 or 5 =  $N(A \cup B \cup C) =$

$$N(A) + N(B) + N(C) - N(A \cap B) - N(B \cap C) - N(A \cap C) + N(A \cap B \cap C)$$

$$= 61 + 41 + 24 - 20 - 12 - 8 + 4 = 90$$

$X = \{ n, 1 \leq n \leq 123, n \text{ is not divisible by either 2, 3 or 5} \}$

Cardinality =  $123 - 90 = 33$

Correct Answer: B

4 45 votes

-- Praveen Saini (41.9k points)

## Answer Keys

4.1.1	N/A	4.1.2	N/A	4.1.3	C	4.1.4	D	4.1.5	A
4.1.6	A	4.1.7	B	4.1.8	A	4.2.1	True	4.2.2	D
4.3.1	N/A	4.3.2	N/A	4.3.3	N/A	4.3.4	B	4.3.5	A
4.3.6	C	4.3.7	N/A	4.3.8	C	4.3.9	A	4.3.10	N/A
4.3.11	A	4.3.12	B	4.3.13	B	4.3.14	D	4.3.15	B
4.3.16	C	4.3.17	C	4.3.18	16	4.3.19	D	4.3.20	B
4.3.21	A	4.3.22	36	4.3.23	0.95	4.3.24	2	4.3.25	B;C
4.3.26	C	4.3.27	D	4.4.1	N/A	4.4.2	N/A	4.4.3	N/A
4.4.4	N/A	4.4.5	C	4.4.6	D	4.4.7	N/A	4.4.8	C
4.4.9	C	4.4.10	D	4.4.11	N/A	4.4.12	N/A	4.4.13	N/A
4.4.14	B	4.4.15	A	4.4.16	D	4.4.17	C	4.4.18	A
4.4.19	C	4.4.20	A	4.4.21	A	4.4.22	C	4.4.23	A
4.4.24	5	4.4.25	4	4.4.26	42	4.4.27	B	4.4.28	7
4.4.29	B	4.5.1	N/A	4.5.2	N/A	4.5.3	N/A	4.5.4	B
4.5.5	N/A	4.5.6	B	4.5.7	D	4.5.8	0	4.5.9	A
4.6.1	N/A	4.6.2	N/A	4.7.1	N/A	4.7.2	24	4.7.3	8

4.7.4	36	4.7.5	D	4.7.6	D	4.7.7	C	4.8.1	N/A
4.8.2	D	4.8.3	E	4.8.4	B	4.8.5	A	4.8.6	N/A
4.8.7	D	4.8.8	A	4.8.9	C	4.8.10	D	4.9.1	B
4.9.2	D	4.9.3	A	4.9.4	8	4.10.1	False	4.10.2	N/A
4.10.3	N/A	4.10.4	N/A	4.10.5	N/A	4.10.6	N/A	4.10.7	D
4.10.8	B	4.10.9	N/A	4.10.10	N/A	4.10.11	A	4.10.12	B
4.10.13	C	4.10.14	N/A	4.10.15	N/A	4.10.16	B	4.10.17	C
4.10.18	A;C	4.10.19	N/A	4.10.20	C	4.10.21	B	4.10.22	D
4.10.23	N/A	4.10.24	B	4.10.25	C	4.10.26	D	4.10.27	A
4.10.28	B	4.10.29	D	4.10.30	C	4.10.31	D	4.10.32	C
4.10.33	B	4.10.34	0.1249:0.1259	4.10.35	C	4.10.36	C	4.11.1	N/A
4.11.2	C	4.11.3	B	4.11.4	N/A	4.11.5	C	4.11.6	192
4.11.7	A	4.11.8	D	4.11.9	B	4.11.10	N/A	4.11.11	C
4.11.12	N/A	4.11.13	A	4.11.14	C	4.11.15	C	4.11.16	D
4.11.17	A	4.11.18	C	4.11.19	2048	4.11.20	D	4.11.21	B
4.11.22	271	4.11.23	B	4.11.24	C	4.11.25	B	4.11.26	C
4.11.27	B								

## 5

## Engineering Mathematics: Calculus (44)



**Syllabus:** Limits, Continuity, and Differentiability, Maxima and minima, Mean value theorem, Integration.

## Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
1 Mark Count	1	1	1	1	1	0	1	1	1	0	0.88	1
2 Marks Count	0	0	0	0	0	1	0	0	0	0	0.1	1
Total Marks	1	1	1	1	1	2	1	1	1	1	1.1	2

## 5.1

Continuity (8) top ↴5.1.1 Continuity: GATE CSE 1996 | Question: 3 top ↴<https://gateoverflow.in/2755>

Let  $f$  be a function defined by

$$f(x) = \begin{cases} x^2 & \text{for } x \leq 1 \\ ax^2 + bx + c & \text{for } 1 < x \leq 2 \\ x + d & \text{for } x > 2 \end{cases}$$

Find the values for the constants  $a$ ,  $b$ ,  $c$  and  $d$  so that  $f$  is continuous and differentiable everywhere on the real line.

gate1996 calculus continuity differentiation normal descriptive

Answer

5.1.2 Continuity: GATE CSE 1998 | Question: 1.4 top ↴<https://gateoverflow.in/1641>

Consider the function  $y = |x|$  in the interval  $[-1, 1]$ . In this interval, the function is

- A. continuous and differentiable
- B. continuous but not differentiable
- C. differentiable but not continuous
- D. neither continuous nor differentiable

gate1998 calculus continuity differentiation easy

Answer

5.1.3 Continuity: GATE CSE 2007 | Question: 1 top ↴<https://gateoverflow.in/1200>

Consider the following two statements about the function  $f(x) = |x|$ :

- P.  $f(x)$  is continuous for all real values of  $x$ .
- Q.  $f(x)$  is differentiable for all real values of  $x$ .

Which of the following is TRUE?

- A.  $P$  is true and  $Q$  is false.
- B.  $P$  is false and  $Q$  is true.
- C. Both  $P$  and  $Q$  are true.
- D. Both  $P$  and  $Q$  are false.

gate2007-cse calculus continuity differentiation easy

Answer

5.1.4 Continuity: GATE CSE 2013 | Question: 22 top ↴<https://gateoverflow.in/1533>

Which one of the following functions is continuous at  $x = 3$ ?

$$\text{A. } f(x) = \begin{cases} 2, & \text{if } x = 3 \\ x - 1 & \text{if } x > 3 \\ \frac{x+3}{3} & \text{if } x < 3 \end{cases}$$

- B.  $f(x) = \begin{cases} 4, & \text{if } x = 3 \\ 8 - x & \text{if } x \neq 3 \end{cases}$
- C.  $f(x) = \begin{cases} x + 3, & \text{if } x \leq 3 \\ x - 4 & \text{if } x > 3 \end{cases}$
- D.  $f(x) = \begin{cases} \frac{1}{x^3 - 27} & \text{if } x \neq 3 \\ 0 & \text{if } x = 3 \end{cases}$

gate2013-cse calculus continuity normal

Answer 

#### 5.1.5 Continuity: GATE CSE 2014 Set 1 | Question: 47

<https://gateoverflow.in/1925>



A function  $f(x)$  is continuous in the interval  $[0, 2]$ . It is known that  $f(0) = f(2) = -1$  and  $f(1) = 1$ . Which one of the following statements must be true?

- A. There exists a  $y$  in the interval  $(0, 1)$  such that  $f(y) = f(y + 1)$
- B. For every  $y$  in the interval  $(0, 1)$ ,  $f(y) = f(2 - y)$
- C. The maximum value of the function in the interval  $(0, 2)$  is 1
- D. There exists a  $y$  in the interval  $(0, 1)$  such that  $f(y) = -f(2 - y)$

gate2014-cse-set1 calculus continuity normal

Answer 

#### 5.1.6 Continuity: GATE CSE 2015 Set 2 | Question: 26

<https://gateoverflow.in/8124>



Let  $f(x) = x^{-(\frac{1}{3})}$  and  $A$  denote the area of region bounded by  $f(x)$  and the X-axis, when  $x$  varies from  $-1$  to  $1$ . Which of the following statements is/are TRUE?

- I.  $f$  is continuous in  $[-1, 1]$
- II.  $f$  is not bounded in  $[-1, 1]$
- III.  $A$  is nonzero and finite
- A. II only
- B. III only
- C. II and III only
- D. I, II and III

gate2015-cse-set2 continuity functions normal

Answer 

#### 5.1.7 Continuity: GATE CSE 2021 Set 2 | Question: 25

<https://gateoverflow.in/357515>



Suppose that  $f : \mathbb{R} \rightarrow \mathbb{R}$  is a continuous function on the interval  $[-3, 3]$  and a differentiable function in the interval  $(-3, 3)$  such that for every  $x$  in the interval,  $f'(x) \leq 2$ . If  $f(-3) = 7$ , then  $f(3)$  is at most \_\_\_\_\_

gate2021-cse-set2 numerical-answers calculus continuity

Answer 

#### 5.1.8 Continuity: GATE2010 ME

<https://gateoverflow.in/41570>



The function  $y = |2 - 3x|$

- A. is continuous  $\forall x \in R$  and differentiable  $\forall x \in R$
- B. is continuous  $\forall x \in R$  and differentiable  $\forall x \in R$  except at  $x = \frac{3}{2}$
- C. is continuous  $\forall x \in R$  and differentiable  $\forall x \in R$  except at  $x = \frac{2}{3}$
- D. is continuous  $\forall x \in R$  except  $x = 3$  and differentiable  $\forall x \in R$

calculus gate2010me engineering-mathematics continuity

Answer 

## Answers: Continuity

5.1.1 Continuity: GATE CSE 1996 | Question: 3 [top ↴](#)<https://gateoverflow.in/2755>

- ✓  $f$  is differentiable at 1 if

$$\lim_{h \rightarrow 0^-} \frac{f(1+h) - f(1)}{h} = \lim_{h \rightarrow 0^+} \frac{f(1+h) - f(1)}{h}$$

$$\Rightarrow 2 = 2a + b - (1)$$

$f$  is differentiable at 2 if

$$\lim_{h \rightarrow 0^-} \frac{f(2+h) - f(2)}{h} = \lim_{h \rightarrow 0^+} \frac{f(2+h) - f(2)}{h}$$

$$\Rightarrow 4a + b = 1 - (2)$$

Solving (1) and (2), we get

$$a = -0.5, b = 3$$

Now,  $f$  has to be continuous on 1 also, so

$$\lim_{x \rightarrow 1^-} f(x) = \lim_{x \rightarrow 1^+} f(x) = f(1)$$

$$\Rightarrow 1 = a + b + c$$

$$\Rightarrow c = -1.5$$

Similarly,  $f$  has to be continuous on 2 also, so

$$\lim_{x \rightarrow 2^-} f(x) = \lim_{x \rightarrow 2^+} f(x) = f(2)$$

$$\Rightarrow 4a + 2b + c = 2 + d$$

$$\Rightarrow d = 0.5$$

So,  $a = -0.5, b = 3, c = -1.5, d = 0.5$

21 votes

-- Happy Mittal (8.2k points)

5.1.2 Continuity: GATE CSE 1998 | Question: 1.4 [top ↴](#)<https://gateoverflow.in/1641>

- ✓ (b)  $y$  is continuous but not differentiable at  $x = 0$  as left hand limit will be negative while the right hand limit will be positive but for differentiation, both must be same.

15 votes

-- Gate\_15\_isHere (459 points)

5.1.3 Continuity: GATE CSE 2007 | Question: 1 [top ↴](#)<https://gateoverflow.in/1200>

- ✓ Ans is A.

$f(x) = |x|$ . Here, for all values of  $x$ ,  $f(x)$  exists. Therefore, it is continuous for all real values of  $x$ .

At  $x = 0$ ,  $f(x)$  is not differentiable. Because if we take the left hand limit here, it is negative while the right hand limit is positive making  $LHL \neq RHL$

Ref: <http://math.stackexchange.com/questions/991475/why-is-the-absolute-value-function-not-differentiable-at-x-0>

## References



19 votes

-- jayendra (6.7k points)

**5.1.4 Continuity: GATE CSE 2013 | Question: 22**<https://gateoverflow.in/1533>

- ✓ For continuity, Left hand limit must be equal to right hand limit. For continuity at  $x = 3$ ,

the value of  $f(x)$  just above and just below 3 must be the same.

- A.  $f(3) = 2 \cdot f(3+) = x - 1 = 2 \cdot f(3-) = \frac{(x+3)}{3} = \frac{6}{3} = 2$ . Hence, continuous.
- B.  $f(3) = 4 \cdot f(3+) = f(3-) = 8 - 3 = 5$ . So, not continuous.
- C.  $f(3) = f(3-) = x + 3 = 6 \cdot f(3+) = x - 4 = -1$ . So, not continuous.
- D.  $f(3)$  is not existing. So, not continuous.

Correct Answer: A

36 votes

-- Arjun Suresh (328k points)

**5.1.5 Continuity: GATE CSE 2014 Set 1 | Question: 47**<https://gateoverflow.in/1925>

Let us define a new function  $g$ :

$$g(y) = f(y) - f(y+1)$$

Since, function  $f$  is continuous in  $[0, 2]$ ,  $g$  would be continuous in  $[0, 1]$ .

$$g(0) = -2, g(1) = 2$$

Since,  $g$  is continuous and goes from negative to positive value in  $[0, 1]$ , at some point  $g$  would be 0 in  $(0, 1)$ .

$$g = 0 \implies f(y) = f(y+1) \text{ for some } y \in (0, 1).$$

Therefore, correct answer would be (A).

77 votes

-- suraj (4.8k points)

**5.1.6 Continuity: GATE CSE 2015 Set 2 | Question: 26**<https://gateoverflow.in/8124>

- ✓ Answer: C

I. False.

II. True.

III. True. An area is always positive, while the definite integral might be composed of several regions, some positive and some negative. A definite integral gets you the net area, because any part of the graph that is below the x-axis will give you a negative area. So, a definite integral is not necessarily the area under the curve, but the value of the area above the x-axis less the area under the x-axis. So, A is non-zero and finite.

23 votes

-- Rajarshi Sarkar (27.8k points)

**5.1.7 Continuity: GATE CSE 2021 Set 2 | Question: 25**<https://gateoverflow.in/357515>

- ✓ Given that  $f'(X) \leq 2$  and  $f(-3) = 7$ ,

As maximum slope is positive and we need value of  $f(x)$  at 3 which is on right side of  $-3$ , we can assume  $f(x)$  as a straight line with slope 2. It will give us the correct result.

Let  $f(x) = 2x + b$ ,

$$f(-3) = -6 + b = 7 \Rightarrow b = 13$$

$$f(x) = 2x + 13$$

$$f(3)_{\max} = 6 + 13 = 19.$$

Correct method would be using Mean Value Theorem. Above method will work only if you can analyze the cases correctly and can assume the  $f(x)$  without any loss of accuracy, otherwise you are very prone to commit a mistake that way.

Using Mean Value Theorem:

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

$$\Rightarrow f'(c) = \frac{f(3)-f(-3)}{3-(-3)} = \frac{f(3)-7}{6}$$

$$\Rightarrow f(3) = 6f'(c) + 7$$

As  $f'(c) \leq 2$ ,

$$\Rightarrow f(3) \leq 6 * 2 + 7 = 19.$$

1 votes

-- Nikhil Dhama (2.3k points)

### 5.1.8 Continuity: GATE2010 ME [top](#)

<https://gateoverflow.in/41570>



✓  $y = \begin{cases} 2 - 3x, & 2 - 3x \geq 0 \\ 3x - 2, & 2 - 3x < 0 \end{cases}$

$$\Rightarrow y = \begin{cases} 2 - 3x, & x \leq \frac{2}{3} \\ 3x - 2, & x > \frac{2}{3} \end{cases}$$

As  $y$  is polynomial it is continuous and differentiable at all points but do not know at  $x = \frac{2}{3}$ .

To check continuity at  $x = \frac{2}{3}$

$$\text{Left limit} = 2 - 3 \times \frac{2}{3} = 0$$

$$\text{Right limit} = 3 \times \frac{2}{3} - 2 = 0$$

$$f(a) = f(2/3) = 2 - 3 \times \frac{2}{3} = 0$$

$\because \text{LL} = \text{RL} = f(a)$ ,  $y$  is continuous  $\forall_{x \in R}$ .

To check differentiability at  $x = \frac{2}{3}$

$$\text{Left derivative} = 0 - 3 = -3$$

$$\text{Right derivative} = 3 - 0 = 3$$

$\therefore \text{LD} \neq \text{RD}$ ,  $y$  is not differentiable at  $x = \frac{2}{3}$ .

**So, Answer is option C.**

37 votes

-- Lokesh Dafale (8.2k points)

## 5.2

### Differentiation (5) [top](#)

#### 5.2.1 Differentiation: GATE CSE 1996 | Question: 1.6 [top](#)

<https://gateoverflow.in/2710>



The formula used to compute an approximation for the second derivative of a function  $f$  at a point  $X_0$  is

- A.  $\frac{f(x_0 + h) + f(x_0 - h)}{2}$
- B.  $\frac{f(x_0 + h) - f(x_0 - h)}{2h}$
- C.  $\frac{f(x_0 + h) + 2f(x_0) + f(x_0 - h)}{h^2}$
- D.  $\frac{f(x_0 + h) - 2f(x_0) + f(x_0 - h)}{h^2}$

[gate1996](#) [calculus](#) [differentiation](#) [normal](#)

Answer

#### 5.2.2 Differentiation: GATE CSE 2014 Set 1 | Question: 46 [top](#)

<https://gateoverflow.in/1924>



The function  $f(x) = x \sin x$  satisfies the following equation:

$$f''(x) + f(x) + t \cos x = 0$$

The value of  $t$  is \_\_\_\_\_.

[gate2014-cse-set1](#) [calculus](#) [easy](#) [numerical-answers](#) [differentiation](#)

Answer

5.2.3 Differentiation: GATE CSE 2014 Set 1 | Question: 6 [top ↗](#)<https://gateoverflow.in/1763>

Let the function

$$f(\theta) = \begin{vmatrix} \sin \theta & \cos \theta & \tan \theta \\ \sin\left(\frac{\pi}{6}\right) & \cos\left(\frac{\pi}{6}\right) & \tan\left(\frac{\pi}{6}\right) \\ \sin\left(\frac{\pi}{3}\right) & \cos\left(\frac{\pi}{3}\right) & \tan\left(\frac{\pi}{3}\right) \end{vmatrix}$$

where

 $\theta \in \left[\frac{\pi}{6}, \frac{\pi}{3}\right]$  and  $f'(\theta)$  denote the derivative of  $f$  with respect to  $\theta$ . Which of the following statements is/are **TRUE**?

- I. There exists  $\theta \in \left(\frac{\pi}{6}, \frac{\pi}{3}\right)$  such that  $f'(\theta) = 0$   
 II. There exists  $\theta \in \left(\frac{\pi}{6}, \frac{\pi}{3}\right)$  such that  $f'(\theta) \neq 0$

- A. I only  
 B. II only  
 C. Both I and II  
 D. Neither I nor II

[gate2014-cse-set1](#) [calculus](#) [differentiation](#) [normal](#)

Answer

5.2.4 Differentiation: GATE CSE 2016 Set 2 | Question: 02 [top ↗](#)<https://gateoverflow.in/39571>Let  $f(x)$  be a polynomial and  $g(x) = f'(x)$  be its derivative. If the degree of  $(f(x) + f(-x))$  is 10, then the degree of  $(g(x) - g(-x))$  is \_\_\_\_\_.[gate2016-cse-set2](#) [calculus](#) [normal](#) [numerical-answers](#) [differentiation](#)

Answer

5.2.5 Differentiation: GATE CSE 2017 Set 2 | Question: 10 [top ↗](#)<https://gateoverflow.in/118262>If  $f(x) = R \sin\left(\frac{\pi x}{2}\right) + S$ ,  $f'\left(\frac{1}{2}\right) = \sqrt{2}$  and  $\int_0^1 f(x) dx = \frac{2R}{\pi}$ , then the constants  $R$  and  $S$  are

- A.  $\frac{2}{\pi}$  and  $\frac{16}{\pi}$   
 B.  $\frac{2}{\pi}$  and 0  
 C.  $\frac{4}{\pi}$  and 0  
 D.  $\frac{4}{\pi}$  and  $\frac{16}{\pi}$

[gate2017-cse-set2](#) [engineering-mathematics](#) [calculus](#) [differentiation](#)

Answer

## Answers: Differentiation

5.2.1 Differentiation: GATE CSE 1996 | Question: 1.6 [top ↗](#)<https://gateoverflow.in/2710>

- ✓ Option D.

Ref: [http://en.wikipedia.org/wiki/Second\\_derivative](http://en.wikipedia.org/wiki/Second_derivative)

## References



15 votes

-- Arjun Suresh (328k points)

5.2.2 Differentiation: GATE CSE 2014 Set 1 | Question: 46 [top ↗](#)<https://gateoverflow.in/1924>

- ✓  $f'(x) = x \cos(x) + \sin(x)$

$$f''(x) = x(-\sin x) + \cos x + \cos x$$

now  $f''(x) + f(x) + t \cos x = 0$

$$\Rightarrow x(-\sin x) + \cos x + \cos x + x \sin x + t \cos x = 0$$

$$\Rightarrow 2 \cos x + t \cos x = 0$$

$$\Rightarrow \cos x(t+2) = 0$$

$$\Rightarrow t+2=0, t=-2$$

28 votes

-- SAKET NANDAN (4.2k points)

### 5.2.3 Differentiation: GATE CSE 2014 Set 1 | Question: 6 top

<https://gateoverflow.in/1763>



- ✓ We need to solve this by [Rolle's theorem](#). To apply Rolle's theorem following 3 conditions should be satisfied:

1.  $f(x)$  should be continuous in interval  $[a, b]$ ,
2.  $f(x)$  should be differentiable in interval  $(a, b)$ , and
3.  $f(a) = f(b)$

If these 3 conditions are satisfied simultaneously then, there exists at least one ' $x'$  such that  $f'(x) = 0$

For the given question, it satisfies all the three conditions, so we can apply Rolle's theorem, i.e., there exists at least one  $\theta$  that gives  $f'(\theta) = 0$

Also, the given function is also not a constant function, i.e., for some  $\theta$ ,  $f'(\theta) \neq 0$

So, answer is C.

#### References



42 votes

-- Saurabh Sharma (441 points)

### 5.2.4 Differentiation: GATE CSE 2016 Set 2 | Question: 02 top

<https://gateoverflow.in/39571>



- ✓ Let  $f(x) = x^{10}$  Degree= 10.

$$\begin{aligned} f(x) + f(-x) &= x^{10} + (-x)^{10} \\ &= x^{10} + x^{10} \\ &= 2.x^{10} \end{aligned}$$

$$\begin{aligned} g(x) - g(-x) &= 10.x^9 - \{-10x^9\} \\ &= 20.x^9 \end{aligned}$$

So, answer is 9.

61 votes

-- Akash Kanase (36k points)

### 5.2.5 Differentiation: GATE CSE 2017 Set 2 | Question: 10 top

<https://gateoverflow.in/118262>



- ✓ Correct Option: C.

$$f(x) = R * \sin\left(\frac{\pi*x}{2}\right) + S$$

$$f'(x) = R * \cos\left(\frac{\pi*x}{2}\right) * \frac{\pi}{2}$$

$$f'\left(\frac{1}{2}\right) = R * \cos\left(\frac{\pi}{4}\right) * \frac{\pi}{2} = \sqrt{2}$$

$$R = \frac{\sqrt{2} * \sqrt{2} * 2}{\pi} = \frac{4}{\pi}$$

$$f(x) = \frac{4}{\pi} * \sin\left(\frac{\pi x}{2}\right) + S$$

$$\int_0^1 f(x) * dx = \int_0^1 \left( \frac{4}{\pi} * \sin\left(\frac{\pi x}{2}\right) + S \right) * dx = \frac{2*R}{\pi} = \frac{8}{\pi^2}$$

$$\frac{4}{\pi} \int_0^1 \sin\left(\frac{\pi x}{2}\right) * dx + \int_0^1 S * dx = \frac{8}{\pi^2}$$

$$\frac{4}{\pi} \left[ -\cos\left(\frac{\pi x}{2}\right) * \frac{2}{\pi} \right]_0^1 + S[x]_0^1 = \frac{8}{\pi^2}$$

$$\frac{8}{\pi^2} [-0 + 1] + S = \frac{8}{\pi^2}$$

$$S = 0.$$

28 votes

-- Dhruv Patel (1.6k points)

### 5.3

### Integration (9) top ↗

#### 5.3.1 Integration: GATE CSE 2000 | Question: 2.3 top ↗

☞ <https://gateoverflow.in/650>



Let  $S = \sum_{i=3}^{100} i \log_2 i$ , and  $T = \int_2^{100} x \log_2 x dx$ .

Which of the following statements is true?

- A.  $S > T$
- B.  $S = T$
- C.  $S < T$  and  $2S > T$
- D.  $2S \leq T$

gate2000-cse calculus integration normal

Answer

#### 5.3.2 Integration: GATE CSE 2009 | Question: 25 top ↗

☞ <https://gateoverflow.in/802>



$$\int_0^{\pi/4} (1 - \tan x) / (1 + \tan x) dx$$

- A. 0
- B. 1
- C.  $\ln 2$
- D.  $1/2 \ln 2$

gate2009-cse calculus integration normal

Answer

#### 5.3.3 Integration: GATE CSE 2011 | Question: 31 top ↗

☞ <https://gateoverflow.in/2133>



Given  $i = \sqrt{-1}$ , what will be the evaluation of the definite integral  $\int_0^{\pi/2} \frac{\cos x + i \sin x}{\cos x - i \sin x} dx$ ?

- A. 0
- B. 2
- C.  $-i$
- D.  $i$

gate2011-cse calculus integration normal

Answer

#### 5.3.4 Integration: GATE CSE 2014 Set 3 | Question: 47 top ↗

☞ <https://gateoverflow.in/2081>



The value of the integral given below is

$$\int_0^{\pi} x^2 \cos x dx$$

- A.  $-2\pi$
- B.  $\pi$
- C.  $-\pi$
- D.  $2\pi$

[gate2014-cse-set3](#) [calculus](#) [limits](#) [integration](#) [normal](#)

Answer 

### 5.3.5 Integration: GATE CSE 2014 Set 3 | Question: 6 [top](#)

<https://gateoverflow.in/2040>



If  $\int_0^{2\pi} |x \sin x| dx = k\pi$ , then the value of  $k$  is equal to \_\_\_\_\_.

[gate2014-cse-set3](#) [calculus](#) [integration](#) [limits](#) [numerical-answers](#) [easy](#)

Answer 

### 5.3.6 Integration: GATE CSE 2015 Set 1 | Question: 44 [top](#)

<https://gateoverflow.in/8314>



Compute the value of:

$$\int_{\frac{1}{\pi}}^{\frac{2}{\pi}} \frac{\cos(1/x)}{x^2} dx$$

[gate2015-cse-set1](#) [calculus](#) [integration](#) [normal](#) [numerical-answers](#)

Answer 

### 5.3.7 Integration: GATE CSE 2015 Set 3 | Question: 45 [top](#)

<https://gateoverflow.in/8554>



If for non-zero  $x$ ,  $af(x) + bf(\frac{1}{x}) = \frac{1}{x} - 25$  where  $a \neq b$  then  $\int_1^2 f(x) dx$  is

- A.  $\frac{1}{a^2-b^2} \left[ a(\ln 2 - 25) + \frac{47b}{2} \right]$
- B.  $\frac{1}{a^2-b^2} \left[ a(2 \ln 2 - 25) - \frac{47b}{2} \right]$
- C.  $\frac{1}{a^2-b^2} \left[ a(2 \ln 2 - 25) + \frac{47b}{2} \right]$
- D.  $\frac{1}{a^2-b^2} \left[ a(\ln 2 - 25) - \frac{47b}{2} \right]$

[gate2015-cse-set3](#) [calculus](#) [integration](#) [normal](#)

Answer 

### 5.3.8 Integration: GATE CSE 2018 | Question: 16 [top](#)

<https://gateoverflow.in/204090>



The value of  $\int_0^{\pi/4} x \cos(x^2) dx$  correct to three decimal places (assuming that  $\pi = 3.14$ ) is \_\_\_\_\_

[gate2018-cse](#) [calculus](#) [integration](#) [normal](#) [numerical-answers](#)

Answer 

### 5.3.9 Integration: GATE IT 2005 | Question: 35 [top](#)

<https://gateoverflow.in/3782>



What is the value of  $\int_0^{2\pi} (x - \pi)^2 (\sin x) dx$

- A.  $-1$
- B.  $0$
- C.  $1$
- D.  $\pi$

[gate2005-it](#) [calculus](#) [integration](#) [normal](#)
[Answer](#)

### Answers: Integration

#### 5.3.1 Integration: GATE CSE 2000 | Question: 2.3 [top](#)

<https://gateoverflow.in/650>


- ✓  $x \log_2 x$  is a continuously increasing function, and for a continuously increasing function  $f(x)$ ,

$$\sum_{x=a}^b f(x) > \int_a^b f(x) dx$$

But in question, summation of L.H.S. above,  $a = 3$  and in R.H.S,  $a = 2$ , so we don't know whether  $S > T$ . So we compute some initial values :

$$\sum_{x=3}^4 x \log_2 x \approx 12.754, \text{ and } \int_2^4 x \log_2 x = 11$$

Since  $\sum_{x=3}^4 x \log_2 x > \int_2^4 x \log_2 x$ , and since we already know that

$$\sum_{x=5}^{100} x \log_2 x > \int_5^{100} x \log_2 x$$

$$\text{So } \sum_{x=3}^{100} x \log_2 x > \int_2^{100} x \log_2 x$$

So S > T, and option (A) is correct.

24 votes

-- Happy Mittal (8.2k points)

#### 5.3.2 Integration: GATE CSE 2009 | Question: 25 [top](#)

<https://gateoverflow.in/802>


✓ Let  $I = \int_0^{\frac{\pi}{4}} \frac{1 - \tan x}{1 + \tan x} dx = \int_0^{\frac{\pi}{4}} \frac{\cos x - \sin x}{\cos x + \sin x} dx$

Now put  $\cos x + \sin x = t$ , Then  $(-\sin x + \cos x) dx = dt$  and changing limit

$$\text{So we get } I = \int_1^{\sqrt{2}} \frac{1}{t} dt = [\ln t] = \ln(\sqrt{2}) = \frac{\ln 2}{2}$$

Correct Answer: D

43 votes

-- Jagdish Singh (413 points)

#### 5.3.3 Integration: GATE CSE 2011 | Question: 31 [top](#)

<https://gateoverflow.in/2133>


- ✓ Answer is D.

$$\int_0^{\frac{\pi}{2}} \frac{e^{ix}}{e^{-ix}} dx = \int_0^{\frac{\pi}{2}} e^{2ix} dx = \frac{e^{2ix}}{2i} \Big|_0^{\frac{\pi}{2}} = \frac{-2}{2i} = \frac{-1}{i} = \frac{-1 \times i}{i \times i} = \frac{-i}{i^2} = \frac{-i}{-1} = i$$

35 votes

-- Sona Praneeth Akula (3.4k points)

#### 5.3.4 Integration: GATE CSE 2014 Set 3 | Question: 47 [top](#)

<https://gateoverflow.in/2081>


- ✓ Answer is A.

$$\begin{aligned} & \int_0^{\pi} x^2 \cos x dx \\ &= x^2 \sin x \Big|_0^{\pi} - \int_0^{\pi} 2x \sin x \\ &= x^2 \sin x \Big|_0^{\pi} + 2x \cos x \Big|_0^{\pi} - \int_0^{\pi} 2 \cos x dx \\ &= x^2 \sin x \Big|_0^{\pi} + 2x \cos x \Big|_0^{\pi} - 2 \sin x \Big|_0^{\pi} \\ &= [\pi^2(0) - 0] + 2[\pi(-1) - 0] - 2[0 - 0] \\ &= -2\pi \end{aligned}$$

! Integral of a multiplied by b equals a multiplied by integral of b minus integral of derivative of a multiplied by integral of b

21 votes

-- Keith Kr (4.6k points)

### 5.3.5 Integration: GATE CSE 2014 Set 3 | Question: 6 top

<https://gateoverflow.in/2040>



- ✓ There is a mod term in the given integral. So, first we have to remove that. We know that  $x$  is always positive here and  $\sin x$  is positive from 0 to  $\pi$ . From  $\pi$  to  $2\pi$ ,  $x$  is positive while  $\sin x$  changes sign. So, we can write

$$\int_0^{2\pi} |x \sin x| dx = \int_0^\pi x \sin x dx + \left( - \int_\pi^{2\pi} x \sin x dx \right)$$

$$= \int_0^\pi x \sin x dx - \int_\pi^{2\pi} x \sin x dx.$$

$$\int_0^\pi u dv = uv - \int_0^\pi v du$$

Here  $u = x, du = dx, dv = \sin x dx$ , so  $v = -\cos x$

$$\therefore \int_0^\pi x \sin x dx = [-x \cos x]_0^\pi + \int_0^\pi \cos x dx$$

$$= \pi + [\sin x]_0^\pi = \pi$$

$$\text{Now, } \int_\pi^{2\pi} x \sin x = [-x \cos x]_\pi^{2\pi} + \int_\pi^{2\pi} \cos x dx$$

$$= -3\pi + [\sin x]_\pi^{2\pi} = -3\pi$$

So, given integral =  $\pi - (-3\pi) = 4\pi$

So, k = 4.

46 votes

-- Arjun Suresh (328k points)

### 5.3.6 Integration: GATE CSE 2015 Set 1 | Question: 44 top

<https://gateoverflow.in/8314>



- ✓ For the integrand  $\frac{\cos(1/x)}{x^2}$ , substitute  $u = \frac{1}{x}$  and  $du = -\frac{1}{x^2} dx$ .

This gives a new lower bound  $u = \frac{1}{1/\pi} = \pi$  and upper bound  $u = \frac{1}{2/\pi} = \frac{\pi}{2}$ . Now, our integral becomes:

$$I = - \int_{\pi}^{\pi/2} \cos(u) du$$

$$= \int_{\pi/2}^{\pi} \cos(u) du$$

Since the antiderivative of  $\cos(u)$  is  $\sin(u)$ , applying the fundamental theorem of calculus, we get:

$$\begin{aligned} I &= \sin(u) \Big|_{\pi/2}^{\pi} \\ &= \sin(\pi) - \sin\left(\frac{\pi}{2}\right) \\ &= 0 - 1 \\ &= -1 \end{aligned}$$

42 votes

-- Shyam Singh (1.3k points)

### 5.3.7 Integration: GATE CSE 2015 Set 3 | Question: 45 top

<https://gateoverflow.in/8554>



- ✓  $af(x) + bf\left(\frac{1}{x}\right) = \frac{1}{x} - 25 \quad \dots (1)$

Integrating both sides,

$$a \int_1^2 f(x) dx + b \int_1^2 f\left(\frac{1}{x}\right) dx = [\log(x) - 25x]_1^2 = \log 2 - 25 \quad \dots (2)$$

Replacing  $x$  by  $\frac{1}{x}$  in (1), we get

$$af\left(\frac{1}{x}\right) + bf(x) = x - 25$$

Integrating both sides, we get

$$a \int_1^2 f\left(\frac{1}{x}\right) dx + b \int_1^2 f(x) dx = \left[\frac{x^2}{2} - 25x\right]_1^2 = -\frac{47}{2} \quad \dots (3)$$

Eliminate  $\int_1^2 f\left(\frac{1}{x}\right) dx$  between (2) and (3) by multiplying (2) by  $a$  and (3) by  $b$  and subtracting

$$\therefore (a^2 - b^2) \int_1^2 f(x) dx = a(\log 2 - 25) + b \times \frac{47}{2}$$

$$\therefore \int_1^2 f(x) dx = \frac{1}{(a^2 - b^2)} [a(\log 2 - 25) + \frac{47b}{2}]$$

$$\text{Answer: A. } \frac{1}{(a^2 - b^2)} [a(\log 2 - 25) + \frac{47b}{2}]$$

80 votes

-- Shyam Singh (1.3k points)

### 5.3.8 Integration: GATE CSE 2018 | Question: 16 [top](#)



✓  $\int_0^{\frac{\pi}{4}} x \cos(x^2) dx$

put  $x^2 = t$

$2xdx = dt$

$t$  will range from 0 to  $\frac{\pi^2}{16}$

Now our new integral is :  $\frac{1}{2} \int_0^{\frac{\pi^2}{16}} \cos(t) dt$

$$= \frac{1}{2} [\sin(t)]_0^{\frac{\pi^2}{16}} = \frac{1}{2} [\sin(.616225) - 0] = \frac{0.5779}{2}$$

$\sin(.616225 \text{ radians}) =$

0.5779586366

0.289 Answer

26 votes

-- sumit\_goyal (6.9k points)

### 5.3.9 Integration: GATE IT 2005 | Question: 35 [top](#)



✓ answer is (b)

Put  $x - \pi = t$  then limit 0 changes to  $-\pi$  and upper limit  $2\pi$  changes to  $\pi$ .

$$\frac{d}{dx}(x - \pi) = dt \implies dx = dt$$

Integration of  $t^2 \sin t dt$  for limit  $-\pi$  to  $\pi$ . One is an odd function and one is even and product of odd and even functions is odd function and integrating an odd function from the same negative value to positive value gives 0.

20 votes

-- SAKET NANDAN (4.2k points)

5.4

### Limits (10) [top](#)

#### 5.4.1 Limits: GATE CSE 1993 | Question: 02.1 [top](#)

<https://gateoverflow.in/605>



$$\lim_{x \rightarrow 0} \frac{x(e^x - 1) + 2(\cos x - 1)}{x(1 - \cos x)} \text{ is } \underline{\hspace{2cm}}$$

gate1993 limits calculus normal fill-in-the-blanks

Answer

**5.4.2 Limits: GATE CSE 1995 | Question: 7(B) top ↗**<https://gateoverflow.in/359942>

Compute without using power series expansion  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ .

[gate1995](#) [calculus](#) [limits](#) [numerical-answers](#)

Answer

**5.4.3 Limits: GATE CSE 2008 | Question: 1 top ↗**<https://gateoverflow.in/399>

$\lim_{x \rightarrow \infty} \frac{x - \sin x}{x + \cos x}$  equals

- A. 1
- B. -1
- C.  $\infty$
- D.  $-\infty$

[gate2008-cse](#) [calculus](#) [limits](#) [easy](#)

Answer

**5.4.4 Limits: GATE CSE 2010 | Question: 5 top ↗**<https://gateoverflow.in/1151>

What is the value of  $\lim_{n \rightarrow \infty} \left(1 - \frac{1}{n}\right)^{2n}$  ?

- A. 0
- B.  $e^{-2}$
- C.  $e^{-1/2}$
- D. 1

[gate2010-cse](#) [calculus](#) [limits](#) [normal](#)

Answer

**5.4.5 Limits: GATE CSE 2015 Set 1 | Question: 4 top ↗**<https://gateoverflow.in/8021>

$\lim_{x \rightarrow \infty} x^{\frac{1}{x}}$  is

- A.  $\infty$
- B. 0
- C. 1
- D. Not defined

[gate2015-cse-set1](#) [calculus](#) [limits](#) [normal](#)

Answer

**5.4.6 Limits: GATE CSE 2015 Set 3 | Question: 9 top ↗**<https://gateoverflow.in/8403>

The value of  $\lim_{x \rightarrow \infty} (1 + x^2)^{e^{-x}}$  is

- A. 0
- B.  $\frac{1}{2}$
- C. 1
- D.  $\infty$

[gate2015-cse-set3](#) [calculus](#) [limits](#) [normal](#)

Answer

**5.4.7 Limits: GATE CSE 2016 Set 1 | Question: 3** [top ↴](#)<https://gateoverflow.in/39630>

$$\lim_{x \rightarrow 4} \frac{\sin(x - 4)}{x - 4} = \underline{\hspace{2cm}}$$

[gate2016-cse-set1](#) [calculus](#) [limits](#) [easy](#) [numerical-answers](#)

Answer

**5.4.8 Limits: GATE CSE 2017 Set 1 | Question: 28** [top ↴](#)<https://gateoverflow.in/118309>

The value of  $\lim_{x \rightarrow 1} \frac{x^7 - 2x^5 + 1}{x^3 - 3x^2 + 2}$

- A. is 0
- B. is -1
- C. is 1
- D. does not exist

[gate2017-cse-set1](#) [calculus](#) [limits](#) [normal](#)

Answer

**5.4.9 Limits: GATE CSE 2019 | Question: 13** [top ↴](#)<https://gateoverflow.in/302835>

Compute  $\lim_{x \rightarrow 3} \frac{x^4 - 81}{2x^2 - 5x - 3}$

- A. 1
- B. 53/12
- C. 108/7
- D. Limit does not exist

[gate2019-cse](#) [engineering-mathematics](#) [calculus](#) [limits](#)

Answer

**5.4.10 Limits: GATE CSE 2021 Set 1 | Question: 20** [top ↴](#)<https://gateoverflow.in/357431>

Consider the following expression.

$$\lim_{x \rightarrow -3} \frac{\sqrt{2x + 22} - 4}{x + 3}$$

The value of the above expression (rounded to 2 decimal places) is \_\_\_\_\_.

[gate2021-cse-set1](#) [calculus](#) [limits](#) [numerical-answers](#)

Answer

**Answers: Limits****5.4.1 Limits: GATE CSE 1993 | Question: 02.1** [top ↴](#)<https://gateoverflow.in/605>

- ✓ Use LH rule:

First Derivative: 
$$\frac{[x(e^x) + (e^x - 1) - 2(\sin x)]}{[x \sin x + (1 - \cos x)]}$$

Second Derivative: 
$$\frac{[xe^x + e^x + e^x - 2\cos x]}{[x\cos x + \sin x + \sin x]}$$

Third Derivative:  $\frac{[xe^x + e^x + e^x + e^x + 2 \sin x]}{[-x \sin x + \cos x + \cos x + \cos x]}$

$$\text{Put } x = 0 : \frac{[0 + 1 + 1 + 1 + 0]}{[0 + 1 + 1 + 1]} = \frac{3}{3} = 1.$$

15 votes

-- Rajarshi Sarkar (27.8k points)

#### 5.4.2 Limits: GATE CSE 1995 | Question: 7(B) [top](#)

<https://gateoverflow.in/359942>



✓  $\lim_{x \rightarrow 0} \frac{\sin x}{x} = \lim_{x \rightarrow 0} \frac{\cos x}{1}$  (Applying L-Hospital's rule since 0/0 form)

$$= 1.$$

10 votes

-- abhi18459 (281 points)

#### 5.4.3 Limits: GATE CSE 2008 | Question: 1 [top](#)

<https://gateoverflow.in/399>



$$\begin{aligned} & \checkmark \lim_{x \rightarrow \infty} \frac{x - \sin x}{x + \cos x} \\ &= \lim_{x \rightarrow \infty} \frac{x(1 - \frac{\sin x}{x})}{x(1 + \frac{\cos x}{x})} \\ &= \lim_{x \rightarrow \infty} \frac{1 - \frac{\sin x}{x}}{1 + \frac{\cos x}{x}} \end{aligned}$$

now to calculate values of  $\frac{\sin x}{x}$  and  $\frac{\cos x}{x}$  we use Squeezing Theorem.

$$-1 \leq \sin x \leq +1 \quad \frac{-1}{x} \leq \frac{\sin x}{x} \leq \frac{+1}{x}$$

$$-1 \leq \cos x \leq +1 \quad \frac{-1}{x} \leq \frac{\cos x}{x} \leq \frac{+1}{x}$$

now as  $x \rightarrow \infty$  we get  $\frac{1}{x} \rightarrow 0$ , this implies that:

$$0 \leq \frac{\sin x}{x} \leq 0 \quad 0 \leq \frac{\cos x}{x} \leq 0$$

Hence,

$$\begin{aligned} & \lim_{x \rightarrow \infty} \frac{x - \sin x}{x + \cos x} \\ &= \lim_{x \rightarrow \infty} \frac{1 - \frac{\sin x}{x}}{1 + \frac{\cos x}{x}} \\ &= \lim_{x \rightarrow \infty} \frac{1 - 0}{1 + 0} = 1 \end{aligned}$$

answer = **option A**

48 votes

-- Amar Vashishth (25.2k points)

#### 5.4.4 Limits: GATE CSE 2010 | Question: 5 [top](#)

<https://gateoverflow.in/1151>



✓ I will solve by two methods

**Method 1:**

$$y = \lim_{n \rightarrow \infty} \left(1 - \frac{1}{n}\right)^{2n}$$

Taking log

$$\begin{aligned} \log y &= \lim_{n \rightarrow \infty} 2n \log\left(1 - \frac{1}{n}\right) \\ &= \lim_{n \rightarrow \infty} \frac{\log\left(1 - \frac{1}{n}\right)}{\left(\frac{1}{2n}\right)} \quad \text{(converted this so as to have form } \left(\frac{0}{0}\right)\text{)} \end{aligned}$$

Apply L' hospital rule

$$\log y = \lim_{n \rightarrow \infty} \frac{\left(\frac{1}{1 - \frac{1}{n}}\right) \cdot \frac{1}{n^2}}{\left(\frac{-1}{2n^2}\right)}$$

$$\log y = -2$$

$$y = e^{-2}.$$

**Method 2:**

it takes 1 to power infinity form

$$\begin{aligned} \lim_{x \rightarrow \infty} f(x)^{g(x)} \\ = e^{\lim_{x \rightarrow \infty} (f(x)-1)g(x)} \end{aligned}$$

$$\text{where, } (f(x) - 1) * g(x) = \frac{-1}{n} * 2n = -2.$$

i.e., -2 constant.

so we get final ans is  $= e^{-2}$ .

You can refer this link for second method

[http://www.vitutor.com/calculus/limits/one\\_infinity.html](http://www.vitutor.com/calculus/limits/one_infinity.html)

Correct Answer: *B*

**References**

46 votes

-- Pooja Palod (24k points)

**5.4.5 Limits: GATE CSE 2015 Set 1 | Question: 4**

<https://gateoverflow.in/8021>

- ✓ Apply an exponential of a logarithm to the expression.

$$\lim_{x \rightarrow \infty} x^{\frac{1}{x}} = \lim_{x \rightarrow \infty} \exp\left(\log\left(x^{\frac{1}{x}}\right)\right) = \lim_{x \rightarrow \infty} \exp\left(\frac{\log(x)}{x}\right)$$

Since the exponential function is continuous, we may factor it out of the limit.

$$\lim_{x \rightarrow \infty} \exp\left(\frac{\log(x)}{x}\right) = \exp\left(\lim_{x \rightarrow \infty} \frac{\log(x)}{x}\right)$$

Logarithmic functions grow asymptotically slower than polynomials.

Since  $\log(x)$  grows asymptotically slower than the polynomial  $x$  as  $x$  approaches  $\infty$ ,

$$\lim_{x \rightarrow \infty} \frac{\log(x)}{x} = 0:$$

$$e^0 = 1$$

Correct Answer: *C*

29 votes

-- Shyam Singh (1.3k points)

**5.4.6 Limits: GATE CSE 2015 Set 3 | Question: 9**

<https://gateoverflow.in/8403>

- ✓ Apply an exponential of a logarithm to the expression.

$$\lim_{x \rightarrow \infty} (x^2 + 1)^{e^{-x}} = \lim_{x \rightarrow \infty} \exp\left(\log((x^2 + 1)^{e^{-x}})\right)$$

$$= \lim_{x \rightarrow \infty} \exp\left(\frac{\log(x^2 + 1)}{e^x}\right)$$

Since the exponential function is continuous, we may factor it out of the limit.

$$\lim_{x \rightarrow \infty} \exp\left(\frac{\log(x^2 + 1)}{e^x}\right)$$

$$= \exp\left(\lim_{x \rightarrow \infty} \frac{\log(x^2 + 1)}{e^x}\right)$$

The numerator of  $e^{-x} \log(x^2 + 1)$  grows asymptotically slower than its denominator as  $x$  approaches  $\infty$ .

Since  $\log(x^2 + 1)$  grows asymptotically slower than  $e^x$  as  $x$  approaches  $\infty$ ,  $\lim_{x \rightarrow \infty} e^{-x} \log(x^2 + 1) = 0 : e^0$ .

Evaluate  $e^0$ .

$e^0 = 1$ :

Answer: 1.

Correct Answer: C

41 votes

-- Shyam Singh (1.3k points)

#### 5.4.7 Limits: GATE CSE 2016 Set 1 | Question: 3 [top](#)

<https://gateoverflow.in/39630>



- ✓ Substitute  $h = x - 4$ , it becomes  $\lim_{h \rightarrow 0} \frac{\sin h}{h}$ .

This is a standard limit and answer is 1.

24 votes

-- Abhilash Panicker (7.6k points)

#### 5.4.8 Limits: GATE CSE 2017 Set 1 | Question: 28 [top](#)

<https://gateoverflow.in/118309>



- ✓ Since substituting  $x = 1$  we get  $\frac{0}{0}$  which is indeterminate.

After applying L'Hospital rule, we get  $\frac{(7x^6 - 10x^4)}{(3x^2 - 6x)}$

Now substituting  $x = 1$  we get  $(\frac{-3}{-3}) = 1$ .

Hence, answer is 1.

Correct Answer: C

24 votes

-- sriv\_shubham (2.8k points)

#### 5.4.9 Limits: GATE CSE 2019 | Question: 13 [top](#)

<https://gateoverflow.in/302835>



- ✓ Let  $y = \lim_{x \rightarrow 3} \frac{x^4 - 81}{2x^2 - 5x - 3}$

When we put 3 in the equation we get  $\frac{0}{0}$  form, so we can apply L Hospital's rule.

Differentiate the numerator and denominator separately

$$y = \lim_{x \rightarrow 3} \frac{4x^3 - 0}{4x - 5 - 0}$$

$$y = \lim_{x \rightarrow 3} \frac{4x^3}{4x - 5}$$

Put the limit and get the value

$$y = \frac{4 \times (3)^3}{4 \times (3) - 5}$$

$$y = \frac{4 \times 27}{7}$$

$$y = \frac{108}{7}$$

Correct Answer is C.

16 votes

-- Lakshman Patel (63.9k points)

**5.4.10 Limits: GATE CSE 2021 Set 1 | Question: 20** [top](#)<https://gateoverflow.in/357431>

✓  $\lim_{x \rightarrow -3} \frac{\sqrt{2x+22} - 4}{x + 3}$  ( $\frac{0}{0}$  form)

Using L'Hôpital's rule

$$\lim_{x \rightarrow -3} \frac{\frac{1}{\sqrt{2x+22}}(2) - 0}{1 + 0} = \lim_{x \rightarrow -3} \frac{1}{\sqrt{2x+22}} = \frac{1}{\sqrt{2(-3)+22}} = \frac{1}{4} = 0.25$$

2 votes

-- Konan-kun (143 points)

**5.5****Maxima Minima (10)** [top](#)<https://gateoverflow.in/80571>**5.5.1 Maxima Minima: GATE CSE 1987 | Question: 1-xxvi** [top](#)

If  $f(x_i), f(x_{i+1}) < 0$  then

- A. There must be a root of  $f(x)$  between  $x_i$  and  $x_{i+1}$
- B. There need not be a root of  $f(x)$  between  $x_i$  and  $x_{i+1}$
- C. There fourth derivative of  $f(x)$  with respect to  $x$  vanishes at  $x_i$
- D. The fourth derivative of  $f(x)$  with respect to  $x$  vanishes at  $x_{i+1}$

[gate1987](#) [calculus](#) [maxima-minima](#)

Answer

**5.5.2 Maxima Minima: GATE CSE 1995 | Question: 1.21** [top](#)<https://gateoverflow.in/2608>

In the interval  $[0, \pi]$  the equation  $x = \cos x$  has

- A. No solution
- B. Exactly one solution
- C. Exactly two solutions
- D. An infinite number of solutions

[gate1995](#) [calculus](#) [normal](#) [maxima-minima](#)

Answer

**5.5.3 Maxima Minima: GATE CSE 1995 | Question: 25a** [top](#)<https://gateoverflow.in/2664>

Find the minimum value of  $3 - 4x + 2x^2$ .

[gate1995](#) [calculus](#) [maxima-minima](#) [easy](#) [descriptive](#)

Answer

**5.5.4 Maxima Minima: GATE CSE 1997 | Question: 4.1** [top](#)<https://gateoverflow.in/2242>

What is the maximum value of the function  $f(x) = 2x^2 - 2x + 6$  in the interval  $[0, 2]$ ?

- A. 6
- B. 10
- C. 12
- D. 5.5

[gate1997](#) [calculus](#) [maxima-minima](#) [normal](#)

Answer

**5.5.5 Maxima Minima: GATE CSE 1998 | Question: 8** [top](#)<https://gateoverflow.in/1722>

- a. Find the points of local maxima and minima, if any, of the following function defined in  $0 \leq x \leq 6$ .

$$x^3 - 6x^2 + 9x + 15$$

- b. Integrate

$$\int_{-\pi}^{\pi} x \cos x dx$$

[gate1998](#) [calculus](#) [maxima-minima](#) [integration](#) [normal](#) [descriptive](#)

Answer 

### 5.5.6 Maxima Minima: GATE CSE 2008 | Question: 25 top ↗

<https://gateoverflow.in/423>



A point on a curve is said to be an extremum if it is a local minimum or a local maximum. The number of distinct extrema for the curve  $3x^4 - 16x^3 + 24x^2 + 37$  is

- A. 0
- B. 1
- C. 2
- D. 3

[gate2008-cse](#) [calculus](#) [maxima-minima](#) [easy](#)

Answer 

### 5.5.7 Maxima Minima: GATE CSE 2012 | Question: 9 top ↗

<https://gateoverflow.in/41>



Consider the function  $f(x) = \sin(x)$  in the interval  $x = [\frac{\pi}{4}, \frac{7\pi}{4}]$ . The number and location(s) of the local minima of this function are

- A. One, at  $\frac{\pi}{2}$
- B. One, at  $\frac{3\pi}{2}$
- C. Two, at  $\frac{\pi}{2}$  and  $\frac{3\pi}{2}$
- D. Two, at  $\frac{\pi}{4}$  and  $\frac{3\pi}{2}$

[gate2012-cse](#) [calculus](#) [maxima-minima](#) [normal](#)

Answer 

### 5.5.8 Maxima Minima: GATE CSE 2015 Set 2 | Question: GA-3 top ↗

<https://gateoverflow.in/8030>



Consider a function  $f(x) = 1 - |x|$  on  $-1 \leq x \leq 1$ . The value of  $x$  at which the function attains a maximum, and the maximum value of the function are:

- A. 0, -1
- B. -1, 0
- C. 0, 1
- D. -1, 2

[gate2015-cse-set2](#) [set-theory&algebra](#) [functions](#) [normal](#) [maxima-minima](#)

Answer 

### 5.5.9 Maxima Minima: GATE CSE 2020 | Question: 1 top ↗

<https://gateoverflow.in/333230>



Consider the functions

- I.  $e^{-x}$
- II.  $x^2 - \sin x$
- III.  $\sqrt{x^3 + 1}$

Which of the above functions is/are increasing everywhere in  $[0, 1]$ ?

- A. III only
- B. II only
- C. II and III only
- D. I and III only

[gate2020-cse](#) [engineering-mathematics](#) [calculus](#) [maxima-minima](#)

Answer 

### 5.5.10 Maxima Minima: GATE IT 2008 | Question: 31

<https://gateoverflow.in/3341>



If  $f(x)$  is defined as follows, what is the minimum value of  $f(x)$  for  $x \in (0, 2]$ ?

$$f(x) = \begin{cases} \frac{25}{8x} & \text{when } x \leq \frac{3}{2} \\ x + \frac{1}{x} & \text{otherwise} \end{cases}$$

- A. 2
- B.  $2\frac{1}{12}$
- C.  $2\frac{1}{6}$
- D.  $2\frac{1}{2}$

[gate2008-it](#) [calculus](#) [maxima-minima](#) [normal](#)

Answer 

### Answers: Maxima Minima

#### 5.5.1 Maxima Minima: GATE CSE 1987 | Question: 1-xxvi

<https://gateoverflow.in/80571>



- ✓ As  $f(x_i) \cdot f(x_{i+1}) < 0$

Means one of them is positive and one of them in negative . as their multiplication is negative.

So, when you draw the graph for  $f(x)$  where  $x_i \leq x \leq x_{i+1}$ . Definitely  $F(x)$  will cut the  $X$ - axis.

So, there will definitely a root of  $F(x)$  between  $x_i$  and  $x_{i+1}$ .

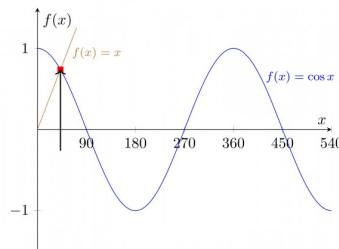
Correct Answer: A.

 16 votes

-- Amit Pal (3k points)

#### 5.5.2 Maxima Minima: GATE CSE 1995 | Question: 1.21

<https://gateoverflow.in/2608>



Looking at the diagram it is clear that at a single point,  $x$  and  $\cos x$  intersect.

Therefore, answer is B.

PS: Even for any interval, we will have only **one point** of intersection for  $x = \cos x$ . You can see that in the plot,  $f(x)$  is slanting more vertically, and hence it will not meet the  $\cos x$  graph even when  $x$  becomes negative.

 36 votes

-- Akash Kanase (36k points)

#### 5.5.3 Maxima Minima: GATE CSE 1995 | Question: 25a

<https://gateoverflow.in/2664>



- ✓  $f(x) = 3 - 4x + 2x^2$

$$f'(x) = -4 + 4x = 0 \implies x = 1$$

$$f''(x) = 4$$

$$f''(1) = 4 > 0$$

Therefore at  $x = 1$  we will get minimum value, which is :  $3 - 4(1) + 2(1)^2 = 1$ .

15 votes

-- jayendra (6.7k points)

#### 5.5.4 Maxima Minima: GATE CSE 1997 | Question: 4.1 top ↴

<https://gateoverflow.in/2242>

✓ Answer: B

For  $f(x)$  to be maximum

$$f'(x) = 4x - 2 = 0 \implies x = \frac{1}{2}$$

So at  $x = \frac{1}{2}$ ,  $f(x)$  is an extremum (either maximum or minimum).

$$f(2) = 2(2)^2 - 2(2) + 6 = 8 - 4 + 6 = 10$$

$$f\left(\frac{1}{2}\right) = 2\frac{1}{2}^2 - 2\frac{1}{2} + 6 = 5.5, \text{ so } x = \frac{1}{2} \text{ is a mimimum.}$$

$$f(0) = 6.$$

So, the maximum value is at  $x = 2$  which is 10 as there are no other extremum for the given function.

16 votes

-- Rajarshi Sarkar (27.8k points)

#### 5.5.5 Maxima Minima: GATE CSE 1998 | Question: 8 top ↴

<https://gateoverflow.in/1722>

✓ (a)  $f(x) = x^3 - 6x^2 + 9x + 15$

$$\text{so } f'(x) = 3x^2 - 12x + 9 = 0 \Rightarrow x = 1, 3$$

$$\text{Now } f''(x) = 6x - 12$$

$f''(1) < 0$ , so  $x = 1$  is point of local maxima,  $f''(3) > 0$ , so  $x = 3$  is point of local minima.

Also the end points 0 and 6 are critical points. 0 is point of local minima, because it is to the left of  $x = 1$  (which is point of maxima). Similarly  $x = 6$  is point of local maxima.

(b) Since  $x \cos x$  is an odd function, by the properties of definite integration, answer is 0.

19 votes

-- Happy Mittal (8.2k points)

#### 5.5.6 Maxima Minima: GATE CSE 2008 | Question: 25 top ↴

<https://gateoverflow.in/423>

✓ Answer is (b).

$$f(x) = 3x^4 - 16x^3 + 24x^2 + 37$$

$$f'(x) = 12x^3 - 48x^2 + 48x = 0$$

$$\implies 12x(x^2 - 4x + 4) = 0$$

$$x(x-2)^2 = 0$$

$$\implies x = 0, 2$$

$$f''(x) = 36x^2 - 96x + 48$$

at  $x = 0, f''(x) = 48 > 0$  it means that  $x = 0$  is local minima.

but at  $x = 2, f''(x) = 0$  so we can't apply second derivative test. So, we can apply first derivative test.

$f'(1) = 12, f'(3) = 36$ . So,  $f'(x)$  is not changing sign on either side of 2. So,  $x = 2$  is neither maxima nor minima.

So, only one extremum i.e.  $x=0$ .

Ref: [https://cims.nyu.edu/~kiryl/Calculus/Section\\_4.3--Derivatives\\_and\\_the\\_Shapes\\_of\\_Graphs/Derivatives\\_and\\_the\\_Shapes\\_of\\_Graphs.pdf](https://cims.nyu.edu/~kiryl/Calculus/Section_4.3--Derivatives_and_the_Shapes_of_Graphs/Derivatives_and_the_Shapes_of_Graphs.pdf)

#### References



36 votes

-- SAKET NANDAN (4.2k points)

#### 5.5.7 Maxima Minima: GATE CSE 2012 | Question: 9

<https://gateoverflow.in/41>



✓ Answer is (D)

$f'(s) = \cos x = 0$  gives root  $\frac{\pi}{2}$  and  $\frac{3\pi}{2}$  which lie between the given domain in question  $[\frac{\pi}{4}, \frac{7\pi}{4}]$

$f''(x) = -\sin x$  at  $\frac{\pi}{2}$  gives  $-1 < 0$  which means it is local maxima and at  $\frac{3\pi}{2}$  it gives  $1 > 0$  which is local minima.

Since, at  $\frac{\pi}{2}$  it is local maxima so, before it, graph is strictly increasing, so  $\frac{\pi}{4}$  is also local minima.

So, there are two local minima  $\frac{\pi}{4}$  and  $\frac{3\pi}{2}$ .

41 votes

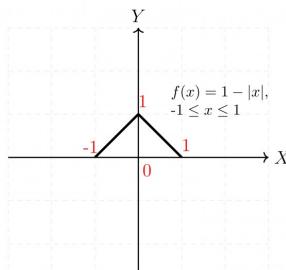
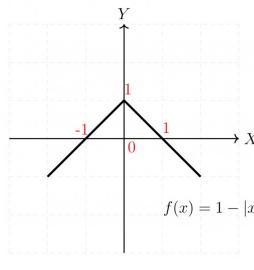
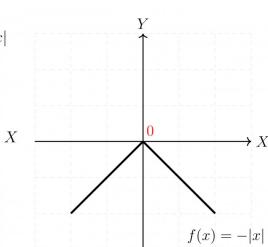
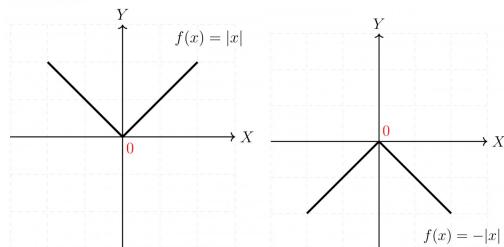
-- SAKET NANDAN (4.2k points)

#### 5.5.8 Maxima Minima: GATE CSE 2015 Set 2 | Question: GA-3

<https://gateoverflow.in/8030>



✓



Here in diagram we can clearly see that,  
At  $x = 0, f(x)$  would be maximum which is 1.

*Option C is correct.*

#### Alternate Approach -

Put the value of  $x$  of all the options in  $f(x)$  and find the value of  $f(x)$ .

22 votes

-- Ramjilal choudhary (249 points)

**5.5.9 Maxima Minima: GATE CSE 2020 | Question: 1** top ↴<https://gateoverflow.in/333230>

- ✓ Answer A. III Only (i.e.  $\sqrt{x^3 + 1}$ )

**Explanation**

Decreasing/Increasing nature of a function can be determined by observing the first derivative of equations in given domain.

If the derivative is positive in given domain, **It is increasing**, else a negative value indicates **it is decreasing**.

Now testing one by one

I.  $e^{-x}$

Here,  $\frac{d}{dx} e^{-x} = -e^{-x}$

This will remain negative in entire domain [0,1] hence decreasing.

II.  $x^2 - \sin(x)$

Here,  $\frac{d}{dx}(x^2 - \sin(x)) = 2x - \cos(x)$

**Here the switch happens!** Observe  $2x - \cos(x)$  is negative for  $x = 0$  (i.e. = -1) and positive at  $x = 1$  (i.e. =  $\sim 1.4596977$ ). Though we can find the exact point where it switches but that's not required here. **We can confirm that till some point in the domain [0,1], this function decreases and then increases.**

III.  $\sqrt{x^3 + 1}$

Here, (Though this one is intuitive),  $\frac{d}{dx} \sqrt{x^3 + 1} = \frac{3x^2}{2\sqrt{x^3+1}}$  This will remain positive throughout [0,1] and hence will be increasing.

35 votes

-- dhruvhacks (561 points)

**5.5.10 Maxima Minima: GATE IT 2008 | Question: 31** top ↴<https://gateoverflow.in/3341>

$$f'(x) = \begin{cases} \frac{-25x^{-2}}{8}; & x \leq \frac{3}{2}, \\ 1 - \frac{1}{x^2}; & \text{otherwise,} \end{cases} \begin{array}{l} \text{decreasing in this interval} \\ \text{increasing in this interval} \end{array}$$

$f''(x) > 0, x \in \left(0, \frac{3}{2}\right]$ ;  $f(x)$  will be minimum at  $x = \frac{3}{2}$   $f''(x) < 0$ , otherwise;  $f(x)$  will be maximum at  $x = 2$

$f(x)$  is decreasing in  $(0, \frac{3}{2}]$  and in  $(\frac{3}{2}, 2]$  it is increasing.

So, minimum value of  $f(x)$  must be at  $x = \frac{3}{2}$

$$f\left(\frac{3}{2}\right) = \frac{25}{12} = 2\frac{1}{12}$$

35 votes

-- Digvijay (44.9k points)

**5.6****Polynomials (2)** top ↴**5.6.1 Polynomials: GATE CSE 1987 | Question: 1-xxii** top ↴<https://gateoverflow.in/80379>

The equation  $7x^7 + 14x^6 + 12x^5 + 3x^4 + 12x^3 + 10x^2 + 5x + 7 = 0$  has

- A. All complex roots
- B. At least one real root
- C. Four pairs of imaginary roots
- D. None of the above

gate1987 calculus polynomials

Answer

**5.6.2 Polynomials: GATE CSE 1995 | Question: 2.8** top ↴<https://gateoverflow.in/2620>

If the cube roots of unity are  $1, \omega$  and  $\omega^2$ , then the roots of the following equation are

$$(x - 1)^3 + 8 = 0$$

- A.  $-1, 1 + 2\omega, 1 + 2\omega^2$

- B.  $1, 1 - 2\omega, 1 - 2\omega^2$   
 C.  $-1, 1 - 2\omega, 1 - 2\omega^2$   
 D.  $-1, 1 + 2\omega, -1 + 2\omega^2$

gate1995 calculus normal polynomials

Answer 

### Answers: Polynomials

#### 5.6.1 Polynomials: GATE CSE 1987 | Question: 1-xxii top ↗

<https://gateoverflow.in/80379>



✓ Since the polynomial has the highest degree 7. So there are 7 roots possible for it

Now suppose if an imaginary number  $a + bi$  is also the root of this polynomial then  $a - bi$  will also be the root of this polynomial

That means there must be an even number of complex roots possible because they occur in pairs.

Now we will solve this question option wise

##### A) All complex root

This is not possible. The polynomial has 7 roots and as I mention a polynomial should have an even number of complex roots and 7 is not even. So this option is wrong

##### B) At least one real root

This is possible. Since polynomial has 7 roots and only an even number of the complex root is possible, that means this polynomial has max 6 complex roots and Hence a minimum of one real root. So this option is correct

##### C) Four pairs of imaginary roots

4 pair means 8 complex root. But this polynomial can have at most 7 roots. So this option is also wrong

Hence answer should be (B).

 23 votes

-- Digvijaysingh Gautam (6.2k points)

#### 5.6.2 Polynomials: GATE CSE 1995 | Question: 2.8 top ↗

<https://gateoverflow.in/2620>



✓ The given equation is:  $(x - 1)^3 = -8$

or,  $((x - 1)/ - 2)^3 = 1$

Let  $((x - 1)/ - 2) = Z$

So, the equation will be changed to:  $Z^3 = 1$

The roots will be  $Z = 1, \omega, \omega^2$

Putting back the value of  $Z$

$$(x - 1)/ - 2 = 1, \omega, \omega^2 \\ \Rightarrow x = -1, 1 - 2\omega, 1 - 2\omega^2$$

Correct Answer: C

 28 votes

-- Vivek Srivastava (3k points)

Answer is C,

Just put values of C in place of x. It will satisfy the equation.

 14 votes

-- jayendra (6.7k points)

## Answer Keys

5.1.1	N/A	5.1.2	B	5.1.3	A	5.1.4	A	5.1.5	A
5.1.6	C	5.1.7	19 : 19	5.1.8	C	5.2.1	D	5.2.2	-2
5.2.3	C	5.2.4	9	5.2.5	C	5.3.1	A	5.3.2	D

5.3.3	D	5.3.4	A	5.3.5	4	5.3.6	-1	5.3.7	A
5.3.8	0.288 : 0.289	5.3.9	B	5.4.1	1	5.4.2	1	5.4.3	A
5.4.4	B	5.4.5	C	5.4.6	C	5.4.7	1	5.4.8	C
5.4.9	C	5.4.10	0.25 : 0.25	5.5.1	A	5.5.2	B	5.5.3	1
5.5.4	B	5.5.5	N/A	5.5.6	B	5.5.7	D	5.5.8	C
5.5.9	A	5.5.10	B	5.6.1	B	5.6.2	C		

## 6

## Engineering Mathematics: Linear Algebra (74)



**Syllabus:** Matrices, determinants, System of linear equations, Eigenvalues and eigenvectors, LU decomposition.

Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
1 Mark Count	0	1	0	1	1	1	1	1	2	0	0.88	2
2 Marks Count	1	1	1	1	1	2	1	0	0	0	0.88	2
Total Marks	2	3	2	3	3	5	3	1	2	1	2.66	5

## 6.1

Cartesian Coordinates (1) top ↗6.1.1 Cartesian Coordinates: GATE IT 2007 | Question: 80 top ↗<https://gateoverflow.in/3532>

Let  $P_1, P_2, \dots, P_n$  be  $n$  points in the  $xy$ -plane such that no three of them are collinear. For every pair of points  $P_i$  and  $P_j$ , let  $L_{ij}$  be the line passing through them. Let  $L_{ab}$  be the line with the steepest gradient amongst all  $\frac{n(n-1)}{2}$  lines.

Which one of the following properties should necessarily be satisfied?

- A.  $P_a$  and  $P_b$  are adjacent to each other with respect to their  $x$ -coordinate
- B. Either  $P_a$  or  $P_b$  has the largest or the smallest  $y$ -coordinate among all the points
- C. The difference between  $x$ -coordinates  $P_a$  and  $P_b$  is minimum
- D. None of the above

[gate2007-it](#) [cartesian-coordinates](#)

Answer

## Answers: Cartesian Coordinates

6.1.1 Cartesian Coordinates: GATE IT 2007 | Question: 80 top ↗<https://gateoverflow.in/3532>

✓ A is correct.

If we arrange all points in ascending order of their  $x$ -coordinates, then the steepest gradient will be between two adjacent points.

Ref: <https://stackoverflow.com/questions/8222108/max-slope-from-set-of-points>

Counter example for (C) is as follows:

Consider 3 points

1.  $(x_1, y_1) = (1, 10)$
2.  $(x_2, y_2) = (2, 2)$
3.  $(x_3, y_3) = (4, 22)$

$$\text{Grad}_{12} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 10}{2 - 1} = -8/1 = -8$$

$$\text{Grad}_{32} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{22 - 2}{4 - 2} = 20/2 = 10$$

$$\text{Grad}_{31} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{22 - 10}{4 - 1} = 12/3 = 4$$

Here,  $\text{Grad}_{32}$  is steepest, but  $x_3 - x_2 = 4 - 2 = 2$  is not minimum.

## References



15 votes

-- Himanshu Agarwal (12,4k points)

## 6.2

Determinant (6) top ↗6.2.1 Determinant: GATE CSE 1997 | Question: 1.3 top ↗<https://gateoverflow.in/2219>

The determinant of the matrix

$$\begin{bmatrix} 6 & -8 & 1 & 1 \\ 0 & 2 & 4 & 6 \\ 0 & 0 & 4 & 8 \\ 0 & 0 & 0 & -1 \end{bmatrix}$$

- A. 11
- B. -48
- C. 0
- D. -24

[gate1997](#) [linear-algebra](#) [normal](#) [determinant](#)

Answer 

### 6.2.2 Determinant: GATE CSE 2000 | Question: 1.3 top ↗

↗ <https://gateoverflow.in/626>



The determinant of the matrix

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 8 & 1 & 7 & 2 \\ 2 & 0 & 2 & 0 \\ 9 & 0 & 6 & 1 \end{bmatrix}$$

- A. 4
- B. 0
- C. 15
- D. 20

[gate2000-cse](#) [linear-algebra](#) [easy](#) [determinant](#)

Answer 

### 6.2.3 Determinant: GATE CSE 2013 | Question: 3 top ↗

↗ <https://gateoverflow.in/1412>



Which one of the following does NOT equal

$$\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix} \quad ?$$

- A.  $\begin{vmatrix} 1 & x(x+1) & x+1 \\ 1 & y(y+1) & y+1 \\ 1 & z(z+1) & z+1 \\ 1 & x+1 & x^2+1 \end{vmatrix}$
- B.  $\begin{vmatrix} 1 & y+1 & y^2+1 \\ 1 & z+1 & z^2+1 \\ 0 & x-y & x^2-y^2 \end{vmatrix}$
- C.  $\begin{vmatrix} 0 & y-z & y^2-z^2 \\ 1 & z & z^2 \\ 2 & x+y & x^2+y^2 \end{vmatrix}$
- D.  $\begin{vmatrix} 2 & y+z & y^2+z^2 \\ 1 & z & z^2 \end{vmatrix}$

[gate2013-cse](#) [linear-algebra](#) [normal](#) [determinant](#)

Answer 

### 6.2.4 Determinant: GATE CSE 2014 Set 2 | Question: 4 top ↗

↗ <https://gateoverflow.in/1956>



If the matrix  $A$  is such that

$$A = \begin{bmatrix} 2 \\ -4 \\ 7 \end{bmatrix} [1 \ 9 \ 5]$$

then the determinant of  $A$  is equal to \_\_\_\_\_.

[gate2014-cse-set2](#) [linear-algebra](#) [numerical-answers](#) [easy](#) [determinant](#)

Answer 

### 6.2.5 Determinant: GATE CSE 2019 | Question: 9

<https://gateoverflow.in/302839>



Let  $X$  be a square matrix. Consider the following two statements on  $X$ .

- I.  $X$  is invertible
- II. Determinant of  $X$  is non-zero

Which one of the following is TRUE?

- A. I implies II; II does not imply I
- B. II implies I; I does not imply II
- C. I does not imply II; II does not imply I
- D. I and II are equivalent statements

[gate2019-cse](#) [engineering-mathematics](#) [linear-algebra](#) [determinant](#)

Answer 

### 6.2.6 Determinant: GATE IT 2005 | Question: 3

<https://gateoverflow.in/3747>



The determinant of the matrix given below is

$$\begin{bmatrix} 0 & 1 & 0 & 2 \\ -1 & 1 & 1 & 3 \\ 0 & 0 & 0 & 1 \\ 1 & -2 & 0 & 1 \end{bmatrix}$$

- A. -1
- B. 0
- C. 1
- D. 2

[gate2005-it](#) [linear-algebra](#) [normal](#) [determinant](#)

Answer 

## Answers: Determinant

### 6.2.1 Determinant: GATE CSE 1997 | Question: 1.3

<https://gateoverflow.in/2219>



- ✓ As the given matrix upper triangular matrix, determinant will be the product of main diagonal elements.

$$\det(A) = 6 * 2 * 4 * -1 = -48.$$

Similar concept can be applied, if Matrix is lower triangular or Diagonal Matrix.

 27 votes

-- durgesh (189 points)

### 6.2.2 Determinant: GATE CSE 2000 | Question: 1.3

<https://gateoverflow.in/626>



✓ Let  $|A| = \begin{vmatrix} 2 & 0 & 0 & 0 \\ 8 & 1 & 7 & 2 \\ 2 & 0 & 2 & 0 \\ 9 & 0 & 6 & 1 \end{vmatrix}$

$$\Rightarrow |A| = 2 \times \begin{vmatrix} 1 & 7 & 2 \\ 0 & 2 & 0 \\ 0 & 6 & 1 \end{vmatrix}$$

$$\Rightarrow |A| = 2 \times 1 \times \begin{vmatrix} 2 & 0 \\ 6 & 1 \end{vmatrix}$$

$$\Rightarrow |A| = 2 \times 1 \times (2 - 0)$$

$$\Rightarrow |A| = 2 \times 1 \times 2 = 4$$

Answer: A

19 votes

-- Rajarshi Sarkar (27.8k points)

### 6.2.3 Determinant: GATE CSE 2013 | Question: 3 top ↴



- ✓ Answer is A.

Operations are:

$$C_3 \leftarrow C_3 + C_2$$

$$C_2 \leftarrow C_2 + C_1$$

Swap  $C_2$  &  $C_3$

The Swapping operations make the determinant as  $(-1) * |A|$

whereas the other options have their determinant as  $|A|$ .

36 votes

-- Sona Praneeth Akula (3.4k points)

### 6.2.4 Determinant: GATE CSE 2014 Set 2 | Question: 4 top ↴



- ✓ For these kind of matrices Determinant is zero.

$A$  will be a  $3 \times 3$  matrix where the first row will be  $2[1 \ 9 \ 5]$ , second row will be  $-4[1 \ 9 \ 5]$  and third will be  $7[1 \ 9 \ 5]$ . That is, all the rows of  $A$  are linearly dependent which means  $A$  is singular.

When matrix is singular  $|A| = 0$ .

Reference: [https://www.youtube.com/watch?v=aKX5\\_DucNq8&list=PL221E2BBF13BECF6C&index=19](https://www.youtube.com/watch?v=aKX5_DucNq8&list=PL221E2BBF13BECF6C&index=19)

#### References



53 votes

-- Prasanna Ranganathan (4k points)

### 6.2.5 Determinant: GATE CSE 2019 | Question: 9 top ↴



- ✓ Square Matrix is invertible iff it is non-singular.  
So both statements are same. Answer is (D).

18 votes

-- Digvijay (44.9k points)

### 6.2.6 Determinant: GATE IT 2005 | Question: 3 top ↴



- ✓

$$\begin{bmatrix} 0 & 1 & 0 & 2 \\ -1 & 1 & 1 & 3 \\ 0 & 0 & 0 & 1 \\ 1 & -2 & 0 & 1 \end{bmatrix}$$

Reduce this matrix into Upper Triangular matrix using row and column transformations:

$R1 \leftrightarrow R2$

$R3 \leftrightarrow R4$

$$\begin{bmatrix} -1 & 1 & 1 & 3 \\ 0 & 1 & 0 & 2 \\ 1 & -2 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$R3 \leftarrow R1 + R3$

$R3 \leftarrow R2 - R3$

Resulting Upper Triangular matrix will be:

$$\begin{bmatrix} -1 & 1 & 1 & 3 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Determinant will be product of diagonal elements =  $-1 * 1 * 1 * 1 = -1$

**Hence, A is correct option!**

21 votes

-- Manu Thakur (34k points)

$$\begin{aligned} &+0 \begin{bmatrix} 1 & 1 & 3 \\ 0 & 0 & 1 \\ -2 & 0 & 1 \end{bmatrix} -1 \begin{bmatrix} -1 & 1 & 3 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} +0 \begin{bmatrix} -1 & 1 & 3 \\ 0 & 0 & 1 \\ 1 & -2 & 1 \end{bmatrix} -2 \begin{bmatrix} -1 & 1 & 1 \\ 0 & 0 & 0 \\ 1 & -2 & 0 \end{bmatrix} \\ &= -1 \begin{bmatrix} -1 & 1 & 3 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} = -1 \end{aligned}$$

24 votes

-- neha pawar (3.3k points)

## 6.3

### Eigen Value (25) top ↗

#### 6.3.1 Eigen Value: GATE CSE 1993 | Question: 01.1 top ↗

☞ <https://gateoverflow.in/596>



The eigen vector ( $s$ ) of the matrix

$$\begin{bmatrix} 0 & 0 & \alpha \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}, \alpha \neq 0$$

is (are)

- A.  $(0, 0, \alpha)$
- B.  $(\alpha, 0, 0)$
- C.  $(0, 0, 1)$
- D.  $(0, \alpha, 0)$

gate1993 eigen-value linear-algebra easy multiple-selects

Answer

#### 6.3.2 Eigen Value: GATE CSE 2002 | Question: 5a top ↗

☞ <https://gateoverflow.in/858>



Obtain the eigen values of the matrix

$$A = \begin{bmatrix} 1 & 2 & 34 & 49 \\ 0 & 2 & 43 & 94 \\ 0 & 0 & -2 & 104 \\ 0 & 0 & 0 & -1 \end{bmatrix}$$

gate2002-cse linear-algebra eigen-value normal descriptive

Answer 

### 6.3.3 Eigen Value: GATE CSE 2005 | Question: 49 top ↴

<https://gateoverflow.in/1174>



What are the eigenvalues of the following  $2 \times 2$  matrix?

$$\begin{pmatrix} 2 & -1 \\ -4 & 5 \end{pmatrix}$$

- A. -1 and 1
- B. 1 and 6
- C. 2 and 5
- D. 4 and -1

gate2005-cse linear-algebra eigen-value easy

Answer 

### 6.3.4 Eigen Value: GATE CSE 2007 | Question: 25 top ↴

<https://gateoverflow.in/254>



Let  $A$  be a  $4 \times 4$  matrix with eigen values -5,-2,1,4. Which of the following is an eigen value of the matrix  $\begin{bmatrix} A & I \\ I & A \end{bmatrix}$ , where  $I$  is the  $4 \times 4$  identity matrix?

- A. -5
- B. -7
- C. 2
- D. 1

gate2007-cse eigen-value linear-algebra difficult

Answer 

### 6.3.5 Eigen Value: GATE CSE 2008 | Question: 28 top ↴

<https://gateoverflow.in/426>



How many of the following matrices have an eigenvalue 1?

$$\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix} \text{ and } \begin{bmatrix} -1 & 0 \\ 1 & -1 \end{bmatrix}$$

- A. one
- B. two
- C. three
- D. four

gate2008-cse eigen-value linear-algebra

Answer 

### 6.3.6 Eigen Value: GATE CSE 2010 | Question: 29 top ↴

<https://gateoverflow.in/1155>



Consider the following matrix

$$A = \begin{bmatrix} 2 & 3 \\ x & y \end{bmatrix}$$

If the eigenvalues of A are 4 and 8, then

- A.  $x = 4, y = 10$
- B.  $x = 5, y = 8$
- C.  $x = 3, y = 9$
- D.  $x = -4, y = 10$

[gate2010-cse](#) [linear-algebra](#) [eigen-value](#) [easy](#)

Answer 

### 6.3.7 Eigen Value: GATE CSE 2011 | Question: 40 [top](#)

<https://gateoverflow.in/2142>



Consider the matrix as given below.

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 7 \\ 0 & 0 & 3 \end{bmatrix}$$

Which one of the following options provides the **CORRECT** values of the eigenvalues of the matrix?

- A. 1, 4, 3
- B. 3, 7, 3
- C. 7, 3, 2
- D. 1, 2, 3

[gate2011-cse](#) [linear-algebra](#) [eigen-value](#) [easy](#)

Answer 

### 6.3.8 Eigen Value: GATE CSE 2012 | Question: 11 [top](#)

<https://gateoverflow.in/43>



Let A be the  $2 \times 2$  matrix with elements  $a_{11} = a_{12} = a_{21} = +1$  and  $a_{22} = -1$ . Then the eigenvalues of the matrix  $A^{19}$  are

- A. 1024 and  $-1024$
- B.  $1024\sqrt{2}$  and  $-1024\sqrt{2}$
- C.  $4\sqrt{2}$  and  $-4\sqrt{2}$
- D.  $512\sqrt{2}$  and  $-512\sqrt{2}$

[gate2012-cse](#) [linear-algebra](#) [eigen-value](#)

Answer 

### 6.3.9 Eigen Value: GATE CSE 2014 Set 1 | Question: 5 [top](#)

<https://gateoverflow.in/1760>



The value of the dot product of the eigenvectors corresponding to any pair of different eigenvalues of a  $4 - by - 4$  symmetric positive definite matrix is \_\_\_\_\_

[gate2014-cse-set1](#) [linear-algebra](#) [eigen-value](#) [numerical-answers](#) [normal](#)

Answer 

### 6.3.10 Eigen Value: GATE CSE 2014 Set 2 | Question: 47 [top](#)

<https://gateoverflow.in/2013>



The product of the non-zero eigenvalues of the matrix is \_\_\_\_\_

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}$$

gate2014-cse-set2 linear-algebra eigen-value normal numerical-answers

Answer 

### 6.3.11 Eigen Value: GATE CSE 2014 Set 3 | Question: 4 top ↗

<https://gateoverflow.in/2038>



Which one of the following statements is TRUE about every  $n \times n$  matrix with only real eigenvalues?

- A. If the trace of the matrix is positive and the determinant of the matrix is negative, at least one of its eigenvalues is negative.
- B. If the trace of the matrix is positive, all its eigenvalues are positive.
- C. If the determinant of the matrix is positive, all its eigenvalues are positive.
- D. If the product of the trace and determinant of the matrix is positive, all its eigenvalues are positive.

gate2014-cse-set3 linear-algebra eigen-value normal

Answer 

### 6.3.12 Eigen Value: GATE CSE 2015 Set 1 | Question: 36 top ↗

<https://gateoverflow.in/8285>



Consider the following  $2 \times 2$  matrix  $A$  where two elements are unknown and are marked by  $a$  and  $b$ . The eigenvalues of this matrix are -1 and 7. What are the values of  $a$  and  $b$ ?

$$A = \begin{pmatrix} 1 & 4 \\ b & a \end{pmatrix}$$

- A.  $a = 6, b = 4$
- B.  $a = 4, b = 6$
- C.  $a = 3, b = 5$
- D.  $a = 5, b = 3$

gate2015-cse-set1 linear-algebra eigen-value normal

Answer 

### 6.3.13 Eigen Value: GATE CSE 2015 Set 2 | Question: 5 top ↗

<https://gateoverflow.in/8051>



The larger of the two eigenvalues of the matrix  $\begin{bmatrix} 4 & 5 \\ 2 & 1 \end{bmatrix}$  is \_\_\_\_\_.

gate2015-cse-set2 linear-algebra eigen-value easy numerical-answers

Answer 

### 6.3.14 Eigen Value: GATE CSE 2015 Set 3 | Question: 15 top ↗

<https://gateoverflow.in/8411>



In the given matrix  $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$ , one of the eigenvalues is 1. The eigenvectors corresponding to the eigenvalue 1 are

- A.  $\{a(4, 2, 1) \mid a \neq 0, a \in \mathbb{R}\}$
- B.  $\{a(-4, 2, 1) \mid a \neq 0, a \in \mathbb{R}\}$
- C.  $\{a(\sqrt{2}, 0, 1) \mid a \neq 0, a \in \mathbb{R}\}$
- D.  $\{a(-\sqrt{2}, 0, 1) \mid a \neq 0, a \in \mathbb{R}\}$

gate2015-cse-set3 linear-algebra eigen-value normal

Answer 

**6.3.15 Eigen Value: GATE CSE 2016 Set 1 | Question: 05** [top](#)<https://gateoverflow.in/39634>

Two eigenvalues of a  $3 \times 3$  real matrix  $P$  are  $(2 + \sqrt{-1})$  and 3. The determinant of  $P$  is \_\_\_\_\_.

[gate2016-cse-set1](#) [linear-algebra](#) [eigen-value](#) [numerical-answers](#) [normal](#)

Answer

**6.3.16 Eigen Value: GATE CSE 2016 Set 2 | Question: 06** [top](#)<https://gateoverflow.in/39549>

Suppose that the eigenvalues of matrix  $A$  are 1, 2, 4. The determinant of  $(A^{-1})^T$  is \_\_\_\_\_.

[gate2016-cse-set2](#) [linear-algebra](#) [eigen-value](#) [normal](#) [numerical-answers](#)

Answer

**6.3.17 Eigen Value: GATE CSE 2017 Set 1 | Question: 31** [top](#)<https://gateoverflow.in/118312>

Let  $A$  be  $n \times n$  real valued square symmetric matrix of rank 2 with  $\sum_{i=1}^n \sum_{j=1}^n A_{ij}^2 = 50$ . Consider the following statements.

- I. One eigenvalue must be in  $[-5, 5]$
- II. The eigenvalue with the largest magnitude must be strictly greater than 5

Which of the above statements about eigenvalues of  $A$  is/are necessarily CORRECT?

- A. Both I and II
- B. I only
- C. II only
- D. Neither I nor II

[gate2017-cse-set1](#) [linear-algebra](#) [eigen-value](#) [normal](#)

Answer

**6.3.18 Eigen Value: GATE CSE 2017 Set 2 | Question: 22** [top](#)<https://gateoverflow.in/118363>

Let  $P = \begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$  and  $Q = \begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$  be two matrices.

Then the rank of  $P + Q$  is \_\_\_\_\_.

[gate2017-cse-set2](#) [linear-algebra](#) [eigen-value](#) [numerical-answers](#)

Answer

**6.3.19 Eigen Value: GATE CSE 2017 Set 2 | Question: 52** [top](#)<https://gateoverflow.in/118618>

If the characteristic polynomial of a  $3 \times 3$  matrix  $M$  over  $\mathbb{R}$  (the set of real numbers) is  $\lambda^3 - 4\lambda^2 + a\lambda + 30$ ,  $a \in \mathbb{R}$ , and one eigenvalue of  $M$  is 2, then the largest among the absolute values of the eigenvalues of  $M$  is \_\_\_\_\_.

[gate2017-cse-set2](#) [engineering-mathematics](#) [linear-algebra](#) [numerical-answers](#) [eigen-value](#)

Answer

**6.3.20 Eigen Value: GATE CSE 2018 | Question: 17** [top](#)<https://gateoverflow.in/204091>

Consider a matrix  $A = uv^T$  where  $u = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ ,  $v = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$ . Note that  $v^T$  denotes the transpose of  $v$ . The largest eigenvalue of  $A$  is \_\_\_\_\_.

[gate2018-cse](#) [linear-algebra](#) [eigen-value](#) [normal](#) [numerical-answers](#)

Answer

**6.3.21 Eigen Value: GATE CSE 2018 | Question: 26** top ↴<https://gateoverflow.in/204100>

Consider a matrix  $P$  whose only eigenvectors are the multiples of  $\begin{bmatrix} 1 \\ 4 \end{bmatrix}$ .

Consider the following statements.

- I.  $P$  does not have an inverse
- II.  $P$  has a repeated eigenvalue
- III.  $P$  cannot be diagonalized

Which one of the following options is correct?

- A. Only I and III are necessarily true
- B. Only II is necessarily true
- C. Only I and II are necessarily true
- D. Only II and III are necessarily true

[gate2018-cse](#) [linear-algebra](#) [matrices](#) [eigen-value](#) [normal](#)

Answer

**6.3.22 Eigen Value: GATE CSE 2019 | Question: 44** top ↴<https://gateoverflow.in/302804>

Consider the following matrix:

$$R = \begin{bmatrix} 1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \\ 1 & 5 & 25 & 125 \end{bmatrix}$$

The absolute value of the product of Eigen values of  $R$  is \_\_\_\_\_.

[gate2019-cse](#) [numerical-answers](#) [engineering-mathematics](#) [linear-algebra](#) [eigen-value](#)

Answer

**6.3.23 Eigen Value: GATE CSE 2021 Set 1 | Question: 52** top ↴<https://gateoverflow.in/357399>

Consider the following matrix.

$$\begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

The largest eigenvalue of the above matrix is \_\_\_\_\_.

[gate2021-cse-set1](#) [linear-algebra](#) [matrices](#) [eigen-value](#) [numerical-answers](#)

Answer

**6.3.24 Eigen Value: GATE IT 2006 | Question: 26** top ↴<https://gateoverflow.in/3565>

What are the eigenvalues of the matrix  $P$  given below

$$P = \begin{pmatrix} a & 1 & 0 \\ 1 & a & 1 \\ 0 & 1 & a \end{pmatrix}$$

- A.  $a, a - \sqrt{2}, a + \sqrt{2}$
- B.  $a, a, a$
- C.  $0, a, 2a$
- D.  $-a, 2a, 2a$

[gate2006-it](#) [linear-algebra](#) [eigen-value](#) [normal](#)
[Answer](#)
**6.3.25 Eigen Value: GATE IT 2007 | Question: 2**
top ↗
<https://gateoverflow.in/3433>


Let  $A$  be the matrix  $\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}$ . What is the maximum value of  $x^T Ax$  where the maximum is taken over all  $x$  that are the unit eigenvectors of  $A$ ?

- A. 5
- B.  $\frac{(5+\sqrt{5})}{2}$
- C. 3
- D.  $\frac{(5-\sqrt{5})}{2}$

[gate2007-it](#) [linear-algebra](#) [eigen-value](#) [normal](#)
[Answer](#)
**Answers: Eigen Value**
**6.3.1 Eigen Value: GATE CSE 1993 | Question: 01.1**
top ↗
<https://gateoverflow.in/596>


- ✓ Since, the given matrix is an upper triangular one, all eigenvalues are 0. And hence  $A - \lambda I = A$

So the question asks

$$\begin{bmatrix} 0 & 0 & \alpha \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

what  $x_1, x_2, x_3$  are suitable?

which means  $x_1$  times column1+ $x_2$  times column2+ $x_3$  times column3=Zero Vector

Look carefully, if you take any linear combination of columns 1 and 2 and don't take column 3(means  $x_3 = 0$ ), the result will be a zero vector.

So, if we have our  $X = \begin{bmatrix} \beta \\ \gamma \\ 0 \end{bmatrix}$  where  $\beta, \gamma$  are any scalar quantity,

but  $x_3$  must be necessarily zero to get zero vector.

Hence, only option (B) and (D) satisfy.

31 votes

-- Ayush Upadhyaya (28.2k points)

**6.3.2 Eigen Value: GATE CSE 2002 | Question: 5a**
top ↗
<https://gateoverflow.in/858>


The Eigen values for upper triangular/lower triangular/diagonal matrices are the diagonal elements of the matrix.

∴ The Eigen values are 1, 2, -2, -1.

35 votes

-- Madhur Rawat (2k points)

**6.3.3 Eigen Value: GATE CSE 2005 | Question: 49**
top ↗
<https://gateoverflow.in/1174>


- ✓ Let the eigen values be  $a, b$

**Sum of Eigen Values = Trace(Diagonal Sum)**

$$\implies a + b = 2 + 5 = 7$$

**Product of Eigen Values = Det(A)**

$$\implies a \times b = 6$$

Solving these we get eigenvalues as **1 and 6**.

**Option(B) is Correct.**

27 votes

-- Himanshu Agarwal (12.4k points)

### 6.3.4 Eigen Value: GATE CSE 2007 | Question: 25 top



✓ Ans is (C) 2

$Ax = \lambda x$ , where  $\lambda$  is the eigen value of  $A$ . Hence  $(A - \lambda I)x = 0$  or  $|A - \lambda I| = 0$

So, for our given matrix, we have

$$\begin{bmatrix} A - \lambda I & I \\ I & A - \lambda I \end{bmatrix} = 0$$

This is a  $2 \times 2$  block matrix where the first and last and the second and third elements are the same. So, applying the formula for determinant of a block matrix as given here

When  $A = D$  and  $B = C$ , the blocks are square matrices of the same order and the following formula holds (even if  $A$  and  $B$  do not commute)

$$\det \begin{pmatrix} A & B \\ C & D \end{pmatrix} = \det(A - B) \det(A + B)$$

(second last case) [https://en.wikipedia.org/wiki/Determinant#Block\\_matrices](https://en.wikipedia.org/wiki/Determinant#Block_matrices)

we get,

$$|A - \lambda I - I| \times |A - \lambda I + I| = 0$$

$$\implies |A - (\lambda + 1)I| \times |A - (\lambda - 1)I| = 0$$

Each of the eigen value of  $A$  is the solution of the equation  $|A - \alpha I| = 0$  ( $\alpha$  being the eigen value of  $A$ ). So, we can equate  $\lambda + 1$  and  $\lambda - 1$  to any of the eigen value of  $A$ , and that will get our value of  $\lambda$ . If we take  $\alpha = 1$ , we get  $\lambda = 2$ , and that is one of the choice. For no other choice, this equation holds. So, (c) 2 is the answer.

#### References



46 votes

-- Keith Kr (4.6k points)

### 6.3.5 Eigen Value: GATE CSE 2008 | Question: 28 top



✓ Characteristic equation is  $|A - \lambda I| = 0$

(1)

$$\begin{vmatrix} 1 - \lambda & 0 \\ 0 & -\lambda \end{vmatrix} = 0$$

$$(1 - \lambda)(-\lambda) = 0$$

$$\implies \lambda = 0, 1$$

Similarly, (2)  $\lambda = 0, 0$

(3)  $\lambda \neq 1$

(4)  $\lambda = -1, -1$

Therefore, Answer is (A) one

28 votes

-- Keith Kr (4.6k points)

**6.3.6 Eigen Value: GATE CSE 2010 | Question: 29** [top](#)<https://gateoverflow.in/1155>

- ✓ Sum of eigenvalues is equal to trace (sum of diagonal elements) and product of eigen values is equal to the determinant of matrix

So,  $2 + y = 8 + 4$  and  $2y - 3x = 32$

Solving this we get  $y = 10, x = -4$ .

Option D is answer.

27 votes

-- Pooja Palod (24k points)

**6.3.7 Eigen Value: GATE CSE 2011 | Question: 40** [top](#)<https://gateoverflow.in/2142>

- ✓ The answer is A.

The given matrix is an upper triangular matrix and the eigenvalues of upper or lower triangular matrix are

the diagonal values itself.(Property)

27 votes

-- Sona Praneeth Akula (3.4k points)

**6.3.8 Eigen Value: GATE CSE 2012 | Question: 11** [top](#)<https://gateoverflow.in/43>

- ✓ Characteristic Equation is  $|A - \mu I| = 0$

$$\begin{vmatrix} 1-\mu & 1 \\ 1 & -1-\mu \end{vmatrix} = 0$$

$$\Rightarrow (1-\mu)(-1-\mu) - 1 = 0$$

$$\Rightarrow -1 - \mu + \mu + \mu^2 - 1 = 0$$

$$\Rightarrow \mu^2 - 2 = 0$$

$$\Rightarrow \mu = +\sqrt{2} \text{ and } -\sqrt{2}$$

According to properties of Eigen values,

$$\text{eigen values of } A^{19} = (\text{eigen value of } A)^{19}$$

$$= (\sqrt{2})^{19} \text{ and } (-\sqrt{2})^{19}$$

Hence, Ans is **option (D)**.

52 votes

-- Narayan Kunal (307 points)

**6.3.9 Eigen Value: GATE CSE 2014 Set 1 | Question: 5** [top](#)<https://gateoverflow.in/1760>

- ✓ Let  $\lambda_1$  and  $\lambda_2$  be two distinct eigenvalues of matrix  $A$  and  $u$  and  $v$  be their corresponding eigenvectors respectively.

We know that an eigenvector  $X$  corresponding to an eigenvalue  $\lambda$  of matrix  $A$  satisfies

$$AX = \lambda X$$

$$\therefore Au = \lambda_1 u \rightarrow (1) \text{ and } Av = \lambda_2 v \rightarrow (2)$$

On pre-multiplying eqn (1) with  $v^T$ , we get

$$v^T Au = v^T \lambda_1 u$$

$$(v^T A) u = v^T \lambda_1 u$$

$$(A^T v)^T u = v^T \lambda_1 u$$

$$(Av)^T u = v^T \lambda_1 u \quad (\text{since } A \text{ is a symmetric matrix, we can write } A^T = A)$$

But  $Av = \lambda_2 v \dots$  from (2)

$$(\lambda_2 v)^T u = v^T \lambda_1 u$$

$$\lambda_2 v^T u = v^T \lambda_1 u$$

$$\lambda_2 v^T u = \lambda_1 v^T u \quad (\text{as } \lambda_1 \text{ is a constant, we can write } v^T \lambda_1 = \lambda_1 v^T)$$

$$\lambda_2 v^T u - \lambda_1 v^T u = 0$$

$$(\lambda_2 - \lambda_1) v^T u = 0$$

$\therefore$  Either  $(\lambda_2 - \lambda_1) = 0$  or  $v^T u = 0$

But since  $\lambda_2 \neq \lambda_1$ ,  $v^T u$  must be 0

$v^T u$  is nothing but the dot product of the eigenvectors  $u$  and  $v$

**Hence, we can conclude that the eigenvectors corresponding to distinct eigenvalues of a real symmetric matrix are orthogonal.**

103 votes

-- Sadhbhavana Babar (8.2k points)

### 6.3.10 Eigen Value: GATE CSE 2014 Set 2 | Question: 47 top

<https://gateoverflow.in/2013>



- ✓ Since rank of matrix is 2, we can have maximum 2 non-zero eigen values.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} = \lambda \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix}$$

$$\therefore AX = \lambda X$$

$$x_1 + x_5 = \lambda x_1 \text{ (from first row)}$$

$$x_1 + x_5 = \lambda x_5 \text{ (from last row)}$$

Adding these two,

$$2(x_1 + x_5) = \lambda(x_1 + x_5)$$

$$\implies \lambda = 2.$$

Similarly,

$$x_2 + x_3 + x_4 = \lambda x_2$$

$$x_2 + x_3 + x_4 = \lambda x_3$$

$$x_2 + x_3 + x_4 = \lambda x_4$$

Adding these three,

$$3(x_2 + x_3 + x_4) = \lambda(x_2 + x_3 + x_4)$$

$$\implies \lambda = 3.$$

So, product of non-zero eigenvalues of the matrix =  $2 \times 3 = 6$ .

275 votes

-- Subha (165 points)

### 6.3.11 Eigen Value: GATE CSE 2014 Set 3 | Question: 4 top

<https://gateoverflow.in/2038>



- ✓ Trace is the sum of all diagonal elements of a square matrix.

Determinant of a matrix = Product of eigen values.

(A) Is the right answer. To have the determinant negative, at least one eigen value has to be negative (but reverse may not be true).

We can take simple example with upper or lower triangular matrices. For options (b), (c) and (d) reverse is always true.

38 votes

-- Srinath Jayachandran (2.9k points)

### 6.3.12 Eigen Value: GATE CSE 2015 Set 1 | Question: 36 top

<https://gateoverflow.in/8285>



- ✓ Sum of Eigenvalues = trace of matrix

$$\implies -1 + 7 = 1 + a$$

Product of Eigenvalues = Determinant of matrix

$$\implies -1 \times 7 = a - 4b$$

This gives  $a = 5$  and  $b = 3$

Answer = **option D**

36 votes

-- Amar Vashishth (25.2k points)

**6.3.13 Eigen Value: GATE CSE 2015 Set 2 | Question: 5** top ↗<https://gateoverflow.in/8051>

- ✓ For finding the Eigen Values of a Matrix we need to build the Characteristic equation which is of the form,

$$A - \lambda I$$

where  $A$  is the given Matrix,  $\lambda$  is a constant,  $I$  is the identity matrix.

We'll have a Linear equation after solving  $A - \lambda I$ , which will give us two roots for  $\lambda$ .

$$\begin{aligned} (4 - \lambda)(1 - \lambda) - 10 &= 0 \\ \implies 4 - 5\lambda + \lambda^2 &= 10 \\ \implies \lambda^2 - 5\lambda - 6 &= 0 \\ \implies (\lambda - 6)(\lambda + 1) &= 0 \\ \implies \lambda &= -1, 6. \end{aligned}$$

6 is larger and hence the required answer.

29 votes

-- Gate Keeda (1.6k points)

**6.3.14 Eigen Value: GATE CSE 2015 Set 3 | Question: 15** top ↗<https://gateoverflow.in/8411>

- ✓ 
$$\begin{bmatrix} 1-1 & -1 & 2 \\ 0 & 1-1 & 0 \\ 1 & 2 & 1-1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 2 \\ 0 & 0 & 0 \\ 1 & 2 & 0 \end{bmatrix} * \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$-y + 2z = 0$$

$$x + 2y = 0$$

Now consider each of the triplets as the value of  $x, y, z$  and put in these equations the one which satisfies is the answer.

Why so because an eigen vector represents a vector which passes through all the points which can solve these equations.

So, we can observe that only option B is satisfying the equations.

50 votes

-- Tamojit Chatterjee (1.9k points)

**6.3.15 Eigen Value: GATE CSE 2016 Set 1 | Question: 05** top ↗<https://gateoverflow.in/39634>

- ✓ Eigen values are roots of Characteristic equation  $|A - \lambda I| = 0$ .

For a  $3 \times 3$  matrix, characteristic equation will be cubic, so will have 3 roots. Two roots are given as:  $2 + i$  and  $3$  and We know that complex roots always occur in pairs so, if  $2 + i$  is a root of characteristic equation, then  $2 - i$  must be other root.

$$\lambda_1 = 2 + i, \lambda_2 = 2 - i \text{ and } \lambda_3 = 3$$

$$\det(A) = \lambda_1 \lambda_2 \lambda_3 = (2 + i) * (2 - i) * 3 = (2^2 - i^2) * 3 = 5 * 3 = 15$$

66 votes

-- Manish Joshi (20.5k points)

**6.3.16 Eigen Value: GATE CSE 2016 Set 2 | Question: 06** top ↗<https://gateoverflow.in/39549>

- ✓ Determinant of Matrix  $A$  = product of eigen values =  $1 \times 2 \times 4 = 8$

$$\text{Determinant of Inverse Matrix of } A, \det(A^{-1}) = \frac{1}{\det(A)} = \frac{1}{8}$$

Determinant remains same after the Transpose operation.

$$\text{So, determinant of } (A^{-1})^T = \det(A^{-1}) = \frac{1}{8} = 0.125$$

56 votes

-- Praveen Saini (41.9k points)

**6.3.17 Eigen Value: GATE CSE 2017 Set 1 | Question: 31** top ↗<https://gateoverflow.in/118312>

- ✓ Eigen values of  $\begin{bmatrix} 0 & 5 \\ 5 & 0 \end{bmatrix}$  are  $\pm 5$ . Therefore second statement is false.

Since, the rank of matrix  $A$  is 2, therefore atleast one eigen value would be zero for  $n \geq 3$ .

For  $n=2$ , It can be proven that  $\lambda_1^2 + \lambda_2^2 \leq \sum_{i=1}^n \sum_{j=1}^n A_{ij}^2$ .

$$\lambda_1^2 + \lambda_2^2 \leq 50$$

Both  $\lambda_1$  and  $\lambda_2$  would be real because  $A$  is a real symmetric matrix. Which implies that atleast one eigen value would be in  $[-5,5]$ .

Hence, correct answer is (B)

Now, to prove  $\lambda_1^2 + \lambda_2^2 \leq \sum_{i=1}^n \sum_{j=1}^n A_{ij}^2$  for  $2 \times 2$  matrix, let us consider the matrix is  $\begin{bmatrix} a & c \\ b & d \end{bmatrix}$  and  $\lambda$  is the eigen value of this matrix.

$$\begin{vmatrix} a - \lambda & c \\ b & d - \lambda \end{vmatrix} = 0$$

$$\lambda^2 - (a+d)\lambda + ad - bc = 0$$

Let  $\lambda_1$  and  $\lambda_2$  are roots of this equation.

$$\lambda_1^2 + \lambda_2^2 = (\lambda_1 + \lambda_2)^2 - 2\lambda_1\lambda_2$$

$$= (a+d)^2 - 2(ad - bc)$$

$$= \sum_{i=1}^2 \sum_{j=1}^2 A_{ij}^2 - (b-c)^2$$

For real valued matrix,

$$\leq \sum_{i=1}^2 \sum_{j=1}^2 A_{ij}^2 \quad (\text{For real symmetric matrix, } b=c \text{ and } \leq \text{ would be replaced by equal sign})$$

38 votes

-- suraj (4.8k points)

### 6.3.18 Eigen Value: GATE CSE 2017 Set 2 | Question: 22 top

<https://gateoverflow.in/118363>



✓  $P + Q = \begin{bmatrix} 0 & -1 & -2 \\ 8 & 9 & 10 \\ 8 & 8 & 8 \end{bmatrix}$

$\det(P + Q) = 0$ , So Rank cannot be 3, but there exists a  $2 \times 2$  submatrix such that determinant of submatrix is not 0.

So,  $\text{Rank}(P + Q) = 2$

40 votes

-- Manish Joshi (20.5k points)

### 6.3.19 Eigen Value: GATE CSE 2017 Set 2 | Question: 52 top

<https://gateoverflow.in/118618>



- ✓ Given that  $\lambda = 2$  is an eigen value. So, it must satisfy characteristic equation.

$$2^3 - 4*2^2 + 2a + 30 = 0 \Rightarrow a = -11$$

Characteristic eq :  $\lambda^3 - 4\lambda^2 - 11\lambda + 30$

$$\Rightarrow (\lambda - 2)(\lambda - 5)(\lambda + 3) = 0$$

$$\lambda_1 = 2, \lambda_2 = 5 \text{ and } \lambda_3 = -3$$

Max Eigen Value = 5

53 votes

-- Manish Joshi (20.5k points)

**6.3.20 Eigen Value: GATE CSE 2018 | Question: 17** top ↴<https://gateoverflow.in/204091>

✓  $u = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$

$$v^T = [1 \ 1]$$

$$A = uv^T$$

$$A = \begin{bmatrix} 1 \\ 2 \end{bmatrix} [1 \ 1]$$

$$= \begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$$

$$A - \lambda I = 0$$

$$\Rightarrow \begin{bmatrix} 1 - \lambda & 1 \\ 2 & 2 - \lambda \end{bmatrix} = 0$$

$$\Rightarrow (1 - \lambda)(2 - \lambda) - 2 = 0$$

$$\Rightarrow \lambda^2 - 3\lambda = 0$$

$$\Rightarrow \lambda = 0, 3$$

So, maximum is 3.

24 votes

-- Subham Mishra (11.3k points)

**6.3.21 Eigen Value: GATE CSE 2018 | Question: 26** top ↴<https://gateoverflow.in/204100>

✓ **Theorem:** Suppose the  $n \times n$  matrix  $A$  has  $n$  linearly independent eigenvectors. If these eigenvectors are the columns of a matrix  $S$ , then  $S^{-1}AS$  is a diagonal matrix  $\Lambda$ . The eigenvalues of  $A$  are on the diagonal of  $\Lambda$ .

$S^{-1}AS = \Lambda$  (A diagonal Matrix with diagonal values representing eigen values of A) =

$$\begin{bmatrix} \lambda_1 & & & \\ & \lambda_2 & & \\ & & \ddots & \\ & & & \lambda_n \end{bmatrix}$$

Now if  $A$  is diagonalizable,  $S^{-1}$  must exist. What is  $S$ ?  $S$  is a matrix whose columns are eigen-vectors of matrix  $A$ .

Now  $S^{-1}$  would only exist if  $S$  is invertible. And  $S$  would be invertible if all rows and columns of  $S$  are independent.

If we would have same eigen-vectors, then  $S^{-1}$  won't exist and hence  $A$  won't be diagonalizable.

Even if a matrix  $A$  has same eigen values, it does not mean that it is not diagonalizable. Take the trivial example of the Identity Matrix  $I$ .

$$\begin{bmatrix} 1 & & \\ & 1 & \\ & & 1 \end{bmatrix}$$

The Eigen values are 1, 1, 1 and Eigen vectors are  $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

We form  $S = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$  and this is invertible.

So, this makes  $S^{-1}IS$  as  $I = \Lambda$  which is in-fact a diagonal matrix.

So, even if we have same eigenvalues the matrix may or may not be diagonalizable. But yes, we need full  $n$  set of linearly independent eigenvectors for this matrix  $A$  of size  $n \times n$  to be diagonalizable.

Now our problem says that we have a matrix  $P$  whose only eigenvectors are multiples of  $\begin{bmatrix} 1 \\ 4 \end{bmatrix}$ .

Means we have only  $\begin{bmatrix} 1 \\ 4 \end{bmatrix}$  as independent eigen vector. Surely, this matrix is not diagonalizable.

Since, eigen vectors are multiples of  $\begin{bmatrix} 1 \\ 4 \end{bmatrix}$ , we have repeated eigen values.

Let us assume  $\lambda_1$  and  $\lambda_2$  are different eigen values.

Since, we have only eigen vectors multiple of  $\begin{bmatrix} 1 \\ 4 \end{bmatrix}$ .

Let this vector be  $x_1$ .

$$\text{So, } Px_1 = \lambda_1 x_1$$

$$\implies Px_1 = \lambda_2 x_1$$

$$\implies \lambda_1 x_1 = \lambda_2 x_1$$

Multiply by  $x_1 - 1$  we get  $\lambda_1 = \lambda_2$ . Means, same Eigen vector gives same Eigen Value.

So yes,  $P$  has repeated Eigen Values. (II) statement is true.

Now Statement (I) is not true. We cannot say this statement with exact surety.

Consider a matrix  $A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$

It's eigenvalues are  $\lambda_1 = \lambda_2 = 0$ .

All the eigenvectors of this  $A$  are multiples of vector  $(1, 0)$

$$\begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \cdot x = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\text{or } x = \begin{bmatrix} c \\ 0 \end{bmatrix}.$$

This matrix surely is not diagonalizable but this matrix  $A$  has determinant  $= -1$ .

Since determinant is not 0, so  $A^{-1}$  exists.

Hence, (II) and (III) are surely valid under all cases of this question.

For (I) part, Matrix  $P$  will not have an inverse when  $\det(P) = 0$  and this implies one of the eigenvalue of  $P$  is zero. But in question, no where it is mentioned about what are the eigen values. So, **I is not necessarily true**.

**Answer-(D) (Remember options says "necessarily true")**

36 votes

-- Ayush Upadhyaya (28.2k points)

### 6.3.22 Eigen Value: GATE CSE 2019 | Question: 44 top

<https://gateoverflow.in/302804>



✓ Important properties of Eigen values:

1. Sum of all eigen values = Sum of leading diagonal(principle diagonal) elements = Trace of the matrix.
2. Product of all Eigen values =  $\det(A) = |A|$
3. Any square diagonal(lower triangular or upper triangular) matrix eigen values are leading diagonal (principle diagonal)elements itself.

Example:  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Diagonal matrix

Eigenvalues are 1, 1, 1

$B = \begin{bmatrix} 1 & 9 & 6 \\ 0 & 1 & 12 \\ 0 & 0 & 1 \end{bmatrix}$

Upper triangular matrix

Eigenvalues are 1, 1, 1

$$C = \begin{bmatrix} 1 & 0 & 0 \\ 8 & 1 & 0 \\ 2 & 3 & 1 \end{bmatrix}$$

Lower triangular matrix

Eigenvalues are 1, 1, 1

Now coming to the actual question

$$R = \begin{bmatrix} 1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \\ 1 & 5 & 25 & 125 \end{bmatrix}$$

$$|R| = \begin{vmatrix} 1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \\ 1 & 5 & 25 & 125 \end{vmatrix}$$

Perform

- $R4 \rightarrow R_4 - R_3$
- $R3 \rightarrow R_3 - R_2$
- $R2 \rightarrow R_2 - R_1$

$$\Rightarrow |R| = \begin{vmatrix} 1 & 2 & 4 & 8 \\ 0 & 1 & 5 & 19 \\ 0 & 1 & 7 & 37 \\ 0 & 1 & 9 & 61 \end{vmatrix}$$

Perform

- $R4 \rightarrow R_4 - R_3$
- $R3 \rightarrow R_3 - R_2$

$$\Rightarrow |R| = \begin{vmatrix} 1 & 2 & 4 & 8 \\ 0 & 1 & 5 & 19 \\ 0 & 0 & 2 & 18 \\ 0 & 0 & 2 & 24 \end{vmatrix}$$

Perform

- $R4 \rightarrow R_4 - R_3$

$$\Rightarrow |R| = \begin{vmatrix} 1 & 2 & 4 & 8 \\ 0 & 1 & 5 & 19 \\ 0 & 0 & 2 & 18 \\ 0 & 0 & 0 & 6 \end{vmatrix}$$

The absolute value of product of Eigen values =  $\text{Det}(A) = \text{Product of diagonal elements} = 12$ .

49 votes

-- Lakshman Patel (63.9k points)

### 6.3.23 Eigen Value: GATE CSE 2021 Set 1 | Question: 52 top

<https://gateoverflow.in/357399>



$$\text{Let } A = \begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

Characteristic equation  $|A - \lambda I| = 0$

$$\Rightarrow \begin{vmatrix} -\lambda & 1 & 1 & 1 \\ 1 & -\lambda & 1 & 1 \\ 1 & 1 & -\lambda & 1 \\ 1 & 1 & 1 & -\lambda \end{vmatrix} = 0$$

Perform the operation,  $C_4 \rightarrow C_1 + C_2 + C_3 + C_4$ , we get

$$\Rightarrow \begin{vmatrix} -\lambda & 1 & 1 & 3-\lambda \\ 1 & -\lambda & 1 & 3-\lambda \\ 1 & 1 & -\lambda & 3-\lambda \\ 1 & 1 & 1 & 3-\lambda \end{vmatrix} = 0$$

$$\Rightarrow (3-\lambda) \begin{vmatrix} -\lambda & 1 & 1 & 1 \\ 1 & -\lambda & 1 & 1 \\ 1 & 1 & -\lambda & 1 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0$$

Perform the operation,  $R_1 \rightarrow R_1 - R_2, R_2 \rightarrow R_2 - R_1, R_3 \rightarrow R_3 - R_1$ , we get

$$\Rightarrow (3-\lambda) \begin{vmatrix} -\lambda-1 & 0 & 0 & 0 \\ 1+\lambda & -\lambda-1 & 0 & 0 \\ 1+\lambda & 0 & -\lambda-1 & 0 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0$$

$$\Rightarrow (3-\lambda)(-\lambda-1)(-\lambda-1)(-\lambda-1) = 0$$

$$\Rightarrow \lambda = -1, -1, -1, 3$$

$\therefore$  The largest eigenvalue is 3.

**PS:** For any matrix  $A$ ,

- The determinant of  $A$  equals the product of its eigenvalues.
- The trace of  $A$  equals the sum of its eigenvalues.
- The trace of a matrix is defined as the sum of the leading diagonal entries.
- A real symmetric matrix has only real eigenvalues.

(OR)

$$\text{Let } A = \begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

$$\text{We can write given matrix as : } 3 \begin{pmatrix} 0 & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & 0 & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & 0 & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & 0 \end{pmatrix} = 3A$$

A Markov matrix is a square matrix with all nonnegative entries, and where the sum of the entries down any column is 1. If the entries are all positive, it's a positive Markov matrix. It is also called a doubly stochastic matrix.

The most important facts about a positive Markov matrix are:

- $\lambda = 1$  is an eigenvalue.
- The eigenvector associated with  $\lambda = 1$  can be chosen to be strictly positive.
- All other eigenvalues have a magnitude less than 1.

So, the correct answer is 3.

References:

- [https://www.math.utah.edu/~zwick/Classes/Fall2012\\_2270/Lectures/Lecture40\\_with\\_Examples.pdf](https://www.math.utah.edu/~zwick/Classes/Fall2012_2270/Lectures/Lecture40_with_Examples.pdf)
- <https://webpages.uncc.edu/ghetyei/courses/old/F07.3116/birkhoff.pdf>

### References



2 votes

-- Lakshman Patel (63.9k points)

### 6.3.24 Eigen Value: GATE IT 2006 | Question: 26 top

<https://gateoverflow.in/3565>



✓  $\det(A - \lambda I) = 0$

$$\Rightarrow \begin{vmatrix} a - \lambda & 1 & 0 \\ 1 & a - \lambda & 1 \\ 0 & 1 & a - \lambda \end{vmatrix} = 0$$

$$\Rightarrow (a - \lambda) * [(a - \lambda) * (a - \lambda) - 1 * 1] - 1 * [1 * (a - \lambda) - 0 * 1] + 0 * [1 * 1 - 0 * (a - \lambda)] = 0$$

$$\Rightarrow (a - \lambda)^3 - 2(a - \lambda) = 0$$

$$\Rightarrow (a - \lambda)((a - \lambda) - 2)^2 = 0$$

$$\Rightarrow (a - \lambda)((a - \lambda)^2 - (\sqrt{2})^2) = 0$$

$$\Rightarrow (a - \lambda)(a - \lambda + \sqrt{2})(a - \lambda - \sqrt{2}) = 0$$

Eigen values ,  $\lambda = a, a + \sqrt{2}, a - \sqrt{2}$ .

Correct Answer: A

42 votes

-- Praveen Saini (41.9k points)

### 6.3.25 Eigen Value: GATE IT 2007 | Question: 2 top

<https://gateoverflow.in/3433>



✓ Let  $x = [x_1, x_2]$  be a unit eigen vector

Given  $\sqrt{x_{12} + x_{22}} = 1$

i.e.,  $x_{12} + x_{22} = 1 \quad \because x$  is a unit Eigen vector

$Ax = Lx$ , where  $L$  is eigen value

$$x^T Ax = x^T Lx = Lx^T x = L[x_1, x_2]^T [x_1, x_2] = L[x_{12} + x_{22}] = L(1) = L.$$

The maximum value of  $L = \frac{5+\sqrt{5}}{2}$ .

Hence, maximum value of  $x^T Ax$  is  $\frac{5+\sqrt{5}}{2}$ .

Option B

56 votes

-- saloni (251 points)

## 6.4

### Matrices (22) top

#### 6.4.1 Matrices: GATE CSE 1987 | Question: 1-xxiii top

<https://gateoverflow.in/80380>



A square matrix is singular whenever

- The rows are linearly independent
- The columns are linearly independent
- The row are linearly dependent
- None of the above

[gate1987](#) [linear-algebra](#) [matrices](#)
[Answer](#)
<https://gateoverflow.in/94644>


#### 6.4.2 Matrices: GATE CSE 1988 | Question: 16i [top](#)

Assume that the matrix  $A$  given below, has factorization of the form  $LU = PA$ , where  $L$  is lower-triangular with all diagonal elements equal to 1,  $U$  is upper-triangular, and  $P$  is a permutation matrix. For

$$A = \begin{bmatrix} 2 & 5 & 9 \\ 4 & 6 & 5 \\ 8 & 2 & 3 \end{bmatrix}$$

Compute  $L$ ,  $U$ , and  $P$  using Gaussian elimination with partial pivoting.

[gate1988](#) [normal](#) [descriptive](#) [linear-algebra](#) [matrices](#)
[Answer](#)
<https://gateoverflow.in/611>


#### 6.4.3 Matrices: GATE CSE 1993 | Question: 02.7 [top](#)

If  $A = \begin{pmatrix} 1 & 0 & 0 & 1 \\ 0 & -1 & 0 & -1 \\ 0 & 0 & i & i \\ 0 & 0 & 0 & -i \end{pmatrix}$  the matrix  $A^4$ , calculated by the use of Cayley-Hamilton theorem or otherwise, is

[gate1993](#) [linear-algebra](#) [normal](#) [matrices](#) [fill-in-the-blanks](#)
[Answer](#)
<https://gateoverflow.in/2438>


#### 6.4.4 Matrices: GATE CSE 1994 | Question: 1.2 [top](#)

Let  $A$  and  $B$  be real symmetric matrices of size  $n \times n$ . Then which one of the following is true?

- A.  $AA' = I$
- B.  $A = A^{-1}$
- C.  $AB = BA$
- D.  $(AB)' = BA$

[gate1994](#) [linear-algebra](#) [normal](#) [matrices](#)
[Answer](#)
<https://gateoverflow.in/2498>


#### 6.4.5 Matrices: GATE CSE 1994 | Question: 3.12 [top](#)

Find the inverse of the matrix  $\begin{bmatrix} 1 & 0 & 1 \\ -1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

[gate1994](#) [linear-algebra](#) [matrices](#) [easy](#) [descriptive](#)
[Answer](#)

#### 6.4.6 Matrices: GATE CSE 1996 | Question: 10 [top](#)

<https://gateoverflow.in/2762>


Let  $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$  and  $B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$  be two matrices such that  $AB = I$ . Let  $C = A \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$  and  $CD = I$ . Express the elements of  $D$  in terms of the elements of  $B$ .

[gate1996](#) [linear-algebra](#) [matrices](#) [normal](#) [descriptive](#)
[Answer](#)

**6.4.7 Matrices: GATE CSE 1996 | Question: 2.6** top ↗<https://gateoverflow.in/2735>

The matrices  $\begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$  and  $\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$  commute under multiplication

- A. if  $a = b$  or  $\theta = n\pi, n$  an integer
- B. always
- C. never
- D. if  $a \cos \theta = b \sin \theta$

[gate1996](#) [linear-algebra](#) [normal](#) [matrices](#)

Answer

**6.4.8 Matrices: GATE CSE 1997 | Question: 4.2** top ↗<https://gateoverflow.in/2243>

Let  $A = (a_{ij})$  be an  $n$ -rowed square matrix and  $I_{12}$  be the matrix obtained by interchanging the first and second rows of the  $n$ -rowed Identity matrix. Then  $AI_{12}$  is such that its first

- A. Row is the same as its second row
- B. Row is the same as the second row of  $A$
- C. Column is the same as the second column of  $A$
- D. Row is all zero

[gate1997](#) [linear-algebra](#) [easy](#) [matrices](#)

Answer

**6.4.9 Matrices: GATE CSE 1998 | Question: 2.1** top ↗<https://gateoverflow.in/1673>

The rank of the matrix given below is:

$$\begin{bmatrix} 1 & 4 & 8 & 7 \\ 0 & 0 & 3 & 0 \\ 4 & 2 & 3 & 1 \\ 3 & 12 & 24 & 21 \end{bmatrix}$$

- A. 3
- B. 1
- C. 2
- D. 4

[gate1998](#) [linear-algebra](#) [matrices](#) [normal](#)

Answer

**6.4.10 Matrices: GATE CSE 1998 | Question: 2.2** top ↗<https://gateoverflow.in/1674>

Consider the following determinant  $\Delta = \begin{vmatrix} 1 & a & bc \\ 1 & b & ca \\ 1 & c & ab \end{vmatrix}$

Which of the following is a factor of  $\Delta$ ?

- A.  $a + b$
- B.  $a - b$
- C.  $a + b + c$
- D.  $abc$

[gate1998](#) [linear-algebra](#) [matrices](#) [normal](#)

Answer

**6.4.11 Matrices: GATE CSE 2001 | Question: 1.1** top ↗<https://gateoverflow.in/694>

Consider the following statements:

- S1: The sum of two singular  $n \times n$  matrices may be non-singular
- S2: The sum of two  $n \times n$  non-singular matrices may be singular

Which one of the following statements is correct?

- A. S1 and S2 both are true
- B. S1 is true, S2 is false
- C. S1 is false, S2 is true
- D. S1 and S2 both are false

[gate2001-cse](#) [linear-algebra](#) [normal](#) [matrices](#)

Answer

**6.4.12 Matrices: GATE CSE 2002 | Question: 1.1** top ↗<https://gateoverflow.in/805>

The rank of the matrix  $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$  is

- A. 4
- B. 2
- C. 1
- D. 0

[gate2002-cse](#) [linear-algebra](#) [easy](#) [matrices](#)

Answer

**6.4.13 Matrices: GATE CSE 2004 | Question: 26** top ↗<https://gateoverflow.in/1023>

The number of different  $n \times n$  symmetric matrices with each element being either 0 or 1 is: (Note:  $\text{power}(2, X)$  is same as  $2^X$ )

- A.  $\text{power}(2, n)$
- B.  $\text{power}(2, n^2)$
- C.  $\text{power}\left(2, \frac{(n^2+n)}{2}\right)$
- D.  $\text{power}\left(2, \frac{(n^2-n)}{2}\right)$

[gate2004-cse](#) [linear-algebra](#) [normal](#) [matrices](#)

Answer

**6.4.14 Matrices: GATE CSE 2004 | Question: 27** top ↗<https://gateoverflow.in/1024>

Let  $A, B, C, D$  be  $n \times n$  matrices, each with non-zero determinant. If  $ABCD = I$ , then  $B^{-1}$  is

- A.  $D^{-1}C^{-1}A^{-1}$
- B.  $CDA$
- C.  $ADC$
- D. Does not necessarily exist

[gate2004-cse](#) [linear-algebra](#) [normal](#) [matrices](#)

Answer

**6.4.15 Matrices: GATE CSE 2004 | Question: 76** top ↗<https://gateoverflow.in/1070>

In an  $M \times N$  matrix all non-zero entries are covered in  $a$  rows and  $b$  columns. Then the maximum number of non-zero entries, such that no two are on the same row or column, is

- A.  $\leq a + b$

- B.  $\leq \max(a, b)$   
 C.  $\leq \min(M - a, N - b)$   
 D.  $\leq \min(a, b)$

gate2004-cse linear-algebra normal matrices

Answer 

#### 6.4.16 Matrices: GATE CSE 2006 | Question: 23

<https://gateoverflow.in/984>



$F$  is an  $n \times n$  real matrix.  $b$  is an  $n \times 1$  real vector. Suppose there are two  $n \times 1$  vectors,  $u$  and  $v$  such that,  $u \neq v$  and  $Fu = b, Fv = b$ . Which one of the following statements is false?

- A. Determinant of  $F$  is zero.  
 B. There are an infinite number of solutions to  $Fx = b$   
 C. There is an  $x \neq 0$  such that  $Fx = 0$   
 D.  $F$  must have two identical rows

gate2006-cse linear-algebra normal matrices

Answer 

#### 6.4.17 Matrices: GATE CSE 2015 Set 1 | Question: 18

<https://gateoverflow.in/8241>



In the LU decomposition of the matrix  $\begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$ , if the diagonal elements of  $U$  are both 1, then the lower diagonal entry  $l_{22}$  of  $L$  is \_\_\_\_\_.

gate2015-cse-set1 linear-algebra matrices numerical-answers

Answer 

#### 6.4.18 Matrices: GATE CSE 2015 Set 2 | Question: 27

<https://gateoverflow.in/8131>



Perform the following operations on the matrix  $\begin{bmatrix} 3 & 4 & 45 \\ 7 & 9 & 105 \\ 13 & 2 & 195 \end{bmatrix}$

- i. Add the third row to the second row  
 ii. Subtract the third column from the first column.

The determinant of the resultant matrix is \_\_\_\_\_.

gate2015-cse-set2 linear-algebra matrices easy numerical-answers

Answer 

#### 6.4.19 Matrices: GATE CSE 2020 | Question: 27

<https://gateoverflow.in/333204>



Let  $A$  and  $B$  be two  $n \times n$  matrices over real numbers. Let  $\text{rank}(M)$  and  $\det(M)$  denote the rank and determinant of a matrix  $M$ , respectively. Consider the following statements.

- I.  $\text{rank}(AB) = \text{rank}(A)\text{rank}(B)$   
 II.  $\det(AB) = \det(A)\det(B)$   
 III.  $\text{rank}(A + B) \leq \text{rank}(A) + \text{rank}(B)$   
 IV.  $\det(A + B) \leq \det(A) + \det(B)$

Which of the above statements are TRUE?

- A. I and II only  
 B. I and IV only  
 C. II and III only  
 D. III and IV only

gate2020-cse linear-algebra matrices

Answer 

#### 6.4.20 Matrices: GATE IT 2004 | Question: 32

 <https://gateoverflow.in/3675>



Let  $A$  be an  $n \times n$  matrix of the following form.

$$A = \begin{bmatrix} 3 & 1 & 0 & 0 & 0 & \dots & 0 & 0 & 0 \\ 1 & 3 & 1 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 1 & 3 & 1 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & 1 & 3 & 1 & \dots & 0 & 0 & 0 \\ \dots & & & & & & & & \\ \dots & & & & & & & & \\ 0 & 0 & 0 & 0 & 0 & \dots & 1 & 3 & 1 \\ 0 & 0 & 0 & 0 & 0 & \dots & 0 & 1 & 3 \end{bmatrix}_{n \times n}$$

What is the value of the determinant of  $A$ ?

- A.  $\left(\frac{5+\sqrt{3}}{2}\right)^{n-1} \left(\frac{5\sqrt{3}+7}{2\sqrt{3}}\right) + \left(\frac{5-\sqrt{3}}{2}\right)^{n-1} \left(\frac{5\sqrt{3}-7}{2\sqrt{3}}\right)$
- B.  $\left(\frac{7+\sqrt{5}}{2}\right)^{n-1} \left(\frac{7\sqrt{5}+3}{2\sqrt{5}}\right) + \left(\frac{7-\sqrt{5}}{2}\right)^{n-1} \left(\frac{7\sqrt{5}-3}{2\sqrt{5}}\right)$
- C.  $\left(\frac{3+\sqrt{7}}{2}\right)^{n-1} \left(\frac{3\sqrt{7}+5}{2\sqrt{7}}\right) + \left(\frac{3-\sqrt{7}}{2}\right)^{n-1} \left(\frac{3\sqrt{7}-5}{2\sqrt{7}}\right)$
- D.  $\left(\frac{3+\sqrt{5}}{2}\right)^{n-1} \left(\frac{3\sqrt{5}+7}{2\sqrt{5}}\right) + \left(\frac{3-\sqrt{5}}{2}\right)^{n-1} \left(\frac{3\sqrt{5}-7}{2\sqrt{5}}\right)$

[gate2004-it](#) [linear-algebra](#) [matrices](#) [normal](#)

Answer 

#### 6.4.21 Matrices: GATE IT 2004 | Question: 36

 <https://gateoverflow.in/3679>



If matrix  $X = \begin{bmatrix} a & 1 \\ -a^2 + a - 1 & 1 - a \end{bmatrix}$  and  $X^2 - X + I = O$  ( $I$  is the identity matrix and  $O$  is the zero matrix), then the inverse of  $X$  is

- A.  $\begin{bmatrix} 1-a & -1 \\ a^2 & a \end{bmatrix}$
- B.  $\begin{bmatrix} 1-a & -1 \\ a^2 - a + 1 & a \end{bmatrix}$
- C.  $\begin{bmatrix} -a & 1 \\ -a^2 + a - 1 & 1 - a \end{bmatrix}$
- D.  $\begin{bmatrix} a^2 - a + 1 & a \\ 1 & 1 - a \end{bmatrix}$

[gate2004-it](#) [linear-algebra](#) [matrices](#) [normal](#)

Answer 

#### 6.4.22 Matrices: GATE IT 2008 | Question: 29

 <https://gateoverflow.in/3319>



If  $M$  is a square matrix with a zero determinant, which of the following assertion (s) is (are) correct?

- S1: Each row of  $M$  can be represented as a linear combination of the other rows
- S2: Each column of  $M$  can be represented as a linear combination of the other columns
- S3:  $MX = 0$  has a nontrivial solution
- S4:  $M$  has an inverse

- A. S3 and S2
- B. S1 and S4
- C. S1 and S3
- D. S1, S2 and S3

[gate2008-it](#) [linear-algebra](#) [normal](#) [matrices](#)
[Answer](#)

## Answers: Matrices

### 6.4.1 Matrices: GATE CSE 1987 | Question: 1-xxiii [top](#)

<https://gateoverflow.in/80380>


- ✓ When the rows are linearly dependent the determinant of the matrix becomes 0 hence in that case it will become singular matrix.

**Hence, C is the correct option.**

19 votes

-- HABIB MOHAMMAD KHAN (67.5k points)

### 6.4.2 Matrices: GATE CSE 1988 | Question: 16i [top](#)

<https://gateoverflow.in/94644>


✓  $A = \begin{bmatrix} 2 & 5 & 9 \\ 4 & 6 & 5 \\ 8 & 2 & 3 \end{bmatrix}$

-- Using Gaussian Elimination, we will change  $A$  into upper triangular matrix  $U$  and simultaneously find out elementary matrices  $E_{21}$ ,  $E_{31}$  and  $E_{32}$ .

-- To get the elementary matrices, we have to do the same operation on the Identity matrix as we do on the original matrix  $A$ .

On applying  $R_2 \leftarrow R_2 - 2R_1$

$A$  becomes  $\begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 8 & 2 & 3 \end{bmatrix}$

and  $E_{21}$  becomes  $\begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$  [ $\because R_2 \leftarrow R_2 - 2R_1$  on identity matrix  $I$  will give  $E_{21}$ ]

We can write it as  $\begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 8 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 2 & 5 & 9 \\ 4 & 6 & 5 \\ 8 & 2 & 3 \end{bmatrix}$

Now, applying  $R_3 \leftarrow R_3 - 4R_1$

$A$  becomes  $\begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & -18 & -33 \end{bmatrix}$

and  $E_{31}$  becomes  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -4 & 0 & 1 \end{bmatrix}$  [ $\because R_3 \leftarrow R_3 - 4R_1$  on identity matrix  $I$  will give  $E_{31}$ ]

Now, applying  $R_3 \leftarrow R_3 - \frac{18}{4}R_2$

$A$  becomes  $\begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & 0 & \frac{51}{2} \end{bmatrix}$

and  $E_{32}$  becomes  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & \frac{-18}{4} & 1 \end{bmatrix}$  [ $\because R_3 \leftarrow R_3 - \frac{18}{4}R_2$  on identity matrix  $I$  will give  $E_{32}$ ]

So, here,

$$U = \begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & 0 & \frac{51}{2} \end{bmatrix}, E_{21} = \begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, E_{31} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -4 & 0 & 1 \end{bmatrix}, E_{32} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -\frac{18}{4} & 1 \end{bmatrix},$$

Now, we can write all these things as:-

$$\Rightarrow E_{32}E_{31}E_{21}(A) = U$$

$$\Rightarrow A = E_{21}^{-1}E_{31}^{-1}E_{32}^{-1}U$$

Here,  $E_{21}^{-1}$ ,  $E_{31}^{-1}$ ,  $E_{32}^{-1}$  are very simple to compute. Just do the reverse operation means in row operations where we have done subtraction, we have to do addition.

So,  $\Rightarrow A = E_{21}^{-1}E_{31}^{-1}E_{32}^{-1}U$  becomes

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 4 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & \frac{18}{4} & 1 \end{bmatrix} * \begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & 0 & \frac{51}{2} \end{bmatrix}$$

$$\Rightarrow A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 4 & \frac{18}{4} & 1 \end{bmatrix} * \begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & 0 & \frac{51}{2} \end{bmatrix}$$

$$\text{It is the LU decomposition where } L = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 4 & \frac{18}{4} & 1 \end{bmatrix} \text{ and } U = \begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & 0 & \frac{51}{2} \end{bmatrix}$$

Since we have not done any row exchange, So, permutation matrix will not be changed. It will remain identity matrix  $I$ .

So, the answer is:-

$$L = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 4 & \frac{18}{4} & 1 \end{bmatrix} \quad U = \begin{bmatrix} 2 & 5 & 9 \\ 0 & -4 & -13 \\ 0 & 0 & \frac{51}{2} \end{bmatrix} \text{ and } P = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

5 votes

-- ankitgupta.1729 (14.9k points)

#### 6.4.3 Matrices: GATE CSE 1993 | Question: 02.7 top

<https://gateoverflow.in/611>



✓ Let  $\lambda$  be eigen value

Characteristic polynomial is

$$(1 - \lambda)(-1 - \lambda)(i - \lambda)(-i - \lambda)$$

$$= (\lambda^2 - 1)(\lambda^2 + 1)$$

$$= \lambda^4 - 1$$

Characteristic equation is  $\lambda^4 - 1 = 0$

According to Cayley Hamilton theorem every matrix satisfies its own characteristic equation

$$\text{So, } A^4 = I$$

46 votes

-- Pooja Palod (24k points)

**6.4.4 Matrices: GATE CSE 1994 | Question: 1.2** top ↴<https://gateoverflow.in/2438>

- ✓ A symmetric matrix is a square matrix that is equal to its transpose.  
 $(AB)' = B'A' = BA$  as both  $A$  and  $B$  are symmetric matrices, hence  $B' = B$  and  $A' = A$

So, (D) is correct option!

Why is (C) not correct option? see the following example:

$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$$

There are two symmetric matrices given of size  $2 \times 2$  and  $AB \neq BA$ . Therefore (C) is not a correct option!

23 votes

-- Manu Thakur (34k points)

**6.4.5 Matrices: GATE CSE 1994 | Question: 3.12** top ↴<https://gateoverflow.in/2498>

- ✓ An Easy Procedure.

Using Eigen values, the characteristic equation we get is -

$$-\lambda^3 + 2\lambda^2 - 2 = 0$$

Using Cayley-Hamilton Theorem-

$$-A^3 + 2A^2 - 2I = 0$$

$$\text{So, } A^{-1} = \frac{1}{2}(2A - A^2)$$

Solving that we get,

$$A^{-1} = \begin{bmatrix} \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & -\frac{1}{2} \end{bmatrix}$$

22 votes

-- Shweta Nair (579 points)

**6.4.6 Matrices: GATE CSE 1996 | Question: 10** top ↴<https://gateoverflow.in/2762>

- ✓  $AB = I$ ,  $B$  is equal to the inverse of  $A$  and vice versa.

$$\text{So, } B = A^{-1}$$

Now  $CD = I$ ,  $C$  is equal to the inverse of  $D$  and vice versa.

$$\text{So, } D = C^{-1}$$

$$= \left( A \cdot \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \right)^{-1}$$

**Remark:**  $(AB)^{-1} = B^{-1}A^{-1}$

$$= \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}^{-1} \cdot A^{-1}$$

$$= \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix} \cdot B$$

$$= \begin{bmatrix} b_{11} & b_{12} \\ b_{21} - b_{11} & b_{22} - b_{12} \end{bmatrix}$$

35 votes

-- Sayantan Ganguly (4.3k points)

**6.4.7 Matrices: GATE CSE 1996 | Question: 2.6** top ↴<https://gateoverflow.in/2735>

- ✓ Answer: A

$$\begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} * \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix} = \begin{bmatrix} a\cos(\theta) & -b\sin(\theta) \\ a\sin(\theta) & b\cos(\theta) \end{bmatrix}$$

and

$$\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix} * \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} = \begin{bmatrix} a\cos(\theta) & -a\sin(\theta) \\ b\sin(\theta) & b\cos(\theta) \end{bmatrix}$$

The multiplication will commute if

$$a\sin(\theta) = b\sin(\theta) \text{ or } a = b \text{ or } \theta = n\pi.$$

19 votes

-- Rajarshi Sarkar (27.8k points)

#### 6.4.8 Matrices: GATE CSE 1997 | Question: 4.2 top ↴

<https://gateoverflow.in/2243>



✓ *C* is the answer.

$AI_{12}$  matrix will result into the same matrix as  $A$  but first column will be exchanged with second column.

$$A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}, I_{12} = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}, AI_{12} = \begin{bmatrix} b & a & c \\ e & d & f \\ h & g & i \end{bmatrix}$$

30 votes

-- Manu Thakur (34k points)

#### 6.4.9 Matrices: GATE CSE 1998 | Question: 2.1 top ↴

<https://gateoverflow.in/1673>



✓  $\begin{bmatrix} 1 & 4 & 8 & 7 \\ 0 & 0 & 3 & 0 \\ 4 & 2 & 3 & 1 \\ 3 & 12 & 24 & 21 \end{bmatrix} = 3 \begin{bmatrix} 1 & 4 & 8 & 7 \\ 0 & 0 & 3 & 0 \\ 4 & 2 & 3 & 1 \\ 1 & 4 & 8 & 7 \end{bmatrix}$

$R_1$  and  $R_4$  are the same and hence we can remove  $R_4$  making the rank surely less than 4.

Taking 3 out from  $R_2 \implies 9 \begin{bmatrix} 1 & 4 & 8 & 7 \\ 0 & 0 & 1 & 0 \\ 4 & 2 & 3 & 1 \end{bmatrix}$

$R_1 \leftarrow R_1 - 8R_2 \implies 9 \begin{bmatrix} 1 & 4 & 0 & 7 \\ 0 & 0 & 1 & 0 \\ 4 & 2 & 0 & 1 \end{bmatrix}$

None of the rows are linearly independent (we cannot make any of them all 0's).

So, Rank will be 3.

(A) is correct option!

26 votes

-- Keith Kr (4.6k points)

#### 6.4.10 Matrices: GATE CSE 1998 | Question: 2.2 top ↴

<https://gateoverflow.in/1674>



✓  $\begin{vmatrix} 1 & a & bc \\ 1 & b & ca \\ 1 & c & ab \end{vmatrix}$

$$\begin{vmatrix} 1 & a & bc \\ 0 & b-a & ca-bc \\ 0 & c-a & ab-bc \end{vmatrix} \quad R_2 \rightarrow R_2 - R_1, R_3 \rightarrow R_3 - R_1$$

$$(b-a)(ab-bc) - (c-a)(ca-bc)$$

$$-(a-b)b(a-c) + (a-c)c(a-b)$$

$$(a - b)(a - c)(c - b)$$

Option(B)  $a - b$  is the correct choice.

26 votes

-- Leen Sharma (28.6k points)

#### 6.4.11 Matrices: GATE CSE 2001 | Question: 1.1 [top](#)

<https://gateoverflow.in/694>

A singular matrix is a square matrix whose determinant is 0. Whenever you solve question related to determinant, think of triangular matrix, like upper triangular matrix, because its determinant is just product of diagonal entries, and so easy to visualize. So definitely, in a singular matrix, one of the entries in diagonal must be zero. Similarly, in non-singular, none of the entries should be zero.

Now take any matrices and just check .

So we see that both S1 and S2 are true. So option (A) is correct.

19 votes

-- dragonball (1.4k points)

#### 6.4.12 Matrices: GATE CSE 2002 | Question: 1.1 [top](#)

<https://gateoverflow.in/805>

- ✓ Rank of this matrix is 1 as the determinant of 2nd order matrix is 0 and 1st order matrix is non zero so rank is 1.

Correct Answer: C

19 votes

-- Bhagirathi Nayak (11.7k points)

#### 6.4.13 Matrices: GATE CSE 2004 | Question: 26 [top](#)

<https://gateoverflow.in/1023>

- ✓ In symmetric matrix,  $A[i][j] = A[j][i]$ . So, we have choice only for either the upper triangular elements or the lower triangular elements. Number of such elements will be  $n + (n - 1) + (n - 2) + \dots + 1 = n \frac{(n+1)}{2} = \frac{(n^2+n)}{2}$ . Now, each element being either 0 or 1 means, we have 2 choices for each element and thus for  $\frac{(n^2+n)}{2}$  elements we have  $2^{\frac{(n^2+n)}{2}}$  possibilities.

Choice is C.

43 votes

-- Arjun Suresh (328k points)

#### 6.4.14 Matrices: GATE CSE 2004 | Question: 27 [top](#)

<https://gateoverflow.in/1024>

- ✓ Given  $ABCD = I$

Multiplying both sides by  $A^{-1}$

$$A^{-1}ABCD = A^{-1}I \text{ (position of } A^{-1} \text{ on both sides should be left)}$$

$$\Rightarrow BCD = A^{-1}$$

$$\Rightarrow BCDD^{-1} = A^{-1}D^{-1}$$

$$\Rightarrow BC = A^{-1}D^{-1}$$

$$\Rightarrow BCC^{-1} = A^{-1}D^{-1}C^{-1}$$

$$\Rightarrow B = A^{-1}D^{-1}C^{-1}$$

$$\text{Now } B^{-1} = (A^{-1}D^{-1}C^{-1})^{-1}$$

$$B^{-1} = CDA$$

49 votes

-- Madhur Rawat (2k points)

#### 6.4.15 Matrices: GATE CSE 2004 | Question: 76 [top](#)

<https://gateoverflow.in/1070>



maximum number of non-zero entries, such that no two are on the same row or column

Any entry will be a member of some row and some column. So, with  $a$  rows we can have maximum  $a$  elements such that no row has a repeated element. Same is applicable for  $b$  columns also. So, combining both, answer should be  $\leq \min(a, b)$ .

We can also apply pigeonhole principle here. Let  $p = \min(a, b)$  be the number of holes. So, we can place up to  $p$  non-zero entries (pigeons) and as soon as  $(p + 1)^{th}$  entry comes it must be making two entries in some column or row.

Correct Answer: D

26 votes

-- Arjun Suresh (328k points)

#### 6.4.16 Matrices: GATE CSE 2006 | Question: 23 top ↴

→ <https://gateoverflow.in/984>



- ✓ (A) : Correct. We are given

$$Fu = b$$

$$Fv = b$$

So  $F(u - v) = 0$

Since  $u \neq v$ , so we have a non-zero solution  $w = (u - v)$  to homogeneous equation  $Fx = 0$ . Now any vector  $\lambda w$  is also a solution of  $Fx = 0$ , and so we have infinitely many solutions of  $Fx = 0$ , and so determinant of F is zero.

(B) : Correct. Consider a vector  $u + \lambda w$ .

$$F(u + \lambda w) = Fu + F(\lambda w) = b + 0 = b$$

So there are infinitely many vectors of the form  $u + \lambda w$ , which are solutions to equation  $Fx = b$ .

(C) : Correct. In option (a), we proved that vector  $(u - v) \neq 0$  satisfies equation  $Fx = 0$ .

(D) : False. This is not necessary.

So, option (D) is the answer.

39 votes

-- Happy Mittal (8.2k points)

#### 6.4.17 Matrices: GATE CSE 2015 Set 1 | Question: 18 top ↴

→ <https://gateoverflow.in/8241>



✓ Given,  $\begin{bmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{bmatrix} * \begin{bmatrix} u_{11} & u_{12} \\ 0 & u_{22} \end{bmatrix}$

$$= \begin{bmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{bmatrix} * \begin{bmatrix} 1 & u_{12} \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$$

$$l_{11} = 2$$

$$l_{11} \times u_{12} = 2$$

Solving,  $u_{12} = 1$

$$l_{21} = 4$$

$$l_{21} \times u_{12} + l_{22} = 9$$

Solving,  $l_{22} = 5$

48 votes

-- GATERush (917 points)

Answer is already given. I am showing the formal method to solve this question.

$$A = \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$$

On applying  $R_2 \leftarrow R_2 - 2R_1$

$$\begin{bmatrix} 2 & 2 \\ 0 & 5 \end{bmatrix} \Leftrightarrow \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$$

So, here Elimination Matrix  $E_{21}$  is  $\begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix}$

It means we can write as :-

$$E_{21}A = U$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix} = \begin{bmatrix} 2 & 2 \\ 0 & 5 \end{bmatrix}$$

Now, Since  $E_{21}A = U$ . So,  $A = E_{21}^{-1}U$

$$\Rightarrow \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix}^{-1} \begin{bmatrix} 2 & 2 \\ 0 & 5 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 2 \\ 0 & 5 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 0 \\ 0 & 5 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

It is  $A = LDU$  decomposition. So, To make it  $A = LU$  decomposition where diagonal entries in U are 1, we have to multiply 1<sup>st</sup> 2 matrices i.e. L and D. Both L and D are lower triangular matrices, So product of 2 lower triangular matrices should also be lower triangular.

So,

$$\Rightarrow \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix} = \begin{bmatrix} 2 & 0 \\ 4 & 5 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

$$\text{Here, } \Rightarrow L = \begin{bmatrix} 2 & 0 \\ 4 & 5 \end{bmatrix} \text{ and } U = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

So,  $l_{22} = 5$



-- ankitgupta.1729 (14.9k points)



#### 6.4.18 Matrices: GATE CSE 2015 Set 2 | Question: 27 top ↴

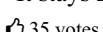
<https://gateoverflow.in/8131>

- ✓ Answer :  $-0$ , because it is easy to see that first column and third column are multiple of each other.

Third column = First column \* 15.

So rank is  $< 3$ , so Determinant must be 0.

It stays zero as row & column transformations don't affect determinant.



-- Akash Kanase (36k points)



#### 6.4.19 Matrices: GATE CSE 2020 | Question: 27 top ↴

<https://gateoverflow.in/333204>

- ✓  $\text{Rank}(AB) = \min(\text{Rank}(A), \text{Rank}(B))$

$$\text{Det}(AB) = \text{Det}(A) \times \text{Det}(B)$$

$\text{Rank}(A + B) \leq \text{Rank}(A) + \text{Rank}(B)$ . Because addition of two matrices can never result in increase in the number of independent columns and rows in the matrix.

**Answer: C**



-- Ayush Upadhyaya (28.2k points)



#### 6.4.20 Matrices: GATE IT 2004 | Question: 32 top ↴

<https://gateoverflow.in/3675>



- ✓ Answer verification is very easy in this question.

Just put  $n = 1$ , you'll get a matrix like [3].

Find its determinant.

Determinant = 3. Now check options.

By putting  $n = 1$ , we get the following results.

- A. 5
- B. 7
- C. 3
- D. 3

$A, B$  cant be the answer.

Now check for  $n = 2$ .

Determinant  $= 9 - 1 = 8$

Put  $n = 2$  in  $C, D$ .

- C. 7
- D. 8

So,  $D$  is the answer.

129 votes

-- Digvijay (44.9k points)

#### 6.4.21 Matrices: GATE IT 2004 | Question: 36 top ↗

↗ <https://gateoverflow.in/3679>



$$\begin{aligned} \checkmark \text{ Given, } X^2 - X + I &= O \\ \implies X^2 &= X - I \\ \implies (X^{-1})(X^2) &= (X^{-1})(X - I) \quad (\text{Multiplying } X^{-1} \text{ on both sides}) \\ \implies X &= I - X^{-1} \\ \implies X^{-1} &= I - X \end{aligned}$$

#### Option (B)

31 votes

-- Himanshu Agarwal (12.4k points)

#### 6.4.22 Matrices: GATE IT 2008 | Question: 29 top ↗

↗ <https://gateoverflow.in/3319>



$\checkmark$  Since,  $M$  has zero determinant, its rank is not full i.e. if  $M$  is of size  $3 * 3$ , then its rank is not 3. So there is a linear combination of rows which evaluates to 0 i.e.

$$k_1 R_1 + k_2 R_2 + \dots + k_n R_n = 0$$

and there is a linear combination of columns which evaluates to 0 i.e.

$$k_1 C_1 + k_2 C_2 + \dots + k_n C_n = 0$$

Now any row  $R_i$  can be written as linear combination of other rows as :

$$R_i = -\frac{k_1}{k_i} R_1 - \frac{k_2}{k_i} R_2 - \dots - \frac{k_{i-1}}{k_i} R_{i-1} - \frac{k_{i+1}}{k_i} R_{i+1} - \dots - \frac{k_n}{k_i} R_n$$

Similar is the case for columns.

Now  $MX = 0$  always has one solution :  $X = 0$  (which is called trivial solution). Now if  $|M| = 0$ , then  $MX = 0$  has non-trivial solutions also.

So,  $(S1)$ ,  $(S2)$ , and  $(S3)$  are true. So, option  $D$  is correct.

36 votes

-- Happy Mittal (8.2k points)

#### 6.5

#### Rank Of Matrix (3) top ↗

#### 6.5.1 Rank Of Matrix: GATE CSE 1994 | Question: 1.9 top ↗

↗ <https://gateoverflow.in/2446>



The rank of matrix  $\begin{bmatrix} 0 & 0 & -3 \\ 9 & 3 & 5 \\ 3 & 1 & 1 \end{bmatrix}$  is:

- A. 0
- B. 1

- C. 2  
D. 3

gate1994 linear-algebra matrices rank-of-matrix easy

Answer 

### 6.5.2 Rank Of Matrix: GATE CSE 1995 | Question: 1.24

<https://gateoverflow.in/2611>



The rank of the following  $(n+1) \times (n+1)$  matrix, where  $a$  is a real number is

$$\begin{bmatrix} 1 & a & a^2 & \dots & a^n \\ 1 & a & a^2 & \dots & a^n \\ \vdots & \vdots & \vdots & & \vdots \\ \vdots & \vdots & \vdots & & \vdots \\ 1 & a & a^2 & \dots & a^n \end{bmatrix}$$

- A. 1  
B. 2  
C.  $n$   
D. Depends on the value of  $a$

gate1995 linear-algebra matrices normal rank-of-matrix

Answer 

### 6.5.3 Rank Of Matrix: GATE CSE 2021 Set 2 | Question: 24

<https://gateoverflow.in/357516>



Suppose that  $P$  is a  $4 \times 5$  matrix such that every solution of the equation  $Px=0$  is a scalar multiple of  $[2 \ 5 \ 4 \ 3 \ 1]^T$ . The rank of  $P$  is \_\_\_\_\_

gate2021-cse-set2 numerical-answers linear-algebra matrices rank-of-matrix

Answer 

## Answers: Rank Of Matrix

### 6.5.1 Rank Of Matrix: GATE CSE 1994 | Question: 1.9

<https://gateoverflow.in/2446>



✓ Answer: C

Determinant comes out to be 0. So, rank cannot be 3. The minor  $\begin{bmatrix} 3 & 5 \\ 1 & 1 \end{bmatrix} \neq 0$ . So, rank is 2.

(OR)

If we do elementary row operations on the given matrix then we get

$$\begin{bmatrix} 0 & 0 & -3 \\ 9 & 3 & 5 \\ 3 & 1 & 1 \end{bmatrix} \xrightarrow{R_2 \leftarrow R_2 - 3R_3} \begin{bmatrix} 0 & 0 & -3 \\ 0 & 0 & 2 \\ 3 & 1 & 1 \end{bmatrix}$$

$$\xrightarrow{R_1 \leftarrow R_1 + \frac{3}{2}R_2} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 2 \\ 3 & 1 & 1 \end{bmatrix} \xrightarrow{R_1 \leftrightarrow R_3} \begin{bmatrix} 3 & 1 & 1 \\ 0 & 0 & 2 \\ 0 & 0 & 0 \end{bmatrix}$$

As the number of non zero rows is 2, the rank of the matrix is also 2.

 25 votes

-- Rajarshi Sarkar (27.8k points)

**6.5.2 Rank Of Matrix: GATE CSE 1995 | Question: 1.24** [top](#)<https://gateoverflow.in/2611>

✓ 
$$\begin{bmatrix} 1 & a & a^2 & \dots & a^n \\ 1 & a & a^2 & \dots & a^n \\ \vdots & \vdots & \vdots & & \vdots \\ \vdots & \vdots & \vdots & & \vdots \\ 1 & a & a^2 & \dots & a^n \end{bmatrix}$$

$R_2 \rightarrow R_2 - R_1, R_3 \rightarrow R_3 - R_1, R_4 \rightarrow R_4 - R_1$ , and so on

$$\begin{bmatrix} 1 & a & a^2 & \dots & a^n \\ 0 & 0 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ \vdots & \vdots & \vdots & & \vdots \\ 0 & 0 & 0 & \dots & 0 \end{bmatrix}$$

Rank of the Matrix = 1

Hence, option (A) 1 is the correct choice.

25 votes

-- Leen Sharma (28.6k points)

**6.5.3 Rank Of Matrix: GATE CSE 2021 Set 2 | Question: 24** [top](#)<https://gateoverflow.in/357516>

- ✓ Every solution to  $Px = 0$  is scalar multiple of  $[2 \ 5 \ 4 \ 3 \ 1]^T$ , It means out of 5 column vectors of matrix  $P$ , 4 are linearly independent as we have only one line in NULL Space (along the given vector).

Rank is nothing but the number of linearly independent column vectors in a matrix which is 4 here.

1 votes

-- Nikhil Dhama (2.3k points)

**6.6****System Of Equations (12)** [top](#)**6.6.1 System Of Equations: GATE CSE 1996 | Question: 1.7** [top](#)<https://gateoverflow.in/2711>

Let  $Ax = b$  be a system of linear equations where  $A$  is an  $m \times n$  matrix and  $b$  is a  $m \times 1$  column vector and  $X$  is an  $n \times 1$  column vector of unknowns. Which of the following is false?

- A. The system has a solution if and only if, both  $A$  and the augmented matrix  $[Ab]$  have the same rank.
- B. If  $m < n$  and  $b$  is the zero vector, then the system has infinitely many solutions.
- C. If  $m = n$  and  $b$  is a non-zero vector, then the system has a unique solution.
- D. The system will have only a trivial solution when  $m = n$ ,  $b$  is the zero vector and  $\text{rank}(A) = n$ .

[gate1996](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

Answer

**6.6.2 System Of Equations: GATE CSE 1998 | Question: 1.2** [top](#)<https://gateoverflow.in/1639>

Consider the following set of equations

- $x + 2y = 5$
- $4x + 8y = 12$
- $3x + 6y + 3z = 15$

This set

- A. has unique solution
- B. has no solution
- C. has finite number of solutions
- D. has infinite number of solutions

[gate1998](#) [linear-algebra](#) [system-of-equations](#) [easy](#)

[Answer](#)**6.6.3 System Of Equations: GATE CSE 1998 | Question: 9** [top](#)<https://gateoverflow.in/1723>

Derive the expressions for the number of operations required to solve a system of linear equations in  $n$  unknowns using the Gaussian Elimination Method. Assume that one operation refers to a multiplication followed by an addition.

gate1998 linear-algebra system-of-equations descriptive

[Answer](#)**6.6.4 System Of Equations: GATE CSE 2003 | Question: 41** [top](#)<https://gateoverflow.in/932>

Consider the following system of linear equations

$$\begin{pmatrix} 2 & 1 & -4 \\ 4 & 3 & -12 \\ 1 & 2 & -8 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} \alpha \\ 5 \\ 7 \end{pmatrix}$$

Notice that the second and the third columns of the coefficient matrix are linearly dependent. For how many values of  $\alpha$ , does this system of equations have infinitely many solutions?

- A. 0
- B. 1
- C. 2
- D. 3

gate2003-cse linear-algebra system-of-equations normal

[Answer](#)**6.6.5 System Of Equations: GATE CSE 2004 | Question: 71** [top](#)<https://gateoverflow.in/1065>

How many solutions does the following system of linear equations have?

- $-x + 5y = -1$
- $x - y = 2$
- $x + 3y = 3$

- A. infinitely many
- B. two distinct solutions
- C. unique
- D. none

gate2004-cse linear-algebra system-of-equations normal

[Answer](#)**6.6.6 System Of Equations: GATE CSE 2005 | Question: 48** [top](#)<https://gateoverflow.in/1173>

Consider the following system of linear equations :

$$2x_1 - x_2 + 3x_3 = 1$$

$$3x_1 + 2x_2 + 5x_3 = 2$$

$$-x_1 + 4x_2 + x_3 = 3$$

The system of equations has

- A. no solution
- B. a unique solution
- C. more than one but a finite number of solutions
- D. an infinite number of solutions

gate2005-cse linear-algebra system-of-equations normal

[Answer](#)**6.6.7 System Of Equations: GATE CSE 2008 | Question: 3** [top](#)<https://gateoverflow.in/401>

The following system of equations

- $x_1 + x_2 + 2x_3 = 1$
- $x_1 + 2x_2 + 3x_3 = 2$
- $x_1 + 4x_2 + \alpha x_3 = 4$

has a unique solution. The only possible value(s) for  $\alpha$  is/are

- A. 0
- B. either 0 or 1
- C. one of 0, 1, or -1
- D. any real number

[gate2008-cse](#) [easy](#) [linear-algebra](#) [system-of-equations](#)

[Answer](#)**6.6.8 System Of Equations: GATE CSE 2014 Set 1 | Question: 4** [top](#)<https://gateoverflow.in/1757>

Consider the following system of equations:

- $3x + 2y = 1$
- $4x + 7z = 1$
- $x + y + z = 3$
- $x - 2y + 7z = 0$

The number of solutions for this system is \_\_\_\_\_

[gate2014-cse-set1](#) [linear-algebra](#) [system-of-equations](#) [numerical-answers](#) [normal](#)

[Answer](#)**6.6.9 System Of Equations: GATE CSE 2015 Set 3 | Question: 33** [top](#)<https://gateoverflow.in/8490>

If the following system has non-trivial solution,

- $px + qy + rz = 0$
- $qx + ry + pz = 0$
- $rx + py + qz = 0$ ,

then which one of the following options is TRUE?

- A.  $p - q + r = 0$  or  $p = q = -r$
- B.  $p + q - r = 0$  or  $p = -q = r$
- C.  $p + q + r = 0$  or  $p = q = r$
- D.  $p - q + r = 0$  or  $p = -q = -r$

[gate2015-cse-set3](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

[Answer](#)**6.6.10 System Of Equations: GATE CSE 2016 Set 2 | Question: 04** [top](#)<https://gateoverflow.in/39545>

Consider the system, each consisting of  $m$  linear equations in  $n$  variables.

- I. If  $m < n$ , then all such systems have a solution.
- II. If  $m > n$ , then none of these systems has a solution.
- III. If  $m = n$ , then there exists a system which has a solution.

Which one of the following is **CORRECT**?

- a. I, II and III are true.
- b. Only II and III are true.
- c. Only III is true.

- d. None of them is true.

[gate2016-cse-set2](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

Answer 

### 6.6.11 System Of Equations: GATE CSE 2017 Set 1 | Question: 3

 <https://gateoverflow.in/118282>



Let  $c_1, \dots, c_n$  be scalars, not all zero, such that  $\sum_{i=1}^n c_i a_i = 0$  where  $a_i$  are column vectors in  $R^n$ .

Consider the set of linear equations

$$Ax = b$$

where  $A = [a_1, \dots, a_n]$  and  $b = \sum_{i=1}^n c_i a_i$ . The set of equations has

- A. a unique solution at  $x = J_n$  where  $J_n$  denotes a  $n$ -dimensional vector of all 1.
- B. no solution
- C. infinitely many solutions
- D. finitely many solutions

[gate2017-cse-set1](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

Answer 

### 6.6.12 System Of Equations: GATE IT 2004 | Question: 6

 <https://gateoverflow.in/3647>



What values of x, y and z satisfy the following system of linear equations?

$$\begin{bmatrix} 1 & 2 & 3 \\ 1 & 3 & 4 \\ 2 & 2 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 8 \\ 12 \end{bmatrix}$$

- A.  $x = 6, y = 3, z = 2$
- B.  $x = 12, y = 3, z = -4$
- C.  $x = 6, y = 6, z = -4$
- D.  $x = 12, y = -3, z = 0$

[gate2004-it](#) [linear-algebra](#) [system-of-equations](#) [easy](#)

Answer 

## Answers: System Of Equations

### 6.6.1 System Of Equations: GATE CSE 1996 | Question: 1.7

 <https://gateoverflow.in/2711>



✓ Answer is C because it is a case of linear non-homogeneous equations. By having  $m = n$ , we can't say that it will have unique solution. Solution depends on rank of matrix A and matrix [A B].

If  $\text{rank}[A] = \text{rank}[A B]$ , then it will have solution, otherwise no solution

 26 votes

-- Vivek sharma (2.1k points)

### 6.6.2 System Of Equations: GATE CSE 1998 | Question: 1.2

 <https://gateoverflow.in/1639>



✓ There are no solutions.

If we multiply 1st equation by 4, we get

$$4x + 8y = 20$$

But 2nd equation says

$$4x + 8y = 12$$

Clearly, there can not be any pair of (x,y), which satisfies both equations.

Correct Answer: **B**

36 votes

-- Happy Mittal (8.2k points)

### 6.6.3 System Of Equations: GATE CSE 1998 | Question: 9 top ↴

☞ <https://gateoverflow.in/1723>



- ✓ Let  $A$  be a  $n \times n$  matrix and we want to solve the system of linear equations expressed by  $Ax = b$ .

We start with the augmented matrix  $[A : b]$  and follow the following steps.

- Step 1: Convert the augmented matrix to row echelon form
- Step 2: Convert pivot elements to 1 (leading coefficient of a non zero row) in the resulting matrix
- Step 3: Convert the resulting matrix to row reduced echelon form (equivalent to solve equations by backward substitutions)

Now let us analyze the number of operations performed in each step.

Step 1: It involves multiplying  $i^{th}$  row by a constant  $c_{ij}$  and subtracting from row  $j > i$  to produce 0 in  $ji$  position.

- For first row we have maximum  $n + 1$  non-zero elements and this requires  $(n + 1)(n - 1)$  operations (multiplication followed by subtraction/addition)
- For the second row we have maximum  $n$  non-zero elements and this requires  $n(n - 2)$  operations
- Likewise the last row will need  $3 \times 1$  operations.

Total number of multiplication followed by subtraction/addition operations in this step

$$= (n + 1)(n - 1) + n(n - 2) + (n - 1)(n - 3) + \dots + 3 \times 1 = \sum_{i=1}^n i \cdot (i + 2) = \sum_{i=1}^{n-1} i^2 + \sum_{i=1}^{n-1} 2i = \frac{(n - 1) \cdot n(2n - 1)}{6}$$

Step 2: To convert pivot elements to 1 we need to divide each non zero row of the matrix obtained after step 1 by the leading coefficient.

Total number of divisions =  $(n + 1) + n + (n - 1) + (n - 2) + \dots + 2 = n(n + 3)/2$

Step 3: It involves back substitutions such that all elements above the pivot elements are zero. To convert all elements to zero above the pivot of  $i^{th}$  row, we need  $2(n - i)$  number of multiplication followed by subtraction/addition operations.

Total number of multiplication followed by subtraction/addition operations in this step

$$= 2(1 + 2 + \dots + (n - 1)) = n(n - 1)$$

Hence, total number of multiplication followed by subtraction/addition operations required to solve a system of linear equations using Gaussian Elimination =  $n(n - 1)(2n + 5)/6 + n(n - 1) = n(n - 1)(2n + 11)/6$ .

2 votes

-- suraj (4.8k points)

### 6.6.4 System Of Equations: GATE CSE 2003 | Question: 41 top ↴

☞ <https://gateoverflow.in/932>



- ✓ Since the second and third columns of the coefficient matrix are linearly dependent, determine 0. So, the system of equations either has infinitely many solutions (if they are consistent) or no solution. To check for consistency, we apply reduction method on  $(A | B)$

$$R_2 \leftarrow R_2 - 2R_1, R_3 \leftarrow R_3 - 0.5R_1, R_3 \leftarrow R_3 - 1.5R_2, R_1 \leftarrow R_1/2$$

obtain the resultant matrix

$$\begin{pmatrix} 2 & 1 & -4 & \alpha \\ 4 & 3 & -12 & 5 \\ 1 & 2 & -8 & 7 \end{pmatrix} \rightarrow \begin{pmatrix} 1 & 0.5 & -2 & 0.5\alpha \\ 0 & 1 & -4 & 5 - 2\alpha \\ 0 & 0 & -0 & -0.5 + 2.5\alpha \end{pmatrix}$$

or infinitely many solutions, we must have  $-0.5 + 2.5\alpha = 0$  i.e.,  $\alpha = \frac{1}{5}$ . So, for only 1 value of  $\alpha$ , this system has infinitely many solutions. So, option (B) is correct.

22 votes

-- Keith Kr (4.6k points)

### 6.6.5 System Of Equations: GATE CSE 2004 | Question: 71 top ↴

☞ <https://gateoverflow.in/1065>



- ✓ answer = C

$$\text{rank} = r(A) = r(A|B) = 2$$

rank = total number of variables

Hence, unique solution

25 votes

-- Amar Vashishth (25.2k points)

### 6.6.6 System Of Equations: GATE CSE 2005 | Question: 48 top ↗

<https://gateoverflow.in/1173>



- ✓ rank of matrix = rank of augmented matrix = no of unknown = 3  
so unique solution..

Correct Answer: B

22 votes

-- Digvijay (44.9k points)

### 6.6.7 System Of Equations: GATE CSE 2008 | Question: 3 top ↗

<https://gateoverflow.in/401>



✓  $A \cdot X = B \implies \begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 1 & 4 & \alpha \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix}$

So,  $X = A^{-1}B$

$$A^{-1} = \frac{\text{adj}(A)}{\det(A)}$$

$\because [\text{adj}(A) = \text{Transpose}(\text{cofactor}(A)), \text{cofactor}(A) = (-1)^{i+j} \text{minor}(A)]$

$$\text{adj}(A) = \begin{bmatrix} 2\alpha - 12 & 8 - \alpha & -1 \\ 3 - \alpha & \alpha - 2 & -1 \\ 2 & -3 & 1 \end{bmatrix}$$

$$\det(A) = 2\alpha - 12 + 3 - \alpha + 4 = \alpha - 5$$

$$\text{Now, } A^{-1}B = \frac{1}{\alpha-5} \begin{bmatrix} 0 \\ \alpha - 5 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

So, the solution is independent of  $\alpha$  and any real value of  $\alpha$  would suffice. (This can be seen even by observing the equations carefully- each equation value is dependent only on  $x_2$ ). But a value of 5 would cause the determinant to be 0 and multiple solutions to the given equation. So, any real value except 5 should be the answer- none of the choices is correct.

Ref: [http://www.mathwords.com/i/inverse\\_of\\_a\\_matrix.htm](http://www.mathwords.com/i/inverse_of_a_matrix.htm)

#### References



32 votes

-- Arjun Suresh (328k points)

### 6.6.8 System Of Equations: GATE CSE 2014 Set 1 | Question: 4 top ↗

<https://gateoverflow.in/1757>



- ✓ Since, equation (2) - equation (1) produces equation (4), we have 3 independent equations in 3 variables, hence unique solution.

So, answer is 1.

36 votes

-- Happy Mittal (8.2k points)

### 6.6.9 System Of Equations: GATE CSE 2015 Set 3 | Question: 33 top ↗

<https://gateoverflow.in/8490>



- ✓ for non-trivial solution

$$|A| = 0$$

$$\text{where } |A| = \begin{bmatrix} p & q & r \\ q & r & p \\ r & p & q \end{bmatrix} = p * (rq - p^2) - q * (q^2 - pr) + r * (qp - r^2) \\ = prq - p^3 - q^3 + prq + prq - r^3 \\ = 3prq - p^3 - q^3 - r^3$$

$$= -(p+q+r)^3 + 3(p+q+r)(pq+qr+pr)$$

now if you check the options the only options where each individual condition can make  $|A| = 0$  zero is C.

35 votes

-- Tamojit Chatterjee (1.9k points)

#### 6.6.10 System Of Equations: GATE CSE 2016 Set 2 | Question: 04 top

<https://gateoverflow.in/39545>



- ✓ Correct answer => C)

why ?

I) This is false. Consider a system with  $m < n$ , which are inconsistent like

$$a + b + c = 2$$

$$a + b + c = 3$$

Here  $m < n$  but no solution because of inconsistency !

II)  $m > n$  but no solution for none of system => What if this system of equations have 2 equations which are dependent ?

$$\text{ex} => a + b = 2$$

$$2a + 2b = 4$$

$$a - b = 0$$

Then  $a = 1, b = 1$  is solutions . II) Is false.

III) this is true,  $M = 2, N = 2$

$$a + b = 2$$

$$a - b = 0$$

Then  $m = 1, n = 1$  Now there exists system which has solution . III) is correct. Answer is C !

52 votes

-- Akash Kanase (36k points)

#### 6.6.11 System Of Equations: GATE CSE 2017 Set 1 | Question: 3 top

<https://gateoverflow.in/118282>



- ✓  $\sum_i c_i a_i = 0$  with  $\exists i : c_i \neq 0$  indicates that column vectors of  $A$  are linearly dependent. Determinant of matrix  $A$  would be zero. Therefore either  $Ax = b$  has no solution or infinitely many solutions. From  $\sum_i a_i = b$ , it is clear that a  $n$ -dimensional vector of all 1 is a solution of equation  $Ax=b$ .

Hence,  $Ax = b$  will have infinitely many solutions. The correct answer is (C).

59 votes

-- suraj (4.8k points)

#### 6.6.12 System Of Equations: GATE IT 2004 | Question: 6 top

<https://gateoverflow.in/3647>



$$\checkmark \begin{bmatrix} 1 & 2 & 3 \\ 1 & 3 & 4 \\ 2 & 2 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 8 \\ 12 \end{bmatrix}$$

- $x + 2y + 3z = 6 \rightarrow (1)$
- $x + 3y + 4z = 8 \rightarrow (2)$
- $2x + 2y + 3z = 12 \rightarrow (3)$

Apply (3) - (1)

$$\implies x = 6$$

Put value of  $x$  in any of the 2 equations. Let's take (1) and (2)

- $2y + 3z = 0$

- $3y + 4z = 2$
- $\Rightarrow y = 6, z = -4$

Hence, Option(C)  $x = 6, y = 6, z = -4$ .

16 votes

-- Leen Sharma (28.6k points)

## 6.7

### Vector Space (5) top ↴

#### 6.7.1 Vector Space: GATE CSE 1995 | Question: 2.13 top ↴

<https://gateoverflow.in/2625>

A unit vector perpendicular to both the vectors  $a = 2i - 3j + k$  and  $b = i + j - 2k$  is:

- A.  $\frac{1}{\sqrt{3}}(i + j + k)$
- B.  $\frac{1}{3}(i + j - k)$
- C.  $\frac{1}{3}(i - j - k)$
- D.  $\frac{1}{\sqrt{3}}(i + j - k)$

[gate1995](#) [linear-algebra](#) [normal](#) [vector-space](#)

Answer

#### 6.7.2 Vector Space: GATE CSE 2007 | Question: 27 top ↴

<https://gateoverflow.in/1225>

Consider the set of (column) vectors defined by

$$X = \left\{ x \in R^3 \mid x_1 + x_2 + x_3 = 0, \text{ where } x^T = [x_1, x_2, x_3]^T \right\}$$

.Which of the following is TRUE?

- A.  $\left\{ [1, -1, 0]^T, [1, 0, -1]^T \right\}$  is a basis for the subspace  $X$ .
- B.  $\left\{ [1, -1, 0]^T, [1, 0, -1]^T \right\}$  is a linearly independent set, but it does not span  $X$  and therefore is not a basis of  $X$ .
- C.  $X$  is not a subspace of  $R^3$ .
- D. None of the above

[gate2007-cse](#) [linear-algebra](#) [normal](#) [vector-space](#)

Answer

#### 6.7.3 Vector Space: GATE CSE 2014 Set 3 | Question: 5 top ↴

<https://gateoverflow.in/2039>

If  $V_1$  and  $V_2$  are 4-dimensional subspaces of a 6-dimensional vector space  $V$ , then the smallest possible dimension of  $V_1 \cap V_2$  is \_\_\_\_\_.

[gate2014-cse-set3](#) [linear-algebra](#) [vector-space](#) [normal](#) [numerical-answers](#)

Answer

#### 6.7.4 Vector Space: GATE CSE 2017 Set 1 | Question: 30 top ↴

<https://gateoverflow.in/118311>

Let  $u$  and  $v$  be two vectors in  $R^2$  whose Euclidean norms satisfy  $\|u\| = 2\|v\|$ . What is the value of  $\alpha$  such that  $w = u + \alpha v$  bisects the angle between  $u$  and  $v$ ?

- A. 2
- B.  $\frac{1}{2}$
- C. 1
- D.  $\frac{-1}{2}$

[gate2017-cse-set1](#) [linear-algebra](#) [normal](#) [vector-space](#)

Answer

**6.7.5 Vector Space: GATE CSE 2021 Set 2 | Question: 38** [top](#)<https://gateoverflow.in/357502>

For a statement  $S$  in a program, in the context of liveness analysis, the following sets are defined:

$\text{USE}(S)$  : the set of variables used in  $S$

$\text{IN}(S)$  : the set of variables that are live at the entry of  $S$

$\text{OUT}(S)$  : the set of variables that are live at the exit of  $S$

Consider a basic block that consists of two statements,  $S_1$  followed by  $S_2$ . Which one of the following statements is correct?

- A.  $\text{OUT}(S_1) = \text{IN}(S_2)$
- B.  $\text{OUT}(S_1) = \text{IN}(S_1) \cup \text{USE}(S_1)$
- C.  $\text{OUT}(S_1) = \text{IN}(S_2) \cup \text{OUT}(S_2)$
- D.  $\text{OUT}(S_1) = \text{USE}(S_1) \cup \text{IN}(S_2)$

[gate2021-cse-set2](#) [linear-algebra](#) [vector-space](#)

Answer

**Answers: Vector Space****6.7.1 Vector Space: GATE CSE 1995 | Question: 2.13** [top](#)<https://gateoverflow.in/2625>

- ✓ The Cross Product of  $a$  and  $b$  is a unit vector perpendicular to both  $a$  and  $b$

The cross product of  $a = \langle a_1, a_2, a_3 \rangle$  and  $b = \langle b_1, b_2, b_3 \rangle$  is

$$a \times b = \begin{vmatrix} i & j & k \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$$

From question,  $a_1 = 2, a_2 = -3, a_3 = 1, b_1 = 1, b_2 = 1, b_3 = -2$

$$\begin{aligned} a \times b &= \begin{vmatrix} i & j & k \\ 2 & -3 & 1 \\ 1 & 1 & -2 \end{vmatrix} \\ &= i \begin{vmatrix} -3 & 1 \\ 1 & -2 \end{vmatrix} - j \begin{vmatrix} 2 & 1 \\ 1 & -2 \end{vmatrix} + k \begin{vmatrix} 2 & -3 \\ 1 & 1 \end{vmatrix} \\ &= 5i + 5j + 5k \end{aligned}$$

Hence the vector  $a \times b = 5i + 5j + 5k = \langle 5, 5, 5 \rangle$  is a vector perpendicular to  $a = 2i - 3j + k$  and  $b = i + j - 2k$

The unit length of the vector  $a \times b = \sqrt{5^2 + 5^2 + 5^2} = \sqrt{5 * 5 * 3} = 5\sqrt{3}$

∴ A unit vector perpendicular to both  $a = 2i - 3j + k$  and  $b = i + j - 2k$  is

$$\frac{\langle 5, 5, 5 \rangle}{5\sqrt{3}} = \frac{\langle 1, 1, 1 \rangle}{\sqrt{3}} = \frac{1}{\sqrt{3}}i + j + k$$

Hence Option A. is correct answer.

Reference :- <http://www.leadinglesson.com/problem-on-finding-a-vector-perpendicular-to-two-vectors>

**References**

8 votes

-- Satbir Singh (20,9k points)

**6.7.2 Vector Space: GATE CSE 2007 | Question: 27** [top](#)<https://gateoverflow.in/1225>

✓  $\begin{vmatrix} 1 & -1 & 0 \\ 1 & 0 & -1 \end{vmatrix} \neq 0$

Rank = 2 because size of largest square submatrix whose determinant value not equal to 0 is 2. i.e. Both are linearly independent vectors

Given,  $x_1 + x_2 + x_3 = 0 \implies x_3 = -(x_1 + x_2)$

$$A = \begin{vmatrix} 1 & -1 & 0 \\ 1 & 0 & -1 \\ x_1 & x_2 & -(x_1 + x_2) \end{vmatrix} = x_2 + 1(-x_1 - x_2) + x_1 = 0$$

which means  $\text{Rank}(A) \neq 3 \implies$  there exist at least one vector which is linearly dependent. We already know that  $[1 \ -1 \ 0]$  and  $[1 \ 0 \ -1]$  are linearly independent.

So, vector  $[x_1 \ x_2 \ x_3]$  where  $x_1 + x_2 + x_3 = 0$  is linearly dependent on  $[1 \ -1 \ 0]$  and  $[1 \ 0 \ -1]$

Since all vectors of form  $[x_1 \ x_2 \ x_3]$  where  $x_1 + x_2 + x_3 = 0$  is a linear combination of  $[1 \ -1 \ 0]$  and  $[1 \ 0 \ -1]$ , I can say that  $[1 \ -1 \ 0]$  and  $[1 \ 0 \ -1]$  is the basis of vector space,  $X$ .

So, (A) is TRUE.

### Subspace of a vector space

Any subset of a vector space(collection of vectors) is called as subspace iff

1. that subset contains zero vector
2. that subset is closed under scalar multiplication
3. that subset is closed under addition of any 2 vectors in that subset.

$X = [x_1 \ x_2 \ x_3]$  where  $x_1 + x_2 + x_3 = 0$

1.  $X$  contains zero vector  $[0 \ 0 \ 0]$  as  $0 + 0 + 0 = 0$

2. Let  $C$  be a scalar (any real number)

$C[x_1 \ x_2 \ x_3] = [Cx_1 \ Cx_2 \ Cx_3] \in X$  because  $Cx_1 + Cx_2 + Cx_3 = C(x_1 + x_2 + x_3) = C.0 = 0$ .

3. Let  $Y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} \in X$  where  $y_1 + y_2 + y_3 = 0$  and  $z = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \end{bmatrix} \in X$  where  $z_1 + z_2 + z_3 = 0$ .

$Y + Z = \begin{bmatrix} y_1 + z_1 \\ y_2 + z_2 \\ y_3 + z_3 \end{bmatrix} \in X$  as

$$\begin{aligned} &y_1 + z_1 + y_2 + z_2 + y_3 + z_3 \\ &= (y_1 + y_2 + y_3) + (z_1 + z_2 + z_3) = 0. \end{aligned}$$

So, clearly  $X$  is subspace of  $R^3$

So (A) is the answer.

27 votes

-- Vicky rix (7k points)

### 6.7.3 Vector Space: GATE CSE 2014 Set 3 | Question: 5 top ↴

→ <https://gateoverflow.in/2039>



- ✓ A 6-dimensional vector space  $\{a_1, a_2, a_3, a_4, a_5, a_6\}$

Let  $V_1$  be  $\{a_1, a_2, a_3, a_4\}$  and  $V_2$  be  $\{a_3, a_4, a_5, a_6\}$

$$V_1 \cap V_2 = \{a_3, a_4\}$$

This is the smallest possible dimension, which is 2.

The largest possible dimension will be 4, when  $V_1 = V_2$

54 votes

-- Srinath Jayachandran (2.9k points)

### 6.7.4 Vector Space: GATE CSE 2017 Set 1 | Question: 30 top ↴

→ <https://gateoverflow.in/118311>



- ✓ Angle between  $u$  and  $w$  = Angle between  $w$  and  $v$

$$\frac{\vec{u} \cdot \vec{w}}{\|u\| \|w\|} = \frac{\vec{w} \cdot \vec{v}}{\|w\| \|v\|}$$

$$\vec{u} \cdot \vec{w} = 2\vec{w} \cdot \vec{v}$$

$$(\alpha - 2)\vec{u} \cdot \vec{v} = 2(\alpha - 2)\|v\|^2$$

LHS and RHS would be equal for  $\alpha = 2$ . Hence, correct answer is (A).

23 votes

-- suraj (4.8k points)

### 6.7.5 Vector Space: GATE CSE 2021 Set 2 | Question: 38 top ↴



Only A is correct.

Reference: See [rule 1 on page 7](#).

#### References



1 votes

-- Nikhil Dhama (2.3k points)

## Answer Keys

6.1.1	A
6.2.5	D
6.3.4	C
6.3.9	0
6.3.14	B
6.3.19	5
6.3.24	A
6.4.4	D
6.4.9	D
6.4.14	B
6.4.19	C
6.5.2	A
6.6.4	B
6.6.9	C
6.7.2	A

6.2.1	B
6.2.6	A
6.3.5	A
6.3.10	6
6.3.15	15
6.3.20	3
6.3.25	B
6.4.5	N/A
6.4.10	B
6.4.15	D
6.4.20	D
6.5.3	4 : 4
6.6.5	C
6.6.10	C
6.7.3	2

6.2.2	A
6.3.1	B;D
6.3.6	D
6.3.11	A
6.3.16	0.125
6.3.21	D
6.4.1	C
6.4.6	N/A
6.4.11	A
6.4.16	D
6.4.21	B
6.6.1	C
6.6.6	B
6.6.11	C
6.7.4	A

6.2.3	A
6.3.2	N/A
6.3.7	A
6.3.12	D
6.3.17	B
6.3.22	12
6.4.2	N/A
6.4.7	A
6.4.12	C
6.4.17	5
6.4.22	D
6.6.2	B
6.6.7	X
6.6.12	C
6.7.5	A

6.2.4	0
6.3.3	B
6.3.8	D
6.3.13	6
6.3.18	2
6.3.23	3 : 3
6.4.3	N/A
6.4.8	C
6.4.13	C
6.4.18	0
6.5.1	C
6.6.3	N/A
6.6.8	1
6.7.1	A



**Syllabus:** Random variables, Uniform, Normal, Exponential, Poisson and Binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem

### Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
<b>1 Mark Count</b>	1	1	0	2	1	1	0	1	1	0	0.88	2
<b>2 Marks Count</b>	2	2	1	1	1	0	3	1	0	0	1.22	3
<b>Total Marks</b>	5	5	2	4	3	1	6	3	1	1	3.33	6

## 7.1

Binomial Distribution (7) [top ↴](#)7.1.1 Binomial Distribution: GATE CSE 2002 | Question: 2.16 [top ↴](#)<https://gateoverflow.in/846>

Four fair coins are tossed simultaneously. The probability that at least one head and one tail turn up is

- A.  $\frac{1}{16}$
- B.  $\frac{1}{8}$
- C.  $\frac{7}{8}$
- D.  $\frac{15}{16}$

[gate2002-cse](#) [probability](#) [easy](#) [binomial-distribution](#)

Answer [∅](#)

7.1.2 Binomial Distribution: GATE CSE 2005 | Question: 52 [top ↴](#)<https://gateoverflow.in/1177>

A random bit string of length  $n$  is constructed by tossing a fair coin  $n$  times and setting a bit to 0 or 1 depending on outcomes head and tail, respectively. The probability that two such randomly generated strings are not identical is:

- A.  $\frac{1}{2^n}$
- B.  $1 - \frac{1}{n}$
- C.  $\frac{1}{n!}$
- D.  $1 - \frac{1}{2^n}$

[gate2005-cse](#) [probability](#) [binomial-distribution](#) [easy](#)

Answer [∅](#)

7.1.3 Binomial Distribution: GATE CSE 2006 | Question: 21 [top ↴](#)<https://gateoverflow.in/982>

For each element in a set of size  $2n$ , an unbiased coin is tossed. The  $2n$  coin tosses are independent. An element is chosen if the corresponding coin toss was a head. The probability that exactly  $n$  elements are chosen is

- A.  $\frac{\frac{2n}{2}C_n}{4^n}$
- B.  $\frac{\frac{2n}{2}C_n}{2^n}$
- C.  $\frac{1}{\frac{2n}{2}C_n}$
- D.  $\frac{1}{2}$

[gate2006-cse](#) [probability](#) [binomial-distribution](#) [normal](#)

Answer [∅](#)

7.1.4 Binomial Distribution: GATE CSE 2011 | Question: 3 [top ↴](#)<https://gateoverflow.in/2105>

If two fair coins are flipped and at least one of the outcomes is known to be a head, what is the probability that both outcomes are heads?

- A.  $\left(\frac{1}{3}\right)$
- B.  $\left(\frac{1}{4}\right)$

- C.  $\left(\frac{1}{2}\right)$   
 D.  $\left(\frac{2}{3}\right)$

gate2011-cse probability easy binomial-distribution

Answer 

### 7.1.5 Binomial Distribution: GATE IT 2005 | Question: 32

 <https://gateoverflow.in/3778>



An unbiased coin is tossed repeatedly until the outcome of two successive tosses is the same. Assuming that the trials are independent, the expected number of tosses is

- A. 3  
 B. 4  
 C. 5  
 D. 6

gate2005-it probability binomial-distribution expectation normal

Answer 

### 7.1.6 Binomial Distribution: GATE IT 2006 | Question: 22

 <https://gateoverflow.in/3561>



When a coin is tossed, the probability of getting a Head is  $p$ ,  $0 < p < 1$ . Let  $N$  be the random variable denoting the number of tosses till the first Head appears, including the toss where the Head appears. Assuming that successive tosses are independent, the expected value of  $N$  is

- A.  $\frac{1}{p}$   
 B.  $\frac{1}{(1-p)}$   
 C.  $\frac{1}{p^2}$   
 D.  $\frac{1}{(1-p^2)}$

gate2006-it probability binomial-distribution expectation normal

Answer 

### 7.1.7 Binomial Distribution: GATE IT 2007 | Question: 1

 <https://gateoverflow.in/3432>



Suppose there are two coins. The first coin gives heads with probability  $\frac{5}{8}$  when tossed, while the second coin gives heads with probability  $\frac{1}{4}$ . One of the two coins is picked up at random with equal probability and tossed. What is the probability of obtaining heads?

- A.  $\left(\frac{7}{8}\right)$   
 B.  $\left(\frac{1}{2}\right)$   
 C.  $\left(\frac{7}{16}\right)$   
 D.  $\left(\frac{5}{32}\right)$

gate2007-it probability normal binomial-distribution

Answer 

## Answers: Binomial Distribution

**7.1.1 Binomial Distribution: GATE CSE 2002 | Question: 2.16** top ↗<https://gateoverflow.in/846>**✓ Answer - C**

$$\text{probability of getting all heads} = \frac{1}{16}$$

$$\text{probability of getting all tails} = \frac{1}{16}$$

$$\text{probability of getting at least one head and one tail} = 1 - \frac{1}{16} - \frac{1}{16} = \frac{7}{8}.$$

25 votes

-- Ankit Rokde (6.9k points)

**7.1.2 Binomial Distribution: GATE CSE 2005 | Question: 52** top ↗<https://gateoverflow.in/1177>**✓ Answer - D**

Suppose there are  $k$  places within  $n$  bit string where mismatch has occurred

Probability of this occurring is

$$\begin{aligned} {}^n C_k \cdot (\text{prob. of mismatch})^k \cdot (\text{prob. of match})^{(n-k)} \\ = {}^n C_k \left(\frac{1}{2}\right)^k \left(\frac{1}{2}\right)^{(n-k)} \\ = {}^n C_k \left(\frac{1}{2}\right)^n. \end{aligned}$$

$k$  can range from 1 to  $n$ , hence the required probability  $\sum ({}^n C_k \left(\frac{1}{2}\right)^n)$  where  $k$  ranges from 1 to  $n$

$$\text{is } \left(\frac{1}{2^n}\right) (2^n - 1).$$

**Alternatively**

Probability of matching at given place  $\frac{1}{2}$ .

there are  $n$  places hence probability of matching  $\frac{1}{2^n}$ .

hence probability of mismatch  $1 - \frac{1}{2^n}$ .

46 votes

-- Ankit Rokde (6.9k points)

**7.1.3 Binomial Distribution: GATE CSE 2006 | Question: 21** top ↗<https://gateoverflow.in/982>**✓ Answer - A**

Ways of getting  $n$  heads out of  $2n$  tries  $= {}^{2n} C_n$ .

$$\text{Probability of getting exactly } n\text{-heads and } n\text{-tails} = \left(\frac{1}{2^n}\right) \cdot \left(\frac{1}{2^n}\right)$$

$$\text{Number of ways} = \frac{{}^{2n} C_n}{4^n}.$$

31 votes

-- Ankit Rokde (6.9k points)

**7.1.4 Binomial Distribution: GATE CSE 2011 | Question: 3** top ↗<https://gateoverflow.in/2105>**✓ Answer - A**

$$\text{prob(at least one head)} = \frac{3}{4}$$

$$\text{prob(both heads)} = \frac{1}{4}$$

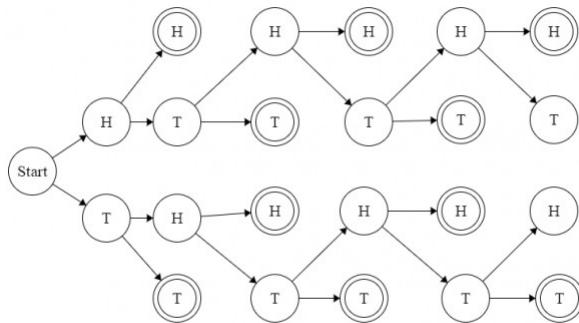
using bayes' theorem =  $\frac{\left(\frac{1}{4}\right)}{\left(\frac{3}{4}\right)} = \frac{1}{3}$ .

28 votes

-- Ankit Rokde (6.9k points)

### 7.1.5 Binomial Distribution: GATE IT 2005 | Question: 32 top

<https://gateoverflow.in/3778>



$$\text{Probability on each branch} = x = \frac{1}{2}$$

2nd toss onwards, each toss layer gives us two success. (i.e. HH event or TT event )

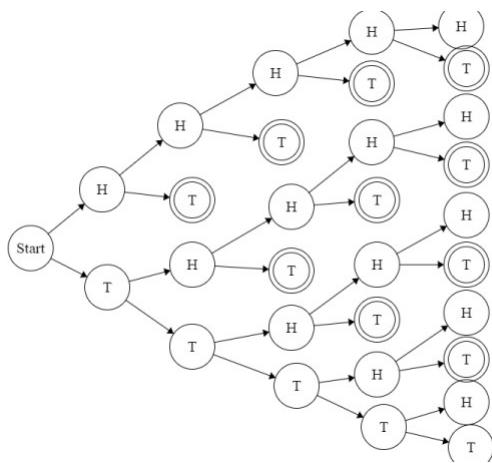
$$\begin{aligned} E &= \sum k \cdot p(k) \\ &= 2 \cdot (2x^2) + 3 \cdot (2x^3) + 4 \cdot (2x^4) + 5 \cdot (2x^5) + \dots \\ &= 2 \cdot [2x^2 + 3x^3 + 4x^4 + 5x^5 + \dots] \\ &= 2 \cdot \left[ \frac{x}{(1-x)^2} - x \right] \end{aligned}$$

$$\text{putting } x = \frac{1}{2} ;$$

$$\begin{aligned} &= 2 \cdot \left[ \frac{\frac{1}{2}}{\left(\frac{1}{2}\right)^2} - \frac{1}{2} \right] \\ &= 3 \end{aligned}$$

A very similar QS :

An unbiased coin is tossed repeatedly and outcomes are recorded. What is the expected no of toss to get HT ( one head and one tail consecutively) ?



Probability in each branch = 0.5. I double circled the satisfying toss events.

While observing the diagram I noticed that, from 2nd toss onward our required event starts showing up. Additionally,

1. in the 2nd toss (or the 3rd level) we have one satisfying case.
2. in the 3rd toss (or the 4th level) we have two satisfying case.
3. in the 4th toss (or the 5th level) we have three satisfying case.
4. in the 5th toss (or the 6th level) we have four satisfying case.
5. etc.

i.e. in the  $k$ th toss we would have  $(k - 1)$  satisfying case.

So,

$$\begin{aligned} E(x) &= \sum_{k=2}^{\infty} k \cdot P(k) \\ &= \sum_{k=2}^{\infty} k \cdot \{(k-1) * (0.5)^k\} \\ &= \sum_{k=2}^{\infty} \{(k^2 - k) * (0.5)^k\} \end{aligned}$$

Using geometric series identity : [https://en.wikipedia.org/wiki/Geometric\\_series#Geometric\\_power\\_series](https://en.wikipedia.org/wiki/Geometric_series#Geometric_power_series)

$$\sum_{k=2}^{\infty} k(k-1)x^{k-2} = \frac{2}{(1-x)^3} \quad \text{for } x$$

In our case :  $x = 0.5$  So,

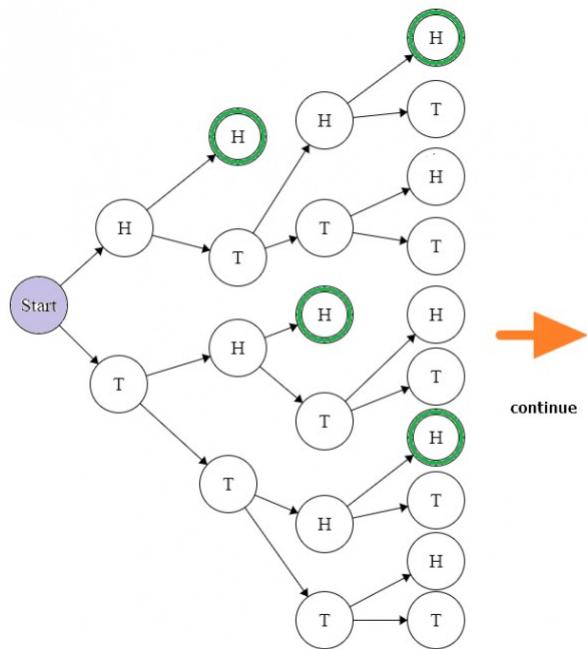
$$E = \sum_{k=2}^{\infty} k(k-1)x^k = x^2 \sum_{k=2}^{\infty} k(k-1)x^{k-2} = x^2 \cdot \frac{2}{(1-x)^3}$$

putting  $x = \frac{1}{2}$  ; we get  $E = 4$

More example:

For consecutive two heads ; HH

By drawing the tree diagram we can find the following series :



$$E = \sum k \cdot P(k) \\ = 2.(1.x^2) + 3.(1.x^3) + 4.(2.x^4) + 5.(3.x^5) + 6.(5.x^6) + 7.(8.x^7) + \dots \infty$$

Above series is a nice combination of AP , generating function and Fibonacci numbers !!!!

- AP terms can be handled by integration or differentiation
- Fibanacci Generating function is  $\frac{1}{1 - x - x^2}$

$$\Rightarrow \frac{E}{x} = 2.(1.x^1) + 3.(1.x^2) + 4.(2.x^3) + 5.(3.x^4) + 6.(5.x^5) + 7.(8.x^6) + \dots \infty \\ \Rightarrow \int \frac{E}{x} \cdot dx = 1.x^2 + 1.x^3 + 2.x^4 + 3.x^5 + 5.x^6 + \dots \infty \\ \Rightarrow \int \frac{E}{x} \cdot dx = x^2 \cdot (1.x^0 + 1.x^1 + 2.x^2 + 3.x^3 + 5.x^4 + \dots \infty) \\ \Rightarrow \int \frac{E}{x} \cdot dx = \frac{x^2}{1 - x - x^2} \\ \Rightarrow \frac{E}{x} = \frac{d}{dx} \left[ \frac{x^2}{1 - x - x^2} \right] \\ \Rightarrow \frac{E}{x} = \frac{2x(1 - x - x^2) + (1 + 2x)x^2}{(1 - x - x^2)^2} \\ \Rightarrow E = x \cdot \left\{ \frac{2x(1 - x - x^2) + (1 + 2x)x^2}{(1 - x - x^2)^2} \right\} \\ \Rightarrow E = \frac{1}{2} \cdot \left\{ \frac{2 \cdot \frac{1}{2}(1 - \frac{1}{2} - \frac{1}{4}) + (1 + 2 \cdot \frac{1}{2}) \cdot \frac{1}{4}}{(1 - \frac{1}{2} - \frac{1}{4})^2} \right\} \\ \Rightarrow E = 6$$

Infact 2nd QS on HT can also be done in the above way using integration.

Correct Answer: A

#### References



78 votes

-- Debashish Deka (40.7k points)

**Answer is (A)**

$$E(X) = \sum X_i \times P_i$$

Where  $X$ =no of tosses when you get successive HEAD/TAIL(only one is possible at a time though).

$P_i$ =Probability that you get in  $X_i$  tosses.

Now see solution:

You need atleast 2 tosses to get 2 heads/tails. Now see if you throw twice probability to get 2 heads/tails is  $\frac{1}{2}$  out of 4 outcomes  $[HT, HH, TH, TT]$ .

Similarly if you get result in 3rd toss that means you did not get in 2nd toss so favourable cases for this can be  $THH$  and  $HTT$  only out of total 8 outcomes. So probability is  $\frac{2}{8} = \frac{1}{2^2}$ .

To generalize ,you can see that in every case you will have only two favourable cases and  $2^n$  sample space. So for n th throw probability is  $\frac{1}{(2^{n-1})}$ .

$$\text{Now coming to } E(X) = 2 \times \frac{1}{2} + 3 \times \frac{1}{4} + 4 \times \frac{1}{8} + \dots \text{ till infinity.}$$

See this is combined AP-GP, So multiplying E(X) by  $\frac{1}{2}$  and subtracting from E(X).

$$E(X) = 2 \times \frac{1}{2} + 3 \times \frac{1}{4} + 4 \times \frac{1}{8} + \dots$$

$$0.5 \times E(X) = 2 \times \frac{1}{4} + 3 \times \frac{1}{8} + \dots$$

$$\text{subtracting, we get } \frac{1}{2} \times E(X) = 1 + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots$$

$$0.5 \times E(X) = 1 + \left(\frac{1}{4}\right) \div (1 - 0.5) = 1 + \frac{1}{2} = \frac{3}{2} \quad \left(\frac{a}{1-r}\right)$$

$$E(x) = 3.$$

88 votes

-- Sandeep\_Uniyal (6.5k points)



#### 7.1.6 Binomial Distribution: GATE IT 2006 | Question: 22 top

<https://gateoverflow.in/3561>

✓  $E = 1 \times p + 2 \times (1-p)p + 3 \times (1-p)(1-p)p + \dots$

multiply both side with  $(1 - p)$  and subtract:

$$E - (1 - p)E = 1 \times p + (1 - p)p + (1 - p)(1 - p)p + \dots$$

$$= p / (1 - (1 - p)) = 1 \text{ (because it is now forming a GP)}$$

$$\Rightarrow (1 - 1 + p)E = 1$$

$$\Rightarrow E = 1/p$$

So, option (A).

40 votes

-- Vicky Bajoria (4.1k points)



#### 7.1.7 Binomial Distribution: GATE IT 2007 | Question: 1 top

<https://gateoverflow.in/3432>

✓ **Answer is C**  $\frac{7}{16}$

Probability of obtaining head= Probability of picking first coin  $\times$  Probability of getting head on first coin  
+Probability of picking second coin  $\times$  Probability of getting head on second coin

$$= \left(\frac{1}{2} \times \frac{5}{8}\right) + \left(\frac{1}{2} \times \frac{1}{4}\right) = \frac{7}{16}.$$

21 votes

-- Prateeksha Keshari (1.7k points)

## 7.2

## Conditional Probability (12)

## 7.2.1 Conditional Probability: GATE CSE 1994 | Question: 1.4, ISRO2017-2

<https://gateoverflow.in/2441>

Let  $A$  and  $B$  be any two arbitrary events, then, which one of the following is TRUE?

- A.  $P(A \cap B) = P(A)P(B)$
- B.  $P(A \cup B) = P(A) + P(B)$
- C.  $P(A | B) = P(A \cap B)P(B)$
- D.  $P(A \cup B) \leq P(A) + P(B)$

[gate1994](#) [probability](#) [conditional-probability](#) [normal](#) [isro2017](#)

Answer

## 7.2.2 Conditional Probability: GATE CSE 1994 | Question: 2.6

<https://gateoverflow.in/2473>

The probability of an event  $B$  is  $P_1$ . The probability that events  $A$  and  $B$  occur together is  $P_2$  while the probability that  $A$  and  $\bar{B}$  occur together is  $P_3$ . The probability of the event  $A$  in terms of  $P_1$ ,  $P_2$  and  $P_3$  is \_\_\_\_\_

[gate1994](#) [probability](#) [normal](#) [conditional-probability](#) [fill-in-the-blanks](#)

Answer

## 7.2.3 Conditional Probability: GATE CSE 2003 | Question: 3

<https://gateoverflow.in/894>

Let  $P(E)$  denote the probability of the event  $E$ . Given  $P(A) = 1$ ,  $P(B) = \frac{1}{2}$ , the values of  $P(A | B)$  and  $P(B | A)$  respectively are

- A.  $\left(\frac{1}{4}, \frac{1}{2}\right)$
- B.  $\left(\frac{1}{2}, \frac{1}{4}\right)$
- C.  $\left(\frac{1}{2}, 1\right)$
- D.  $1, \left(\frac{1}{2}\right)$

[gate2003-cse](#) [probability](#) [easy](#) [conditional-probability](#)

Answer

## 7.2.4 Conditional Probability: GATE CSE 2005 | Question: 51

<https://gateoverflow.in/1176>

Box  $P$  has 2 red balls and 3 blue balls and box  $Q$  has 3 red balls and 1 blue ball. A ball is selected as follows: (i) select a box (ii) choose a ball from the selected box such that each ball in the box is equally likely to be chosen. The probabilities of selecting boxes  $P$  and  $Q$  are  $\frac{1}{3}$  and  $\frac{2}{3}$  respectively. Given that a ball selected in the above process is a red ball, the probability that it came from the box  $P$  is:

- A.  $\frac{4}{19}$
- B.  $\frac{5}{19}$
- C.  $\frac{2}{9}$
- D.  $\frac{19}{30}$

[gate2005-cse](#) [probability](#) [conditional-probability](#) [normal](#)

Answer

**7.2.5 Conditional Probability: GATE CSE 2008 | Question: 27** [top](#)<https://gateoverflow.in/425>

Aishwarya studies either computer science or mathematics everyday. If she studies computer science on a day, then the probability that she studies mathematics the next day is 0.6. If she studies mathematics on a day, then the probability that she studies computer science the next day is 0.4. Given that Aishwarya studies computer science on Monday, what is the probability that she studies computer science on Wednesday?

- A. 0.24
- B. 0.36
- C. 0.4
- D. 0.6

[gate2008-cse](#) [probability](#) [normal](#) [conditional-probability](#)

Answer 

**7.2.6 Conditional Probability: GATE CSE 2009 | Question: 21** [top](#)<https://gateoverflow.in/798>

An unbalanced dice (with 6 faces, numbered from 1 to 6) is thrown. The probability that the face value is odd is 90% of the probability that the face value is even. The probability of getting any even numbered face is the same. If the probability that the face is even given that it is greater than 3 is 0.75, which one of the following options is closest to the probability that the face value exceeds 3?

- A. 0.453
- B. 0.468
- C. 0.485
- D. 0.492

[gate2009-cse](#) [probability](#) [normal](#) [conditional-probability](#)

Answer 

**7.2.7 Conditional Probability: GATE CSE 2012 | Question: 33** [top](#)<https://gateoverflow.in/1751>

Suppose a fair six-sided die is rolled once. If the value on the die is 1, 2, or 3, the die is rolled a second time. What is the probability that the sum total of values that turn up is at least 6 ?

- A.  $\frac{10}{21}$
- B.  $\frac{5}{12}$
- C.  $\frac{2}{3}$
- D.  $\frac{1}{6}$

[gate2012-cse](#) [probability](#) [conditional-probability](#) [normal](#)

Answer 

**7.2.8 Conditional Probability: GATE CSE 2016 Set 2 | Question: 05** [top](#)<https://gateoverflow.in/39541>

Suppose that a shop has an equal number of LED bulbs of two different types. The probability of an LED bulb lasting more than 100 hours given that it is of Type 1 is 0.7, and given that it is of Type 2 is 0.4. The probability that an LED bulb chosen uniformly at random lasts more than 100 hours is \_\_\_\_\_.

[gate2016-cse-set2](#) [probability](#) [conditional-probability](#) [normal](#) [numerical-answers](#)

Answer 

**7.2.9 Conditional Probability: GATE CSE 2017 Set 2 | Question: 26** [top](#)<https://gateoverflow.in/118368>

$P$  and  $Q$  are considering to apply for a job. The probability that  $P$  applies for the job is  $\frac{1}{4}$ , the probability that  $P$  applies for the job given that  $Q$  applies for the job is  $\frac{1}{2}$ , and the probability that  $Q$  applies for the job given that  $P$  applies for the job is  $\frac{1}{3}$ . Then the probability that  $P$  does not apply for the job given that  $Q$  does not apply for this job is

- A.  $\left(\frac{4}{5}\right)$
- B.  $\left(\frac{5}{6}\right)$
- C.  $\left(\frac{7}{8}\right)$
- D.  $\left(\frac{11}{12}\right)$

[gate2017-cse-set2](#) [probability](#) [conditional-probability](#)

Answer 

#### 7.2.10 Conditional Probability: GATE CSE 2018 | Question: 44 [top](#)

<https://gateoverflow.in/204119>



Consider Guwahati, (G) and Delhi (D) whose temperatures can be classified as high ( $H$ ), medium ( $M$ ) and low ( $L$ ). Let  $P(H_G)$  denote the probability that Guwahati has high temperature. Similarly,  $P(M_G)$  and  $P(L_G)$  denotes the probability of Guwahati having medium and low temperatures respectively. Similarly, we use  $P(H_D)$ ,  $P(M_D)$  and  $P(L_D)$  for Delhi.

The following table gives the conditional probabilities for Delhi's temperature given Guwahati's temperature.

	$H_D$	$M_D$	$L_D$
$H_G$	0.40	0.48	0.12
$M_G$	0.10	0.65	0.25
$L_G$	0.01	0.50	0.49

Consider the first row in the table above. The first entry denotes that if Guwahati has high temperature ( $H_G$ ) then the probability of Delhi also having a high temperature ( $H_D$ ) is 0.40; i.e.,  $P(H_D | H_G) = 0.40$ . Similarly, the next two entries are  $P(M_D | H_G) = 0.48$  and  $P(L_D | H_G) = 0.12$ . Similarly for the other rows.

If it is known that  $P(H_G) = 0.2$ ,  $P(M_G) = 0.5$ , and  $P(L_G) = 0.3$ , then the probability (correct to two decimal places) that Guwahati has high temperature given that Delhi has high temperature is \_\_\_\_\_

[gate2018-cse](#) [probability](#) [conditional-probability](#) [numerical-answers](#)

Answer 

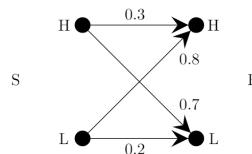
#### 7.2.11 Conditional Probability: GATE CSE 2021 Set 1 | Question: 54 [top](#)

<https://gateoverflow.in/357396>



A sender (S) transmits a signal, which can be one of the two kinds:  $H$  and  $L$  with probabilities 0.1 and 0.9 respectively, to a receiver (R).

In the graph below, the weight of edge  $(u, v)$  is the probability of receiving  $v$  when  $u$  is transmitted, where  $u, v \in \{H, L\}$ . For example, the probability that the received signal is  $L$  given the transmitted signal was  $H$ , is 0.7.



If the received signal is  $H$ , the probability that the transmitted signal was  $H$  (rounded to 2 decimal places) is \_\_\_\_\_.

[gate2021-cse-set1](#) [probability](#) [conditional-probability](#) [numerical-answers](#)

Answer 

#### 7.2.12 Conditional Probability: GATE IT 2006 | Question: 1 [top](#)

<https://gateoverflow.in/3538>



In a certain town, the probability that it will rain in the afternoon is known to be 0.6. Moreover, meteorological data indicates that if the temperature at noon is less than or equal to  $25^\circ C$ , the probability that it will rain in the afternoon is 0.4. The temperature at noon is equally likely to be above  $25^\circ C$ , or at/below  $25^\circ C$ . What is the probability that it will rain in the afternoon on a day when the temperature at noon is above  $25^\circ C$ ?

- A. 0.4
- B. 0.6
- C. 0.8
- D. 0.9

gate2006-it probability normal conditional-probability

Answer 

### Answers: Conditional Probability

#### 7.2.1 Conditional Probability: GATE CSE 1994 | Question: 1.4, ISRO2017-2

 <https://gateoverflow.in/2441>



- ✓
- A. Is true only if events are independent.
  - B. Is true only if events are mutually exclusive i.e.  $P(A \cap B) = 0$
  - C. Is false everywhere.
  - D. Is always true as  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Since,  $P(A \cap B) \geq 0$ ,  $P(A \cup B) \leq P(A) + P(B)$

Correct Answer: D.

 40 votes

-- Happy Mittal (8.2k points)

#### 7.2.2 Conditional Probability: GATE CSE 1994 | Question: 2.6

 <https://gateoverflow.in/2473>



✓  $P(A \cap B') = P(A) - P(A \cap B)$

$$\implies P(A) = P_2 + P_3$$

 25 votes

-- Saumya Bhattacharya (775 points)

#### 7.2.3 Conditional Probability: GATE CSE 2003 | Question: 3

 <https://gateoverflow.in/894>



- ✓ It immediately follows from the monotonicity property that,  
 $0 \leq P(E) \leq 1$ ,

Probability of at least one means union of the probability of events, i.e.,  
 $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

here,  $P(A \cup B) = 1$ , because it can not be more than 1 and if at least one of the event has probability 1 (here,  $P(A) = 1$ ), then union of both should be 1.

So,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$1 = 1 + \frac{1}{2} - P(A \cap B),$$

$$P(A \cap B) = \frac{1}{2},$$

Now,

$$P(A | B) = \frac{P(A \cap B)}{P(B)} = \frac{\left(\frac{1}{2}\right)}{\left(\frac{1}{2}\right)} = 1,$$

$$P(B | A) = \frac{P(A \cap B)}{P(A)} = \frac{\left(\frac{1}{2}\right)}{1} = \frac{1}{2}.$$

Hence, option is (D).

**NOTE :- if at least one of the two events has probability 1, then both events should be independent but vice versa is not true.**

 39 votes

-- Mithlesh Upadhyay (4.3k points)

### 7.2.4 Conditional Probability: GATE CSE 2005 | Question: 51 top ↗

<https://gateoverflow.in/1176>



- ✓ The probability of selecting a red ball,

$$= \left(\frac{1}{3}\right) * \left(\frac{2}{5}\right) + \left(\frac{2}{3}\right) * \left(\frac{3}{4}\right)$$

$$= \frac{2}{15} + \frac{1}{2} = \frac{19}{30}$$

Probability of selecting a red ball from box,

$$P = \left(\frac{1}{3}\right) * \left(\frac{2}{5}\right) = \frac{2}{15}$$

Given that a ball selected in the above process is a red ball, the probability that it came from the box  $P$  is  $= \left(\frac{2}{15} \div \frac{19}{30}\right) = \frac{4}{19}$

Correct Answer: A

20 votes

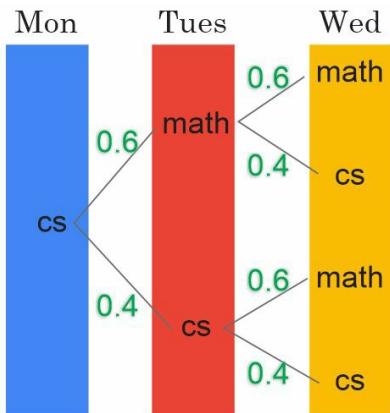
-- akash (799 points)

### 7.2.5 Conditional Probability: GATE CSE 2008 | Question: 27 top ↗

<https://gateoverflow.in/425>



- ✓ on Wednesday we want cs



$$\text{required probability} = 0.6 \times 0.4 + 0.4 \times 0.4 = 0.4$$

answer = option C

63 votes

-- Amar Vashishth (25.2k points)

### 7.2.6 Conditional Probability: GATE CSE 2009 | Question: 21 top ↗

<https://gateoverflow.in/798>



$$\checkmark P_{odd} + P_{even} = 0.9x + x = 1 \Rightarrow x = \frac{1}{1.9}, i.e. P_{even} = \frac{1}{1.9}$$

$$P(\underline{\text{even}}_{>3}) = \frac{P(\text{even})P(\underline{\text{even}}_{>3})}{P(>3)}$$

$$0.75 = \frac{\frac{1}{1.9} * \frac{2}{3}}{P(>3)}$$

$$\Rightarrow P(>3) = 0.468$$

5 votes

-- reboot (1.4k points)

### 7.2.7 Conditional Probability: GATE CSE 2012 | Question: 33 top ↗

<https://gateoverflow.in/1751>



- ✓ Here our sample space consists of  $3 + 3 \times 6 = 21$  events- (4), (5), (6), (1, 1), (1, 2) ... (3, 6).

Favorable cases = (6), (1, 5), (1, 6), (2, 4), (2, 5), (2, 6), (3, 3), (3, 4), (3, 5), (3, 6).

$$\text{Required Probability} = \frac{\text{No. of favorable cases}}{\text{Total cases}} = \frac{10}{21}$$

But this is wrong way of doing. Because due to 2 tosses for some and 1 for some, individual probabilities are not the same. i.e., while (6) has  $\frac{1}{6}$  probability of occurrence, (1, 5) has only  $\frac{1}{36}$  probability. So, our required probability

$$\Rightarrow \frac{1}{6} + \left( 9 \times \frac{1}{36} \right) = \frac{5}{12}.$$

Correct Answer: **B**

128 votes

-- Arjun Suresh (328k points)

#### 7.2.8 Conditional Probability: GATE CSE 2016 Set 2 | Question: 05 top ↴



- ✓ Given that the shop has an equal number of LED bulbs of two different types. Therefore,

Probability of Taking Type 1 Bulb = 0.5

Probability of Taking Type 2 Bulb = 0.5

The probability of an LED bulb lasting more than 100 hours given that it is of Type 1 is 0.7, and given that it is of Type 2 is 0.4. i.e.,

$$Prob(100+ | Type1) = 0.7$$

$$Prob(100+ | Type2) = 0.4$$

$$Prob(100+) = Prob(100+ | Type1) \times Prob(Type1) + Prob(100+ | Type2) \times Prob(Type2)$$

$$= 0.7 \times 0.5 + 0.4 \times 0.5 = 0.55.$$

48 votes

-- Akash Kanase (36k points)

#### 7.2.9 Conditional Probability: GATE CSE 2017 Set 2 | Question: 26 top ↴



- ✓ Let,

$P = P$  applies for the job

$Q = Q$  applies for the job

$$P(P) = \frac{1}{4} \rightarrow (1)$$

$$P(P | Q) = \frac{1}{2} \rightarrow (2)$$

$$P(Q | P) = \frac{1}{3} \rightarrow (3)$$

Now, we need to find  $P(P' | Q')$

From (2)

$$P(P | Q) = \frac{P(P \cap Q)}{P(Q)} = \frac{1}{2} \rightarrow (4)$$

From (1) and (3),

$$P(Q | P) = \frac{P(P \cap Q)}{P(P)} = \frac{P(P \cap Q)}{\frac{1}{4}} = \frac{1}{3}$$

$$\therefore P(P \cap Q) = \frac{1}{12} \rightarrow (5)$$

From (4) and (5),

$$P(Q) = \frac{1}{6} \rightarrow (6)$$

$$\text{Now, } P(P' | Q') = \frac{P(P' \cap Q')}{P(Q')} \rightarrow (7)$$

From (6)

$$P(Q') = 1 - 1/6 = 5/6 \rightarrow (8)$$

$$\begin{aligned}
 \text{Also, } P(P' \cap Q') &= 1 - [P(P \cup Q)] \\
 &= 1 - [P(P) + P(Q) - P(P \cap Q)] \\
 &= 1 - [1/4 + 1/6 - 1/12] \\
 &= 1 - [1/3] \\
 &= 2/3 \rightarrow (9)
 \end{aligned}$$

Hence, from (7), (8) and (9)

$$P(P' | Q') = \frac{\frac{2}{3}}{\frac{5}{6}} = \frac{4}{5}.$$

Correct Answer: A

60 votes

-- Sushant Gokhale (12.8k points)

### 7.2.10 Conditional Probability: GATE CSE 2018 | Question: 44 top ↗



$$\begin{aligned}
 \checkmark \quad P(H_G | H_D) &= \frac{P(H_G \wedge H_D)}{P(H_D)} = P(H_D | H_G) \times \frac{P(H_G)}{P(H_D)} \\
 &= 0.40 \times 0.2 \times \frac{1}{P(H_D)}.
 \end{aligned}$$

$$\begin{aligned}
 P(H_D) &= P(H_D | H_G) \cdot P(H_G) + P(H_D | M_G) \cdot P(M_G) + P(H_D | L_G) \cdot P(L_G) \\
 &= 0.4 \times 0.2 + 0.1 \times 0.5 + 0.01 \times 0.3 = 0.133 \\
 \therefore P(H_G | H_D) &= 0.40 \times 0.2 \times \frac{1}{0.133} = \frac{0.08}{0.133} = 0.6015
 \end{aligned}$$

Ref: [https://en.wikipedia.org/wiki/Bayes%27\\_theorem](https://en.wikipedia.org/wiki/Bayes%27_theorem)

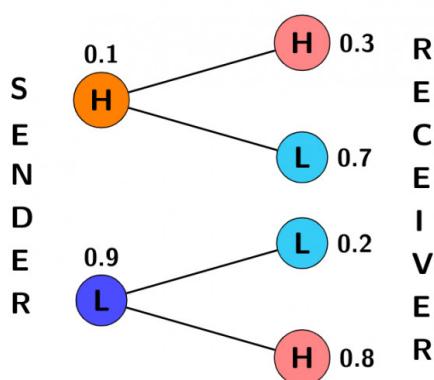
References



35 votes

-- Arjun Suresh (328k points)

### 7.2.11 Conditional Probability: GATE CSE 2021 Set 1 | Question: 54 top ↗



Given that:

$$P(H_s) = 0.1, P(L_s) = 0.9$$

From the diagram we get,

$$P(H_r | H_s) = 0.3, \quad P(L_r | H_s) = 0.7,$$

$$P(H_r | L_s) = 0.8, \quad P(L_r | L_s) = 0.2$$

We have to find:  $P(H_s | H_r)$

By Bayes theorem,

Probability of sending signal 'H' given that signal received is 'H',

$$\begin{aligned}
 P(H_s | H_r) &= \frac{P(H_s \cap H_r)}{P(H_r)} \\
 &= \frac{P(H_r | H_s) \cdot P(H_s)}{P(H_r | H_s) \cdot P(H_s) + P(H_r | L_s) \cdot P(L_s)}
 \end{aligned}$$

$$= \frac{0.3 \times 0.1}{0.3 \times 0.1 + 0.8 \times 0.9} = 0.04$$

4 votes

-- Divyanshu Shukla (2.63 points)

**7.2.12 Conditional Probability: GATE IT 2006 | Question: 1** <https://gateoverflow.in/3538>**✓ Answer is C) 0.8** $P(\text{rain in afternoon}) = 0.5 \times P(\text{rain when temp} \leq 25) + 0.5 \times P(\text{rain when temp} > 25)$ 

$0.6 = 0.5 \times 0.4 + 0.5 \times P(\text{rain when temp} > 25)$

so,

$P(\text{rain when temp} > 25) = 0.8$

(Answer courtesy- Pradeep Pandey sir - <https://gateetude.wordpress.com/category/gate-computer-science/information-technology-solutions/>)

44 votes

-- Prateeksha Keshari (1.7k points)

**7.3****Continuous Distribution (1)** **7.3.1 Continuous Distribution: GATE CSE 2016 Set 1 | Question: 04** <https://gateoverflow.in/39661>A probability density function on the interval  $[a, 1]$  is given by  $1/x^2$  and outside this interval the value of the function is zero. The value of  $a$  is \_\_\_\_\_.[gate2016-cse-set1](#) [probability](#) [normal](#) [numerical-answers](#) [continuous-distribution](#)

Answer

**Answers: Continuous Distribution****7.3.1 Continuous Distribution: GATE CSE 2016 Set 1 | Question: 04** <https://gateoverflow.in/39661>**✓ We know that the sum of all the probabilities is 1**Therefore, on integrating  $\frac{1}{x^2}$  with limits  $a$  to 1, the result should be 1.

Hence,  $\int_a^1 \frac{1}{x^2} dx = 1$

$$\left[ -\frac{1}{x} \right]_a^1 = 1$$

$$-1 + \frac{1}{a} = 1$$

Hence,  $a = 0.5$ 

53 votes

-- ryan sequeira (3k points)

**7.4****Expectation (7)** **7.4.1 Expectation: GATE CSE 1999 | Question: 1.1** <https://gateoverflow.in/1455>Suppose that the expectation of a random variable  $X$  is 5. Which of the following statements is true?

- A. There is a sample point at which  $X$  has the value 5.
- B. There is a sample point at which  $X$  has value greater than 5.
- C. There is a sample point at which  $X$  has a value greater than or equal to 5.
- D. None of the above.

[gate1999](#) [probability](#) [expectation](#) [easy](#)

Answer

**7.4.2 Expectation: GATE CSE 2004 | Question: 74** <https://gateoverflow.in/1068>An examination paper has 150 multiple choice questions of one mark each, with each question having four choices. Each incorrect answer fetches  $-0.25$  marks. Suppose 1000 students choose all their answers randomly with uniform probability. The sum total of the expected marks obtained by all these students is

- A. 0
- B. 2550

- C. 7525  
D. 9375

gate2004-cse probability expectation normal

Answer 

#### 7.4.3 Expectation: GATE CSE 2006 | Question: 18

<https://gateoverflow.in/979>



We are given a set  $X = \{X_1, \dots, X_n\}$  where  $X_i = 2^i$ . A sample  $S \subseteq X$  is drawn by selecting each  $X_i$  independently with probability  $P_i = \frac{1}{2}$ . The expected value of the smallest number in sample  $S$  is:

- A.  $(\frac{1}{n})$   
B. 2  
C.  $\sqrt{n}$   
D.  $n$

gate2006-cse probability expectation normal

Answer 

#### 7.4.4 Expectation: GATE CSE 2011 | Question: 18

<https://gateoverflow.in/2120>



If the difference between the expectation of the square of a random variable ( $E[X^2]$ ) and the square of the expectation of the random variable ( $E[X]^2$ ) is denoted by  $R$ , then

- A.  $R = 0$   
B.  $R < 0$   
C.  $R \geq 0$   
D.  $R > 0$

gate2011-cse probability random-variable expectation normal

Answer 

#### 7.4.5 Expectation: GATE CSE 2013 | Question: 24

<https://gateoverflow.in/1535>



Consider an undirected random graph of eight vertices. The probability that there is an edge between a pair of vertices is  $\frac{1}{2}$ . What is the expected number of unordered cycles of length three?

- A.  $\frac{1}{8}$   
B. 1  
C. 7  
D. 8

gate2013-cse probability expectation normal

Answer 

#### 7.4.6 Expectation: GATE CSE 2014 Set 2 | Question: 2

<https://gateoverflow.in/1954>



Each of the nine words in the sentence "The quick brown fox jumps over the lazy dog" is written on a separate piece of paper. These nine pieces of paper are kept in a box. One of the pieces is drawn at random from the box. The expected length of the word drawn is \_\_\_\_\_. (The answer should be rounded to one decimal place.)

gate2014-cse-set2 probability expectation numerical-answers easy

Answer 

#### 7.4.7 Expectation: GATE CSE 2021 Set 2 | Question: 29

<https://gateoverflow.in/357511>



In an examination, a student can choose the order in which two questions ( QuesA and QuesB) must be attempted.

- If the first question is answered wrong, the student gets zero marks.
- If the first question is answered correctly and the second question is not answered correctly, the student gets the marks only

for the first question.

- If both the questions are answered correctly, the student gets the sum of the marks of the two questions.

The following table shows the probability of correctly answering a question and the marks of the question respectively.

question	probabilty of answering correctly	marks
QuesA	0.8	10
QuesB	0.5	20

Assuming that the student always wants to maximize her expected marks in the examination, in which order should she attempt the questions and what is the expected marks for that order (assume that the questions are independent)?

- First QuesA and then QuesB. Expected marks 14.
- First QuesB and then QuesA. Expected marks 14.
- First QuesB and then QuesA. Expected marks 22.
- First QuesA and then QuesB. Expected marks 16.

gate2021-cse-set2 probability expectation

Answer 

### Answers: Expectation

#### 7.4.1 Expectation: GATE CSE 1999 | Question: 1.1

 <https://gateoverflow.in/1455>



✓ Answer is (C)

Expectation of discrete random variable (finite case)

$$E(X) = x_1 p_1 + x_2 p_2 + \dots + x_n p_n$$

$$E(X) = 5, 0 \leq p_i \leq 1$$

$$p_1 + p_2 + \dots + p_n = 1$$

Therefore,  $E(X) = 5$  is possible only if at-least one of the  $x_i \geq 5$

 30 votes

-- suraj (4.8k points)

#### 7.4.2 Expectation: GATE CSE 2004 | Question: 74

 <https://gateoverflow.in/1068>



✓ Answer is option D.

Probability of choosing the correct option =  $\frac{1}{4}$

Probability of choosing a wrong option =  $\frac{3}{4}$

So, expected mark for a question for a student =  $\frac{1}{4} \times 1 + \frac{3}{4} \times (-0.25) = 0.0625$

Expected mark for a student for 150 questions =  $0.0625 \times 150 = 9.375$

So, sum total of the expected marks obtained by all 1000 students =  $9.375 \times 1000 = 9375$ .

 61 votes

-- Arjun Suresh (328k points)

#### 7.4.3 Expectation: GATE CSE 2006 | Question: 18

 <https://gateoverflow.in/979>



✓ The answer is option D.

The smallest element in sample  $S$  would be  $X_i$  for which  $i$  is smallest.

The given probability is for selection of each item of  $X$ . Independent selection means each item is selected with probability  $\frac{1}{2}$ .

Probability for  $X_1$  to be smallest in  $S = \frac{1}{2}$ .

Value of  $X_1 = 2$ .

Probability for  $X_2$  to be smallest in  $S$  = Probability of  $X_1$  not being in  $S \times$  Probability of  $X_2$  being in  $S = \frac{1}{2} \cdot \frac{1}{2}$ .

Value of  $X_2 = 2^2 = 4$ .

Similarly, Probability for  $X_i$  to be smallest in  $S = (1/2)^i$ .

Value of  $X_i = 2^i$ .

Now Required Expectation =  $\sum_{i=1}^n 2^i \times \left(\frac{1}{2}\right)^i = \sum_{i=1}^n 1 = n$ .

82 votes

-- Mari Ganesh Kumar (1.5k points)

#### 7.4.4 Expectation: GATE CSE 2011 | Question: 18 [top](#)

<https://gateoverflow.in/2120>



✓ Answer is (C).

The difference between  $(E[X^2])$  and  $(E[X])^2$  is called variance of a random variable. Variance measures how far a set of numbers is spread out. (A variance of zero indicates that all the values are identical.) A non-zero variance is always positive.

References



28 votes

-- Divya Bharti (3.8k points)

#### 7.4.5 Expectation: GATE CSE 2013 | Question: 24 [top](#)

<https://gateoverflow.in/1535>



✓ Answer is (C)

A cycle of length 3 requires 3 vertices.

Number of ways in which we can choose 3 vertices from 8 =  ${}^8C_3 = 56$ .

Probability that 3 vertices form a cycle = Probability of edge between vertices 1 and 2  $\times$  Probability of edge between vertices 2 and 3  $\times$  Probability of edge between vertices 1 and 3

$$= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$$

So, expected number of cycles of length 3 =  $56 \times \frac{1}{8} = 7$

ref@ <http://stackoverflow.com/questions/14801072/number-of-cycles-in-a-random-graph>

References



98 votes

-- Arjun Suresh (328k points)

#### 7.4.6 Expectation: GATE CSE 2014 Set 2 | Question: 2 [top](#)

<https://gateoverflow.in/1954>



✓ ANS is 3.9

Each of the nine words have equal probability. So, expected length

$$\begin{aligned} &= 3 \times \frac{1}{9} + 5 \times \frac{1}{9} + 5 \times \frac{1}{9} + 3 \times \frac{1}{9} + 5 \times \frac{1}{9} + 4 \times \frac{1}{9} + 3 \times \frac{1}{9} + 4 \times \frac{1}{9} + 3 \times \frac{1}{9} \\ &= \frac{35}{9} \\ &= 3.9 \end{aligned}$$

42 votes

-- Arjun Suresh (328k points)

#### 7.4.7 Expectation: GATE CSE 2021 Set 2 | Question: 29 [top](#)

<https://gateoverflow.in/357511>



✓ First we answer A, then B:

- Expected marks = Probability<sub>A</sub> is wrong \* 0 + Probability<sub>A</sub> is correct \* Probability<sub>B</sub> is wrong \* 10 + Probability<sub>A</sub> is correct \* Probability<sub>B</sub> is correct \* 30  
 $= 0.2 * 0 + 0.8 * 0.5 * 10 + 0.8 * 0.5 * 30$   
 $= 0 + 4 + 12$   
 $= 16$

First we answer **B**, then **A**:

- Expected marks = Probability<sub>B</sub> is wrong \* 0 + Probability<sub>B</sub> is correct \* Probability<sub>A</sub> is wrong \* 20 + Probability<sub>B</sub> is correct \* Probability<sub>A</sub> is correct \* 30  
 $= 0.5 * 0 + 0.2 * 0.5 * 20 + 0.8 * 0.5 * 30$   
 $= 0 + 2 + 12$   
 $= 14$

So to maximize marks we should first answer *A* and then *B*. The expected marks in such a scenario will be 16.

5 votes

-- chirudeepnamin (2.9k points)

## 7.5

### Exponential Distribution (1) top ↗

#### 7.5.1 Exponential Distribution: GATE IT 2004 | Question: 33 top ↗

→ <https://gateoverflow.in/3676>



Let  $X$  and  $Y$  be two exponentially distributed and independent random variables with mean  $\alpha$  and  $\beta$ , respectively. If  $Z = \min(X, Y)$ , then the mean of  $Z$  is given by

- A.  $\left(\frac{1}{\alpha+\beta}\right)$
- B.  $\min(\alpha, \beta)$
- C.  $\left(\frac{\alpha\beta}{\alpha+\beta}\right)$
- D.  $\alpha + \beta$

gate2004-it probability exponential-distribution random-variable normal

Answer

### Answers: Exponential Distribution

#### 7.5.1 Exponential Distribution: GATE IT 2004 | Question: 33 top ↗

→ <https://gateoverflow.in/3676>



✓ Answer is (C)

$X$  is an exponential random variable of parameter  $\lambda$  when its probability distribution function is

$$f(x) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

For  $a > 0$ , we have the cumulative distribution function

$$F_x(a) = \int_0^a f(x) dx = \int_0^a \lambda e^{-\lambda x} dx = -e^{-\lambda x} \Big|_0^a = 1 - e^{-\lambda a}$$

So,

$$P\{X < a\} = 1 - e^{-\lambda a}$$

and

$$P\{X > a\} = e^{-\lambda a}$$

Now, we use  $P\{X > a\}$  for our problem because our concerned variable  $Z$  is **min** of  $X$  and  $Y$ .

For exponential distribution with parameter  $\lambda$ , mean is given by  $\frac{1}{\lambda}$ .

We have,

$$P\{X > a\} = e^{-\frac{1}{\alpha}a}$$

$$P\{Y > a\} = e^{-\frac{1}{\beta}a}$$

$$P\{Z > a\} = P\{X > a\} P\{Y > a\} (\because X \text{ and } Y \text{ are independent events and } Z > \min(X, Y))$$

$$= e^{-\frac{1}{\alpha}a} e^{-\frac{1}{\beta}a}$$

So,

$$= e^{-(\frac{1}{\alpha} + \frac{1}{\beta})a}$$

$$= e^{-(\frac{\alpha+\beta}{\alpha\beta})a}$$

This shows that  $Z$  is also exponentially distributed with parameter  $\frac{\alpha+\beta}{\alpha\beta}$  and mean  $\frac{\alpha\beta}{\alpha+\beta}$ .

Ref: [http://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2011/lecture-notes/MIT18\\_440S11\\_Lecture20.pdf](http://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2011/lecture-notes/MIT18_440S11_Lecture20.pdf)

## References



31 votes

-- Arjun Suresh (328k points)

## 7.6

### Independent Events (3) top ↗

#### 7.6.1 Independent Events: GATE CSE 1994 | Question: 2.8 top ↗

<https://gateoverflow.in/2475>



Let  $A$ ,  $B$  and  $C$  be independent events which occur with probabilities 0.8, 0.5 and 0.3 respectively. The probability of occurrence of at least one of the event is \_\_\_\_\_

[gate1994](#) [probability](#) [normal](#) [numerical-answers](#) [independent-events](#)

Answer

#### 7.6.2 Independent Events: GATE CSE 1999 | Question: 2.1 top ↗

<https://gateoverflow.in/1479>



Consider two events  $E_1$  and  $E_2$  such that probability of  $E_1$ ,  $P_r[E_1] = \frac{1}{2}$ , probability of  $E_2$ ,  $P_r[E_2] = \frac{1}{3}$ , and probability of  $E_1$  and  $E_2$ ,  $P_r[E_1 \text{ and } E_2] = \frac{1}{5}$ . Which of the following statements is/are true?

- A.  $P_r[E_1 \text{ or } E_2]$  is  $\frac{2}{3}$
- B. Events  $E_1$  and  $E_2$  are independent
- C. Events  $E_1$  and  $E_2$  are not independent
- D.  $P_r[E_1 | E_2] = \frac{4}{5}$

[gate1999](#) [probability](#) [normal](#) [independent-events](#)

Answer

#### 7.6.3 Independent Events: GATE CSE 2000 | Question: 2.2 top ↗

<https://gateoverflow.in/649>



$E_1$  and  $E_2$  are events in a probability space satisfying the following constraints:

- $Pr(E_1) = Pr(E_2)$
- $Pr(E_1 \cup E_2) = 1$
- $E_1$  and  $E_2$  are independent

The value of  $Pr(E_1)$ , the probability of the event  $E_1$ , is

- A. 0
- B.  $\frac{1}{4}$
- C.  $\frac{1}{2}$

D. 1

gate2000-cse probability easy independent-events

Answer 

## Answers: Independent Events

7.6.1 Independent Events: GATE CSE 1994 | Question: 2.8 <https://gateoverflow.in/2475>

✓  $P(A) = 0.8 \implies P(A') = 1 - 0.8 = 0.2$

$$P(B) = 0.5 \implies P(B') = 1 - 0.5 = 0.5$$

$$P(C) = 0.3 \implies P(C') = 1 - 0.3 = 0.7$$

$$P(\text{No event will occur}) = 0.2 * 0.5 * 0.7 = 0.07$$

$$P(\text{at least 1 event will occur}) = 1 - 0.07 = 0.93$$

 25 votes

-- Manu Thakur (34k points)

7.6.2 Independent Events: GATE CSE 1999 | Question: 2.1 <https://gateoverflow.in/1479>

✓ For A:

$$P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1 \cap E_2)$$

$$= \frac{1}{2} + \frac{1}{3} - \frac{1}{5}$$

$$= \frac{19}{30} \neq \frac{2}{3} \therefore A \text{ is not True}$$

For B:

If  $E_1$  and  $E_2$  are independent then

$$P(E_1 \cap E_2) = P(E_1)P(E_2)$$

$$= \frac{1}{2} \times \frac{1}{3}$$

$$= \frac{1}{6} \neq \frac{1}{5} \therefore B \text{ is not True}$$

For D:

$$P\left(\frac{E_1}{E_2}\right) = \frac{P(E_1 \cap E_2)}{P(E_2)}$$

$$= \frac{\frac{1}{5}}{\frac{1}{3}} = \frac{3}{5} \neq \frac{4}{5} \therefore D \text{ is not True}$$

So, the answer is C,  $E_1$  and  $E_2$  are not independent 9 votes

-- Sourabh Gupta (4k points)

7.6.3 Independent Events: GATE CSE 2000 | Question: 2.2 <https://gateoverflow.in/649>

✓ Answer -D

Let probability of Event  $E_1 = x = \text{prob of } E_2$ 

$$\text{prob}(E_1 \cup E_2) = \text{prob}(E_1) + \text{prob}(E_2) - \text{prob}(E_1 \cap E_2)$$

$$1 = x + x - x^2 \quad (\text{prob}(E_1 \text{ intersect } E_2) = \text{prob}(E_1) \times \text{prob}(E_2) \text{ as events are independent})$$

$$\implies x = 1$$

35 votes

-- Ankit Rokde (6.9k points)

7.7

## Normal Distribution (2)

## 7.7.1 Normal Distribution: GATE CSE 2008 | Question: 29

Let  $X$  be a random variable following normal distribution with mean  $+1$  and variance  $4$ . Let  $Y$  be another normal variable with mean  $-1$  and variance unknown. If  $P(X \leq -1) = P(Y \geq 2)$ , the standard deviation of  $Y$  is

- A. 3
- B. 2
- C.  $\sqrt{2}$
- D. 1

[gate2008-cse](#) [random-variable](#) [normal-distribution](#) [probability](#) [normal](#)

Answer

## 7.7.2 Normal Distribution: GATE CSE 2017 Set 1 | Question: 19

Let  $X$  be a Gaussian random variable with mean  $0$  and variance  $\sigma^2$ . Let  $Y = \max(X, 0)$  where  $\max(a, b)$  is the maximum of  $a$  and  $b$ . The median of  $Y$  is \_\_\_\_\_.

[gate2017-cse-set1](#) [probability](#) [numerical-answers](#) [normal-distribution](#)

Answer

## Answers: Normal Distribution

## 7.7.1 Normal Distribution: GATE CSE 2008 | Question: 29

Answer is A

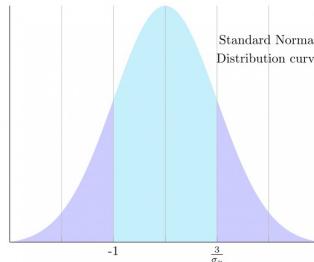
$$P(X \leq -1) = P(Y \geq 2)$$

We can compare their values using standard normal distributions:

$$\begin{array}{c|c} X & Y \\ \mu_X = +1 & \mu_Y = -1 \\ \sigma_X^2 = 4 & \sigma_Y^2 = ? \\ Z_X = \frac{X - 1}{\sqrt{4}} & Z_Y = \frac{Y - (-1)}{\sigma_Y} \\ 2Z_X + 1 = X & Y = \sigma_Y Z_Y - 1 \end{array}$$

$$\implies P(2Z_X + 1 \leq -1) = P(\sigma_Y Z_Y - 1 \geq 2)$$

$$\implies P(Z_X \leq -1) = P(Z_Y \geq \frac{3}{\sigma_Y})$$



$$\implies -(-1) = \frac{3}{\sigma_Y}$$

$$\implies \sigma_Y = 3$$

43 votes

-- Amar Vashishth (25.2k points)

First lets convert both  $X$  and  $Y$  to Standard normal distribution.

$$Z = \frac{X - 1}{2}$$

$$Z = \frac{Y + 1}{\sigma}$$

Now replace  $X$  and  $Y$  in  $P(X \leq -1) = P(Y \leq 2)$  we get  $P(Z \leq -1) = P\left(Z \geq \frac{3}{\sigma}\right)$

Since the Standard Normal Curve is symmetric about the mean( i.e, zero)  $-(-1) = \frac{3}{\sigma} \Rightarrow \sigma = 3$ .

Answer is Option A

31 votes

-- Mari Ganesh Kumar (1.5k points)

### 7.7.2 Normal Distribution: GATE CSE 2017 Set 1 | Question: 19

<https://gateoverflow.in/118299>



- ✓ Variable  $Y$  can take only non-negative values. Median of a distribution is a value  $c$  such that

$$P(0 < Y < c) = P(c < Y < \infty)$$

Now for L.H.S.,  $Y$  will lie between 0 and  $c$  only when  $X < c$  i.e  $P(0 < Y < c) = P(X < c)$ .

For R.H.S,  $Y > c$  only when  $X > c$  i.e.  $P(c < Y < \infty) = P(X > c) = 1 - P(X < c)$

Equating both sides, we get  $P(X < c) = 1 - P(X < c) \implies P(X < c) = 0.5 \implies c = 0$ .

Hence 0 is the answer.

36 votes

-- Happy Mittal (8.2k points)

## 7.8

### Poisson Distribution (4)

<https://gateoverflow.in/88156>



### 7.8.1 Poisson Distribution: GATE CSE 1989 | Question: 4-viii

$P_n(t)$  is the probability of  $n$  events occurring during a time interval  $t$ . How will you express  $P_0(t+h)$  in terms of  $P_0(h)$ , if  $P_0(t)$  has stationary independent increments? (Note:  $P_t(t)$  is the probability density function).

[gate1989](#) [descriptive](#) [probability](#) [poisson-distribution](#)

Answer

### 7.8.2 Poisson Distribution: GATE CSE 2013 | Question: 2

<https://gateoverflow.in/62>



Suppose  $p$  is the number of cars per minute passing through a certain road junction between 5 PM and 6 PM, and  $p$  has a Poisson distribution with mean 3. What is the probability of observing fewer than 3 cars during any given minute in this interval?

- A.  $\frac{8}{(2e^3)}$
- B.  $\frac{9}{(2e^3)}$
- C.  $\frac{17}{(2e^3)}$
- D.  $\frac{26}{(2e^3)}$

[gate2013-cse](#) [probability](#) [poisson-distribution](#) [normal](#)

Answer

**7.8.3 Poisson Distribution: GATE CSE 2017 Set 2 | Question: 48** top ↗<https://gateoverflow.in/118513>

If a random variable  $X$  has a Poisson distribution with mean 5, then the expectation  $E[(x+2)^2]$  equals \_\_\_\_.

[gate2017-cse-set2](#) [expectation](#) [poisson-distribution](#) [numerical-answers](#) [probability](#)

Answer

**7.8.4 Poisson Distribution: GATE IT 2007 | Question: 57** top ↗<https://gateoverflow.in/3499>

In a multi-user operating system on an average, 20 requests are made to use a particular resource per hour. The arrival of requests follows a Poisson distribution. The probability that either one, three or five requests are made in 45 minutes is given by :

- A.  $6.9 \times 10^6 \times e^{-20}$
- B.  $1.02 \times 10^6 \times e^{-20}$
- C.  $6.9 \times 10^3 \times e^{-20}$
- D.  $1.02 \times 10^3 \times e^{-20}$

[gate2007-it](#) [probability](#) [poisson-distribution](#) [normal](#)

Answer

**Answers: Poisson Distribution****7.8.1 Poisson Distribution: GATE CSE 1989 | Question: 4-viii** top ↗<https://gateoverflow.in/88156>

- ✓  $P_0(t)$  denote the probability that no events happened in an interval of length  $t$ .

$$P_0(t+h) = P_0(t)P_0(h)$$

This is because if there are no events in interval  $[0, t+h]$  then there are no events in intervals

1.  $[0, t]$
2.  $[t, t+h]$

These two intervals are non overlapping and it is given in question that  $P_0(t)$  has stationary independent increments and so their probabilities are independent.

PS: One of the axioms of Poisson distribution is that the numbers of events in two nonoverlapping regions are independent.

2 votes

-- Arjun Suresh (328k points)

**7.8.2 Poisson Distribution: GATE CSE 2013 | Question: 2** top ↗<https://gateoverflow.in/62>

- ✓ Answer is (C)

Poisson Probability Density Function (with mean  $\lambda$ ) =  $\frac{\lambda^k}{(e^\lambda k!)}$ ,

We have to sum the probability density function for  $k = 0, 1$  and  $2$  and  $\lambda = 3$  (thus finding the cumulative mass function)

$$= \left( \frac{1}{e^3} \right) + \left( \frac{3}{e^3} \right) + \left( \frac{9}{2e^3} \right)$$

$$= \frac{17}{(2e^3)}$$

44 votes

-- Arjun Suresh (328k points)

**7.8.3 Poisson Distribution: GATE CSE 2017 Set 2 | Question: 48** top ↗<https://gateoverflow.in/118513>

- ✓ In Poisson distribution :

Mean = Variance as n is large and p is small

And we know:

$$\begin{aligned}\text{Variance} &= E(X^2) - [E(X)]^2 \\ \Rightarrow E(X^2) &= [E(X)]^2 + \text{Variance} \\ \Rightarrow E(X^2) &= 5^2 + 5 \\ \Rightarrow E(X^2) &= 30\end{aligned}$$

So, by linearity of expectation,

$$\begin{aligned}E[(X+2)^2] &= E[X^2 + 4X + 4] \\ &= E(X^2) + 4E(X) + 4 \\ &= 30 + (4 \times 5) + 4 \\ &= 54\end{aligned}$$

69 votes

-- HABIB MOHAMMAD KHAN (67.5k points)

#### 7.8.4 Poisson Distribution: GATE IT 2007 | Question: 57 top

<https://gateoverflow.in/3499>



✓ Answer is (B)

20 request in 1 hour. So we can expect 15 request in 45 minutes...

So,  $\lambda = 15$  (expected value)

Poisson distribution formula:  $f(x, \lambda) = p(X=x) = \frac{e^{-\lambda} * \lambda^x}{x!}$

$$\begin{aligned}\text{Prob (1 request)} + \text{Prob (3 requests)} + \text{Prob (5 requests)} \\ &= p(1; 15) + p(3; 15) + p(5; 15) \\ &= 6.9 \times 10^3 \times e^{-15} \\ &= 6.9 \times 10^3 \times e^5 \times e^{-20} \\ &= 1.02 \times 10^6 \times e^{-20}.\end{aligned}$$

36 votes

-- Vicky Bajoria (4.1k points)

#### 7.9

#### Probability (23) top

##### 7.9.1 Probability: GATE CSE 1995 | Question: 1.18 top

<https://gateoverflow.in/780>



The probability that a number selected at random between 100 and 999 (both inclusive) will not contain the digit 7 is:

- A.  $\frac{16}{25}$
- B.  $\left(\frac{9}{10}\right)^3$
- C.  $\frac{27}{75}$
- D.  $\frac{18}{25}$

gate1995 probability normal

Answer

##### 7.9.2 Probability: GATE CSE 1995 | Question: 2.14 top

<https://gateoverflow.in/2626>



A bag contains 10 white balls and 15 black balls. Two balls are drawn in succession. The probability that one of them is black and the other is white is:

- A.  $\frac{2}{3}$
- B.  $\frac{4}{5}$
- C.  $\frac{1}{2}$

D.  $\frac{1}{3}$

gate1995 probability normal

Answer 

### 7.9.3 Probability: GATE CSE 1996 | Question: 1.5

<https://gateoverflow.in/2709>



Two dice are thrown simultaneously. The probability that at least one of them will have 6 facing up is

- A.  $\frac{1}{36}$
- B.  $\frac{1}{3}$
- C.  $\frac{25}{36}$
- D.  $\frac{11}{36}$

gate1996 probability easy

Answer 

### 7.9.4 Probability: GATE CSE 1996 | Question: 2.7

<https://gateoverflow.in/2736>



The probability that top and bottom cards of a randomly shuffled deck are both aces is

- A.  $\frac{4}{52} \times \frac{4}{52}$
- B.  $\frac{4}{52} \times \frac{3}{52}$
- C.  $\frac{4}{52} \times \frac{3}{51}$
- D.  $\frac{4}{52} \times \frac{4}{51}$

gate1996 probability easy

Answer 

### 7.9.5 Probability: GATE CSE 1997 | Question: 1.1

<https://gateoverflow.in/2217>



The probability that it will rain today is 0.5. The probability that it will rain tomorrow is 0.6. The probability that it will rain either today or tomorrow is 0.7. What is the probability that it will rain today and tomorrow?

- A. 0.3
- B. 0.25
- C. 0.35
- D. 0.4

gate1997 probability easy

Answer 

### 7.9.6 Probability: GATE CSE 1998 | Question: 1.1

<https://gateoverflow.in/1638>



A die is rolled three times. The probability that exactly one odd number turns up among the three outcomes is

- A.  $\frac{1}{6}$
- B.  $\frac{3}{8}$
- C.  $\frac{1}{8}$
- D.  $\frac{1}{2}$

gate1998 probability easy

Answer 

**7.9.7 Probability: GATE CSE 2001 | Question: 2.4** [top](#)<https://gateoverflow.in/722>

Seven (distinct) car accidents occurred in a week. What is the probability that they all occurred on the same day?

- A.  $\frac{1}{7^7}$
- B.  $\frac{1}{7^6}$
- C.  $\frac{1}{2^7}$
- D.  $\frac{7}{2^7}$

[gate2001-cse](#) [probability](#) [normal](#)

Answer 

**7.9.8 Probability: GATE CSE 2003 | Question: 60, ISRO2007-45** [top](#)<https://gateoverflow.in/948>

A program consists of two modules executed sequentially. Let  $f_1(t)$  and  $f_2(t)$  respectively denote the probability density functions of time taken to execute the two modules. The probability density function of the overall time taken to execute the program is given by

- A.  $f_1(t) + f_2(t)$
- B.  $\int_0^t f_1(x)f_2(x)dx$
- C.  $\int_0^t f_1(x)f_2(t-x)dx$
- D.  $\max\{f_1(t), f_2(t)\}$

[gate2003-cse](#) [probability](#) [normal](#) [isro2007](#)

Answer 

**7.9.9 Probability: GATE CSE 2004 | Question: 25** [top](#)<https://gateoverflow.in/1022>

If a fair coin is tossed four times. What is the probability that two heads and two tails will result?

- A.  $\frac{3}{8}$
- B.  $\frac{1}{2}$
- C.  $\frac{5}{8}$
- D.  $\frac{3}{4}$

[gate2004-cse](#) [probability](#) [easy](#)

Answer 

**7.9.10 Probability: GATE CSE 2010 | Question: 26** [top](#)<https://gateoverflow.in/1152>

Consider a company that assembles computers. The probability of a faulty assembly of any computer is  $p$ . The company therefore subjects each computer to a testing process. This testing process gives the correct result for any computer with a probability of  $q$ . What is the probability of a computer being declared faulty?

- A.  $pq + (1-p)(1-q)$
- B.  $(1-q)p$
- C.  $(1-p)q$
- D.  $pq$

[gate2010-cse](#) [probability](#) [easy](#)

Answer 

**7.9.11 Probability: GATE CSE 2010 | Question: 27** [top](#)<https://gateoverflow.in/1153>

What is the probability that divisor of  $10^{99}$  is a multiple of  $10^{96}$ ?

- A.  $\left(\frac{1}{625}\right)$
- B.  $\left(\frac{4}{625}\right)$
- C.  $\left(\frac{12}{625}\right)$
- D.  $\left(\frac{16}{625}\right)$

[gate2010-cse](#) [probability](#) [normal](#)

Answer 

#### 7.9.12 Probability: GATE CSE 2011 | Question: 34

<https://gateoverflow.in/2136>



A deck of 5 cards (each carrying a distinct number from 1 to 5) is shuffled thoroughly. Two cards are then removed one at a time from the deck. What is the probability that the two cards are selected with the number on the first card being one higher than the number on the second card?

- A.  $\left(\frac{1}{5}\right)$
- B.  $\left(\frac{4}{25}\right)$
- C.  $\left(\frac{1}{4}\right)$
- D.  $\left(\frac{2}{5}\right)$

[gate2011-cse](#) [probability](#) [normal](#)

Answer 

#### 7.9.13 Probability: GATE CSE 2014 Set 1 | Question: 48

<https://gateoverflow.in/1927>



Four fair six-sided dice are rolled. The probability that the sum of the results being 22 is  $\frac{X}{1296}$ . The value of  $X$  is \_\_\_\_\_.

[gate2014-cse-set1](#) [probability](#) [numerical-answers](#) [normal](#)

Answer 

#### 7.9.14 Probability: GATE CSE 2014 Set 2 | Question: 1

<https://gateoverflow.in/1953>



The security system at an IT office is composed of 10 computers of which exactly four are working. To check whether the system is functional, the officials inspect four of the computers picked at random (without replacement). The system is deemed functional if at least three of the four computers inspected are working. Let the probability that the system is deemed functional be denoted by  $p$ . Then  $100p = \text{_____}$ .

[gate2014-cse-set2](#) [probability](#) [numerical-answers](#) [normal](#)

Answer 

#### 7.9.15 Probability: GATE CSE 2014 Set 2 | Question: 48

<https://gateoverflow.in/2014>



The probability that a given positive integer lying between 1 and 100 (both inclusive) is NOT divisible by 2, 3 or 5 is \_\_\_\_\_.

[gate2014-cse-set2](#) [probability](#) [numerical-answers](#) [normal](#)

Answer 

#### 7.9.16 Probability: GATE CSE 2014 Set 3 | Question: 48

<https://gateoverflow.in/2082>



Let  $S$  be a sample space and two mutually exclusive events  $A$  and  $B$  be such that  $A \cup B = S$ . If  $P(\cdot)$  denotes the probability of the event, the maximum value of  $P(A)P(B)$  is \_\_\_\_\_.

[gate2014-cse-set3](#) [probability](#) [numerical-answers](#) [normal](#)
**Answer**

### 7.9.17 Probability: GATE CSE 2016 Set 1 | Question: 29 [top](#)

<https://gateoverflow.in/39709>


Consider the following experiment.

**Step 1.** Flip a fair coin twice.

**Step 2.** If the outcomes are (TAILS, HEADS) then output  $Y$  and stop.

**Step 3.** If the outcomes are either (HEADS, HEADS) or (HEADS, TAILS), then output  $N$  and stop.

**Step 4.** If the outcomes are (TAILS, TAILS), then go to Step 1.

The probability that the output of the experiment is  $Y$  is (up to two decimal places)

[gate2016-cse-set1](#) [probability](#) [normal](#) [numerical-answers](#)
**Answer**

### 7.9.18 Probability: GATE CSE 2018 | Question: 15 [top](#)

<https://gateoverflow.in/204089>


Two people,  $P$  and  $Q$ , decide to independently roll two identical dice, each with 6 faces, numbered 1 to 6. The person with the lower number wins. In case of a tie, they roll the dice repeatedly until there is no tie. Define a trial as a throw of the dice by  $P$  and  $Q$ . Assume that all 6 numbers on each dice are equi-probable and that all trials are independent. The probability (rounded to 3 decimal places) that one of them wins on the third trial is \_\_\_\_\_

[gate2018-cse](#) [probability](#) [normal](#) [numerical-answers](#)
**Answer**

### 7.9.19 Probability: GATE CSE 2021 Set 2 | Question: 33 [top](#)

<https://gateoverflow.in/357507>


A bag has  $r$  red balls and  $b$  black balls. All balls are identical except for their colours. In a trial, a ball is randomly drawn from the bag, its colour is noted and the ball is placed back into the bag along with another ball of the same colour. Note that the number of balls in the bag will increase by one, after the trial. A sequence of four such trials is conducted. Which one of the following choices gives the probability of drawing a red ball in the fourth trial?

- A.  $\frac{r}{r+b}$
- B.  $\frac{r}{r+b+3}$
- C.  $\frac{r+b+3}{r+3}$
- D.  $\left(\frac{r}{r+b}\right)\left(\frac{r+1}{r+b+1}\right)\left(\frac{r+2}{r+b+2}\right)\left(\frac{r+3}{r+b+3}\right)$

[gate2021-cse-set2](#) [probability](#) [normal](#)
**Answer**

### 7.9.20 Probability: GATE IT 2004 | Question: 1 [top](#)

<https://gateoverflow.in/3642>


In a population of  $N$  families, 50% of the families have three children, 30% of the families have two children and the remaining families have one child. What is the probability that a randomly picked child belongs to a family with two children?

- A.  $\left(\frac{3}{23}\right)$
- B.  $\left(\frac{6}{23}\right)$
- C.  $\left(\frac{3}{10}\right)$
- D.  $\left(\frac{3}{5}\right)$

[gate2004-it](#) [probability](#) [normal](#)

[Answer](#)**7.9.21 Probability: GATE IT 2005 | Question: 1** [top](#)<https://gateoverflow.in/3745>

A bag contains 10 blue marbles, 20 green marbles and 30 red marbles. A marble is drawn from the bag, its colour recorded and it is put back in the bag. This process is repeated 3 times. The probability that no two of the marbles drawn have the same colour is

- A.  $\left(\frac{1}{36}\right)$
- B.  $\left(\frac{1}{6}\right)$
- C.  $\left(\frac{1}{4}\right)$
- D.  $\left(\frac{1}{3}\right)$

[gate2005-it](#) [probability](#) [normal](#)[Answer](#)**7.9.22 Probability: GATE IT 2008 | Question: 2** [top](#)<https://gateoverflow.in/3224>

A sample space has two events  $A$  and  $B$  such that probabilities  $P(A \cap B) = \frac{1}{2}$ ,  $P(A') = \frac{1}{3}$ ,  $P(B') = \frac{1}{3}$ . What is  $P(A \cup B)$ ?

- A.  $\left(\frac{11}{12}\right)$
- B.  $\left(\frac{10}{12}\right)$
- C.  $\left(\frac{9}{12}\right)$
- D.  $\left(\frac{8}{12}\right)$

[gate2008-it](#) [probability](#) [easy](#)[Answer](#)**7.9.23 Probability: GATE IT 2008 | Question: 23** [top](#)<https://gateoverflow.in/3284>

What is the probability that in a randomly chosen group of  $r$  people at least three people have the same birthday?

- A.  $1 - \frac{365 - 364 \dots (365 - r + 1)}{365^r}$
- B.  $\frac{365 \cdot 364 \dots (365 - r + 1)}{365^r} + {}^r C_1 \cdot 365 \cdot \frac{364 \cdot 363 \dots (364 - (r - 2) + 1)}{364^{r-2}}$
- C.  $1 - \frac{365 \cdot 364 \dots (365 - r + 1)}{365^r} - {}^r C_2 \cdot 365 \cdot \frac{364 \cdot 363 \dots (364 - (r - 2) + 1)}{364^{r-2}}$
- D.  $\frac{365 \cdot 364 \dots (365 - r + 1)}{365^r}$

[gate2008-it](#) [probability](#) [normal](#)[Answer](#)**Answers: Probability****7.9.1 Probability: GATE CSE 1995 | Question: 1.18** [top](#)<https://gateoverflow.in/780>

✓ **Answer is (D)**

First digit can be chosen in 8 ways from 1 – 9 excluding 7

Second digit can be chosen in 9 ways from 0 – 9 excluding 7 and similarly the third digit in 9 ways.

So, total no. of ways excluding 7 =  $8 \times 9 \times 9$

Total no. of ways including 7 =  $9 \times 10 \times 10$

$$\text{So, answer} = \frac{(8 \times 9 \times 9)}{(9 \times 10 \times 10)} = \frac{18}{25}$$

47 votes

-- gatecse (60k points)

### 7.9.2 Probability: GATE CSE 1995 | Question: 2.14 top ↗

<https://gateoverflow.in/2626>

✓ Answer is C

- Probability of first ball white and second one black =  $\left(\frac{10}{25}\right) \times \left(\frac{15}{24}\right)$
- Probability of first ball black and second one white =  $\left(\frac{15}{25}\right) \times \left(\frac{10}{24}\right)$
- Probability = sum of above two probabilities =  $\frac{1}{2}$ .

27 votes

-- Ankit Rokde (6.9k points)

### 7.9.3 Probability: GATE CSE 1996 | Question: 1.5 top ↗

<https://gateoverflow.in/2709>

✓ Answer is (D)

$$1 - (\text{no. 6 in both the dice}) = 1 - \left(\frac{5}{6} \times \frac{5}{6}\right) = \frac{11}{36}.$$

20 votes

-- Bhagirathi Nayak (11.7k points)

### 7.9.4 Probability: GATE CSE 1996 | Question: 2.7 top ↗

<https://gateoverflow.in/2736>

✓ There are 52 cards including 4 aces so the probability must be  $\frac{4}{52} \times \frac{3}{51}$ .

Correct Answer: C

22 votes

-- Bhagirathi Nayak (11.7k points)

### 7.9.5 Probability: GATE CSE 1997 | Question: 1.1 top ↗

<https://gateoverflow.in/2217>

✓ Answer: D

$P(\text{it will rain today either today or tomorrow}) = P(\text{it will rain today}) + P(\text{it will rain tomorrow}) - P(\text{it will rain today and tomorrow})$

So,  $0.7 = 0.5 + 0.6 - P(\text{it will rain today and tomorrow})$

$\Rightarrow P(\text{it will rain today and tomorrow}) = 0.4$

21 votes

-- Rajarshi Sarkar (27.8k points)

### 7.9.6 Probability: GATE CSE 1998 | Question: 1.1 top ↗

<https://gateoverflow.in/1638>

✓ Answer - B

There are 6 possible outcomes for a die roll. Out of these 3 are even and 3 are odd. So, when we consider odd/even a die roll has only 2 possible outcomes. So, for three rolls of the die we have 8 possible outcomes.

Out of them only 3 will have exactly one odd number {OEE, EOE, EEO}

Probability = 3/8.

27 votes

-- Ankit Rokde (6.9k points)

### 7.9.7 Probability: GATE CSE 2001 | Question: 2.4 [top](#)

<https://gateoverflow.in/722>



#### ✓ Answer - B

for every car accident we can pick a day in 7 ways

total number of ways in which accidents can be assigned to days =  $7^7$

probability of accidents happening on a particular day =  $\frac{1}{7^7}$

we can choose a day in 7 ways.

hence probability =  $\frac{7}{7^7} = \frac{1}{7^6}$ .

34 votes

-- Ankit Rokde (6.9k points)

### 7.9.8 Probability: GATE CSE 2003 | Question: 60, ISRO2007-45 [top](#)

<https://gateoverflow.in/948>



#### ✓ We assume the total time to be 't' units and $f_1$ executes for 'x' units.

Since,  $f_1(t)$  and  $f_2(t)$  are executed sequentially.

So,  $f_2$  is executed for ' $t-x$ ' units.

We apply convolution on the sum of two independent random variables to get probability density function of the overall time taken to execute the program.

$$f_1(x)*f_2(t-x)$$

Correct Answer: C

28 votes

-- Pranabesh Ghosh (3.3k points)

### 7.9.9 Probability: GATE CSE 2004 | Question: 25 [top](#)

<https://gateoverflow.in/1022>



#### ✓ Answer - A

Out of 4 times 2 times head should be present

No. of ways of selecting these 2 places =  ${}^4C_2$

probability of getting 2 heads and 2 tails =  $\left(\frac{1}{2^2}\right) \cdot \left(\frac{1}{2^2}\right)$

probability =  $\frac{{}^4C_2}{2^4} = \frac{3}{8}$ .

16 votes

-- Ankit Rokde (6.9k points)

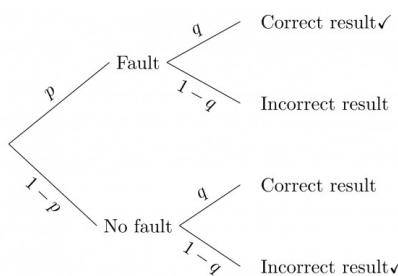
### 7.9.10 Probability: GATE CSE 2010 | Question: 26 [top](#)

<https://gateoverflow.in/1152>



#### ✓ Answer = option A

In image below the ticks show those branches where the result is declared as faulty.



So, required probability = sum of probabilities of those two branches =  $pq + (1-p)(1-q)$

50 votes

-- Amar Vashishth (25.2k points)

**7.9.11 Probability: GATE CSE 2010 | Question: 27** top ↴<https://gateoverflow.in/1153>

- ✓ Prime factorization of  $10 = 2 \times 5$ .

So,  $10^{99} = 2^{99} \times 5^{99}$  and

No. of possible factors for  $10^{99}$  = No. of ways in which prime factors can be combined  
 $= 100 \times 100$  (1 extra possibility for each prime number as prime factor raised to 0 is also possible for a factor)

$$10^{99} = 10^{96} \times 1000$$

So, no. of multiples of  $10^{96}$  which divides  $10^{99}$  = No. of possible factors of 1000

$$= 4 \times 4 (\because 1000 = 2^3 \times 5^3) \text{ (See below)}$$

$$= 16$$

So, required probability =  $\frac{16}{10000}$

$$= \frac{1}{625}$$

Correct Answer: A

How is number of possible factors of 1000 = 16?

Here, we can prime factorize 1000 as  $2^3 \times 5^3$ . Now, any factor of 1000 will be some combination of these prime factors. For 2, a factor has 4 options -  $2^0, 2^1, 2^2$  or  $2^3$ . Similarly 4 options for 5 also. This is true for any number  $n$ , if  $n$  can be prime factorized as  $a_1^{m_1} \cdot a_2^{m_2} \dots a_n^{m_n}$ , number of factors of  $n = (m_1 + 1) \times (m_2 + 1) \times \dots \times (m_n + 1)$ , the extra one in each factor term coming for power being 0.

100 votes

-- Arjun Suresh (328k points)

**7.9.12 Probability: GATE CSE 2011 | Question: 34** top ↴<https://gateoverflow.in/2136>

- ✓ The number on the first card needs to be **One higher** than that on the second card, so possibilities are :

1 <sup>st</sup> card	2 <sup>nd</sup> card
1	-
2	1
3	2
4	3
5	4
-	5

Total : 4 possibilities

Total possible ways of picking up the cards =  $5 \times 4 = 20$

$$\text{Thus, the required Probability} = \frac{\text{favorable ways}}{\text{total possible ways}} = \frac{4}{20} = \frac{1}{5}$$

**Option A is correct**

49 votes

-- Amar Vashishth (25.2k points)

**7.9.13 Probability: GATE CSE 2014 Set 1 | Question: 48** top ↴<https://gateoverflow.in/1927>

- ✓ There are only two possible sets whose elements sum to 22 :  $\{6, 6, 6, 4\}, \{6, 6, 5, 5\}$

$$\text{Number of permutations for } 1^{\text{st}} \text{ set : } \frac{4!}{3!} = 4$$

$$\text{Number of permutations for } 2^{\text{nd}} \text{ set : } \frac{4!}{(2! * 2!)} = 6$$

So total number of ways to sum 22 = 10

So  $X = 10$ .

59 votes

-- Happy Mittal (8.2k points)

### 7.9.14 Probability: GATE CSE 2014 Set 2 | Question: 1 top ↴

<https://gateoverflow.in/1953>



✓ Initially  $P(\text{working computer}) = \frac{4}{10}$ ,  $P(\text{non-working computer}) = \frac{6}{10}$ .

**Case 1 :** three computers are functional : There are 4 sub-cases  $WWWN$ ,  $WWNW$ ,  $WNWW$ ,  $NWWW$ , where  $W$  means working,  $N$  means non-working, but  $P(WWWN) = P(WWNW) = P(WNWW) = P(NWWW)$ ,

because for example  $P(WWWN) = \frac{4}{10} \times \frac{3}{9} \times \frac{2}{8} \times \frac{6}{7} = \frac{144}{5040}$

In all other 3 sub-cases, we get same numerators and denominators (in different order), so total prob in this case is

$$\frac{4 \times 144}{5040} = \frac{576}{5040}.$$

**Case 2 :** all 4 are working

$$P(WWWW) = \frac{4}{10} \times \frac{3}{9} \times \frac{2}{8} \times \frac{1}{7} = \frac{24}{5040}$$

$$P(\text{atleast 3 are working}) = \frac{600}{5040}$$

So  $100 \times p = 11.90$

43 votes

-- Happy Mittal (8.2k points)

all are working + 3 Working and 1 not working

$$\Rightarrow \left( \frac{1}{10C_4} \right) + \frac{\binom{4}{3} \times \binom{6}{1}}{10C_4}$$



77 votes

-- Saumya Bhattacharya (775 points)

### 7.9.15 Probability: GATE CSE 2014 Set 2 | Question: 48 top ↴

<https://gateoverflow.in/2014>



✓ Answer - 0.26

no of integers divisible by 2 = 50

no of integers divisible by 3 = 33

no of integers divisible by 5 = 20

no of integers divisible by 2 and 3 = 16

no of integers divisible by 2 and 5 = 10

no of integers divisible by 3 and 5 = 6

no of integers divisible by 2 and 3 and 5 = 3

total numbers divisible by 2 or 3 or 5 =  $50 + 33 + 20 - 16 - 10 - 6 + 3 = 74$

total number not divisible by 2 or 3 or 5 = 26

probability = 0.26 [EDIT]

32 votes

-- Ankit Rokde (6.9k points)

### 7.9.16 Probability: GATE CSE 2014 Set 3 | Question: 48 top ↴

<https://gateoverflow.in/2082>



✓  $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

$P(A) + P(B) = 1$ , since both are mutually exclusive and  $A \cup B = S$ .

When sum is a constant, product of two numbers becomes maximum when they are equal.

$$\text{So, } P(A) = P(B) = \frac{1}{2}.$$

34 votes

-- Saumya Bhattacharya (775 points)



### 7.9.17 Probability: GATE CSE 2016 Set 1 | Question: 29 top ↗

↗ <https://gateoverflow.in/39709>

- ✓ Answer is 0.33

1<sup>st</sup> time it is  $0.25 \left( \frac{1}{4} \right)$ , when tail tail comes, entire process gets repeated, so next time probability of  $Y$  to happen is  $0.25 \times 0.25 \left( \frac{1}{4} \times \frac{1}{4} \right)$ , likewise it goes on as infinite GP

$$\text{Sum of infinite GP} = \frac{a}{(1 - r)}$$

$$\text{here, } a = \frac{1}{4} \text{ and } r = \frac{1}{4}$$

$$\text{so answer becomes } \frac{1}{3} \text{ i.e. } 0.33$$

43 votes

-- Sreyas S (1.6k points)



### 7.9.18 Probability: GATE CSE 2018 | Question: 15 top ↗

↗ <https://gateoverflow.in/204089>

- ✓ One of them win in the third trial i.e. first two trial would be Tie and third should not be Tie.

$$\text{Probability of Tie} = \frac{6}{36} = \frac{1}{6}$$

$$\text{Probability of NO Tie} = 1 - \frac{1}{6} = \frac{5}{6}$$

$$\text{Winning in the third Tie} = (\text{First Tie}) * (\text{Second Tie}) * (\text{No Tie}) = \frac{1}{6} * \frac{1}{6} * \frac{5}{6} = \frac{5}{216} = 0.023$$

42 votes

-- Digvijay (44.9k points)



### 7.9.19 Probability: GATE CSE 2021 Set 2 | Question: 33 top ↗

↗ <https://gateoverflow.in/357507>



- ✓ Ans :  $\frac{r}{r+b}$

Exp :

Assume that after  $i_{th}$  iteration, we have  $r$  red balls and  $b$  black balls.

So, probability of choosing red ball in  $(i+1)_{th}$  iteration will be :

$$= \frac{r}{r+b}$$

So, Probability of choosing red ball in  $(i+2)_{th}$  iteration will be :

(note that, in  $(i+1)_{th}$  iteration, we could either pick black or red ball.)

$$\begin{aligned} & \frac{r}{r+b} \times \frac{r+1}{r+b+1} + \frac{b}{r+b} \times \frac{r}{r+b+1} \\ &= \frac{r}{r+b} \end{aligned}$$

So, in the beginning we have  $r$  red balls, and  $b$  green balls. So, in every iteration, the probability of choosing a red ball will be  $\frac{r}{r+b}$ .

A beautiful question!! Whatever iteration we take, even in  $100_{th}$  iteration, probability of picking a red ball will be same.

Refer following link. This GATE question can be found here as it is, along with many possible variations.

<http://www.stat.yale.edu/~pollard/Courses/600.spring08/Handouts/Symmetry%5BPolyaUrn%5D.pdf>

### References



6 votes

-- Deepak Poonia (23k points)

### 7.9.20 Probability: GATE IT 2004 | Question: 1 top ↗

<https://gateoverflow.in/3642>



✓ **Answer is (B)  $\frac{6}{23}$**

Let  $N$  be the total number of families.

$$\text{Number of children in a family of 3 children} = \left(\frac{N}{2}\right) \times 3$$

$$\text{Number of children in a family of 2 children} = \left(\frac{3N}{10}\right) \times 2$$

$$\text{Number of children in a family of 1 child} = \left(\frac{N}{5}\right) \times 1$$

$$\text{Probability} = \frac{\text{Favorable cases}}{\text{Total cases}}$$

$$= \frac{\left(\frac{3}{10}\right) \times 2}{\left[\left(\frac{1}{2}\right) \times 3 + \left(\frac{3}{10}\right) \times 2 + \frac{1}{5}\right]} = \frac{6}{23}.$$

27 votes

-- Prateeksha Keshari (1.7k points)

### 7.9.21 Probability: GATE IT 2005 | Question: 1 top ↗

<https://gateoverflow.in/3745>



✓ No two marbles have the same color means, the final outcome of the three draws must be a permutation of Blue, Green, Red

There are  $3! = 6$  such permutations possible.

$$\text{Now, probability of getting a Blue first, Green second and Red third} = \frac{10}{60} \times \frac{20}{60} \times \frac{30}{60}$$

$$\text{Required probability} = 6 \times \frac{10}{60} \times \frac{20}{60} \times \frac{30}{60} = \frac{1}{6}.$$

Correct Answer: B

43 votes

-- Arjun Suresh (328k points)

### 7.9.22 Probability: GATE IT 2008 | Question: 2 top ↗

<https://gateoverflow.in/3224>



✓ **Answer is (B)**

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$= (1 - P(A')) + (1 - P(B')) - P(A \cap B)$$

$$= \left(1 - \frac{1}{3}\right) + \left(1 - \frac{1}{3}\right) - \frac{1}{2}$$

$$= \frac{4}{3} - \frac{1}{2} = \frac{5}{6} = \frac{10}{12}.$$

Here: If we simplify the option(B) we get 5/6.

21 votes

-- Arjun Suresh (328k points)

### 7.9.23 Probability: GATE IT 2008 | Question: 23 top ↴

<https://gateoverflow.in/3284>



- ✓ The question is actually confusing considering the given options. It seems like they asked for probability of at least 3 people sharing birthday with someone (which is different from at least 3 having birthday on same day as there can be many pairs having birthday on same day). So, lets calculate this.

Case 1: Among 365 people If all  $r$  have birthdays on different days.

Then first one can have his birthday in 365 ways. Second one can have in 364 ways, and so on up to  $r^{th}$  person, who can have his birthday in  $(365 - (r - 1))$  ways.

Case 2: Among 365 people If exactly 2 persons have birthdays on same day.

Then we can consider these 2 persons as single entity. Then these two (assumed as first person) can have their birthday in 365 ways.

Third person can have in 364 ways, and so on up to  $r^{th}$  person, who can have his birthday in  $(365 - (r - 2))$  ways (since 1 person is less now).

As we know,

$$P_{\text{at least 3 with same birthday}} = 1 - [P_{\text{no two having same birthday}} + P_{\text{exactly 2 having same birthday}}]$$

Hence,  $P_{\text{at least 3 with same birthday}}$

$$\begin{aligned} &= 1 - \left[ \frac{365 \cdot 364 \dots (365 - (r - 1))}{365^r} + 365 \cdot \frac{364 \cdot 363 \dots (365 - (r - 2))}{365 \cdot 364^{r-2}} \right] \\ &= 1 - \frac{365 \cdot 364 \dots (365 - (r - 1))}{365^r} - \frac{364 \cdot 363 \dots (365 - (r - 2))}{364^{r-2}} \end{aligned}$$

No option matches. Option C might be a typo.

44 votes

-- Rajarshi Sarkar (27.8k points)

### 7.10

### Random Variable (8) top ↴

#### 7.10.1 Random Variable: GATE CSE 2005 | Question: 12, ISRO2009-64 top ↴

<https://gateoverflow.in/1162>



Let  $f(x)$  be the continuous probability density function of a random variable  $x$ , the probability that  $a < x \leq b$ , is :

- A.  $f(b - a)$
- B.  $f(b) - f(a)$
- C.  $\int_a^b f(x) dx$
- D.  $\int_a^b x f(x) dx$

[gate2005-cse](#) [probability](#) [random-variable](#) [easy](#) [isro2009](#)

Answer

#### 7.10.2 Random Variable: GATE CSE 2011 | Question: 33 top ↴

<https://gateoverflow.in/2135>



Consider a finite sequence of random values  $X = [x_1, x_2, \dots, x_n]$ . Let  $\mu_x$  be the mean and  $\sigma_x$  be the standard deviation of  $X$ . Let another finite sequence  $Y$  of equal length be derived from this as  $y_i = a * x_i + b$ , where  $a$  and  $b$  are positive constants. Let  $\mu_y$  be the mean and  $\sigma_y$  be the standard deviation of this sequence.

Which one of the following statements is INCORRECT?

- A. Index position of mode of  $X$  in  $X$  is the same as the index position of mode of  $Y$  in  $Y$
- B. Index position of median of  $X$  in  $X$  is the same as the index position of median of  $Y$  in  $Y$
- C.  $\mu_y = a\mu_x + b$
- D.  $\sigma_y = a\sigma_x + b$

gate2011-cse probability random-variable normal

Answer 

### 7.10.3 Random Variable: GATE CSE 2012 | Question: 21

 <https://gateoverflow.in/1577>



Consider a random variable  $X$  that takes values  $+1$  and  $-1$  with probability  $0.5$  each. The values of the cumulative distribution function  $F(x)$  at  $x = -1$  and  $+1$  are

- A. 0 and 0.5
- B. 0 and 1
- C. 0.5 and 1
- D. 0.25 and 0.75

gate2012-cse probability random-variable easy

Answer 

### 7.10.4 Random Variable: GATE CSE 2015 Set 3 | Question: 37

 <https://gateoverflow.in/8496>



Suppose  $X_i$  for  $i = 1, 2, 3$  are independent and identically distributed random variables whose probability mass functions are  $Pr[X_i = 0] = Pr[X_i = 1] = \frac{1}{2}$  for  $i = 1, 2, 3$ . Define another random variable  $Y = X_1 X_2 \oplus X_3$ , where  $\oplus$  denotes XOR. Then  $Pr[Y = 0 | X_3 = 0] = \underline{\hspace{2cm}}$ .

gate2015-cse-set3 probability random-variable normal numerical-answers

Answer 

### 7.10.5 Random Variable: GATE CSE 2017 Set 2 | Question: 31

 <https://gateoverflow.in/118373>



For any discrete random variable  $X$ , with probability mass function

$P(X = j) = p_j, p_j \geq 0, j \in \{0, \dots, N\}$ , and  $\sum_{j=0}^N p_j = 1$ , define the polynomial function  $g_x(z) = \sum_{j=0}^N p_j z^j$ .

For a certain discrete random variable  $Y$ , there exists a scalar  $\beta \in [0, 1]$  such that  $g_y(z) = (1 - \beta + \beta z)^N$ . The expectation of  $Y$  is

- A.  $N\beta(1 - \beta)$
- B.  $N\beta$
- C.  $N(1 - \beta)$
- D. Not expressible in terms of  $N$  and  $\beta$  alone

gate2017-cse-set2 probability random-variable difficult

Answer 

### 7.10.6 Random Variable: GATE CSE 2021 Set 1 | Question: 18

 <https://gateoverflow.in/357433>



The lifetime of a component of a certain type is a random variable whose probability density function is exponentially distributed with parameter 2. For a randomly picked component of this type, the probability that its lifetime exceeds the expected lifetime (rounded to 2 decimal places) is  $\underline{\hspace{2cm}}$ .

gate2021-cse-set1 probability random-variable numerical-answers

Answer 

### 7.10.7 Random Variable: GATE CSE 2021 Set 1 | Question: 35

 <https://gateoverflow.in/357416>



Consider the two statements.

- $S_1$  : There exist random variables  $X$  and  $Y$  such that  $(\mathbb{E}[(X - \mathbb{E}(X))(Y - \mathbb{E}(Y))])^2 > \text{Var}[X]\text{Var}[Y]$
- $S_2$  : For all random variables  $X$  and  $Y$ ,  $\text{Cov}[X, Y] = \mathbb{E}[|X - \mathbb{E}[X]| |Y - \mathbb{E}[Y]|]$

Which one of the following choices is correct?

- A. Both  $S_1$  and  $S_2$  are true
- B.  $S_1$  is true, but  $S_2$  is false
- C.  $S_1$  is false, but  $S_2$  is true
- D. Both  $S_1$  and  $S_2$  are false

gate2021-cse-set1 probability random-variable difficult

Answer 

### 7.10.8 Random Variable: GATE CSE 2021 Set 2 | Question: 22

 <https://gateoverflow.in/357518>

For a given biased coin, the probability that the outcome of a toss is a head is 0.4. This coin is tossed 1,000 times. Let  $X$  denote the random variable whose value is the number of times that head appeared in these 1,000 tosses. The standard deviation of  $X$  (rounded to 2 decimal place) is \_\_\_\_\_

gate2021-cse-set2 numerical-answers probability random-variable

Answer 

## Answers: Random Variable

### 7.10.1 Random Variable: GATE CSE 2005 | Question: 12, ISRO2009-64

 <https://gateoverflow.in/1162>

- ✓ A. This gives the probability at the point of  $b - a$  which is not having any significant w.r.t  $a$  and  $b$ .
- B. This gives the difference of the probabilities at  $b$  and  $a$ . Note: This is different from cumulative distribution function  $F(b) - F(a)$ . Ref: [https://en.wikipedia.org/wiki/Cumulative\\_distribution\\_function](https://en.wikipedia.org/wiki/Cumulative_distribution_function)
- C. This is Probability Density Function. Ref: [https://en.wikipedia.org/wiki/Probability\\_density\\_function](https://en.wikipedia.org/wiki/Probability_density_function)
- D. This is expected value of continuous random variable. Ref: [https://en.wikipedia.org/wiki/Expected\\_value](https://en.wikipedia.org/wiki/Expected_value)  
Answer is C.

### References



 22 votes

-- Akash Kanase (36k points)

### 7.10.2 Random Variable: GATE CSE 2011 | Question: 33

 <https://gateoverflow.in/2135>

- ✓ Answer - D.

Mean, median and mode are linear functions over a random variable.

So, multiplying by constants or adding constants wont change their relative position.

Standard deviation is not a linear function over a random variable.

 34 votes

-- Ankit Rokde (6.9k points)

### 7.10.3 Random Variable: GATE CSE 2012 | Question: 21

 <https://gateoverflow.in/1577>

- ✓ Given  $P(-1) = 0.5$  and  $P(1) = 0.5$ . So, at all other points P must be zero as the sum of all probabilities must be 1.

So,  $F(-1) = 0.5$  and

$$F(1) = P(-1) + 0 + 0 + \dots + P(1)$$

$$= 0.5 + 0.5 = 1$$

Correct Answer: C

 44 votes

-- Arjun Suresh (328k points)

### 7.10.4 Random Variable: GATE CSE 2015 Set 3 | Question: 37

 <https://gateoverflow.in/8496>

- ✓ Answer is 0.75

As  $X_3 = 0$  is given, to have  $Y = 0$ ,  $X_1 X_2$  should be 0, meaning  $(X_1, X_2)$  should be one of  $\{(0, 0), (0, 1), (1, 0)\}$

So, required probability =  $3 \times \frac{1}{2} \times \frac{1}{2} = 0.75$  ∵ we can choose any of the 3 possibilities in 3 ways and then probability of each set of two combination is  $\frac{1}{2} \times \frac{1}{2}$ .

We can also do like follows:

There are totally 4 possibilities -  $\{(0,0)(0,1)(1,0),(1,1)\}$ , out of which 3 are favourable cases.

So, required probability =  $\frac{3}{4} = 0.75$ .

1 54 votes

-- Srijay Deshpande (299 points)

#### 7.10.5 Random Variable: GATE CSE 2017 Set 2 | Question: 31 [top](#)

<https://gateoverflow.in/1118373>



- ✓ Notice that the derivative of  $g_x(z)$  evaluated at  $z = 1$  gives expectation  $E(X)$   
 $g'_x(z)|_{z=1} = \sum_{j=1}^N j p_j z^{j-1}|_{z=1} = \sum_{j=1}^N j p_j = \sum_{j=0}^N j p_j = E(X)$

Therefore, take derivative of  $g_y(z)$  with respect to  $z$ , and plug in  $z = 1$

$$E(Y) = g'_y(z)|_{z=1} = ((1 - \beta + \beta z)^N)'|_{z=1} = N\beta(1 - \beta + \beta z)^{N-1}|_{z=1} = N\beta(1 - \beta + \beta)^{N-1} = N\beta$$

**So, Answer is option (B)**

1 39 votes

-- madan123456789 (245 points)

#### 7.10.6 Random Variable: GATE CSE 2021 Set 1 | Question: 18 [top](#)

<https://gateoverflow.in/357433>



- ✓ For this question, we don't even need the value of  $\lambda$  to get the answer.

It is good to remember this integration for solving questions on exponential distribution quickly.

$$\int_0^a \lambda e^{-\lambda x} dx = 1 - e^{-\lambda a}$$

So, with this,

$$P(X \leq a) = 1 - e^{-\lambda a},$$

$$P(X > a) = 1 - P(X \leq a) = e^{-\lambda a}$$

$$P(a \leq X \leq b) = P(X \leq b) - P(X \leq a) = (1 - e^{-\lambda b}) - (1 - e^{-\lambda a}) = e^{-\lambda a} - e^{-\lambda b}$$

So, for this question the answer will be  $P(X > E(X)) = P(X > \frac{1}{\lambda})$ , which will be  $e^{-\lambda * \frac{1}{\lambda}} = e^{-1} = 0.37$

Since the answer does not depend upon the value of  $\lambda$ , it means that it holds true for every exponential distribution.

1 3 votes

-- JATIN MITTAL (2k points)

For exponential distribution:

Expected value = mean =  $\frac{1}{\lambda}$

given  $\lambda = 2$ , so mean =  $\frac{1}{2} = 0.5$

$$P(X > \text{mean}) = P(X > 0.5) = \int_{0.5}^{\infty} \lambda e^{-\lambda x} dx = \int_{0.5}^{\infty} 2e^{-2x} dx = \frac{2}{2} e^{-2 \times \frac{1}{2}} = e^{-1} = 0.3678$$

1 2 votes

-- Divyanshu Shukla (263 points)

**7.10.7 Random Variable: GATE CSE 2021 Set 1 | Question: 35** [top](#)<https://gateoverflow.in/357416>

- ✓  $S_1$  : This statement is false because correlation formulae is  $r = \frac{\text{Cov}(x, y)}{\sqrt{\text{Var}(x)\text{Var}(y)}}$ .

So we have  $r^2\text{Var}(x)\text{Var}(y) = (\text{Cov}(x, y))^2$ . By comparing above we can see that the given statement is false

Ref: [https://proofwiki.org/wiki/Square\\_of\\_Covariance\\_is\\_Less\\_Than\\_or\\_Equal\\_to\\_Product\\_of\\_Variances](https://proofwiki.org/wiki/Square_of_Covariance_is_Less_Than_or_Equal_to_Product_of_Variances)

$S_2$  : This statement is false since negative covariance exists (strong negative association between random variable) but RHS of the equation always gives a positive answer.

**References**

2 votes

-- Keval Dodiya (163 points)

**7.10.8 Random Variable: GATE CSE 2021 Set 2 | Question: 22** [top](#)<https://gateoverflow.in/357518>

- ✓ It is Independent trials with same rate of success. So we can use Binomial distribution

Probability of success ( $p$ ) = 0.4

Probability of failure ( $q$ ) =  $1 - 0.4 = 0.6$

Number of trials ( $n$ ) = 1000

Variance =  $n \times p \times q = 1000 * 0.4 * 0.6 = 240$

Standard deviation =  $\sqrt{240} = 15.49$

4 votes

-- zxy123 (2.5k points)

**7.11****Uniform Distribution (7)** [top](#)**7.11.1 Uniform Distribution: GATE CSE 1998 | Question: 3a** [top](#)<https://gateoverflow.in/1694>

Two friends agree to meet at a park with the following conditions. Each will reach the park between 4:00 pm and 5:00 pm and will see if the other has already arrived. If not, they will wait for 10 minutes or the end of the hour whichever is earlier and leave. What is the probability that the two will not meet?

[gate1998](#) [probability](#) [normal](#) [numerical-answers](#) [uniform-distribution](#)

**Answer** **7.11.2 Uniform Distribution: GATE CSE 2004 | Question: 78** [top](#)<https://gateoverflow.in/1072>

Two  $n$  bit binary strings,  $S_1$  and  $S_2$  are chosen randomly with uniform probability. The probability that the Hamming distance between these strings (the number of bit positions where the two strings differ) is equal to  $d$  is

- A.  $\frac{{}^n C_d}{2^n}$
- B.  $\frac{{}^n C_d}{2^d}$
- C.  $\frac{d}{2^n}$
- D.  $\frac{1}{2^d}$

[gate2004-cse](#) [probability](#) [normal](#) [uniform-distribution](#)

**Answer**

**7.11.3 Uniform Distribution: GATE CSE 2004 | Question: 80** [top](#)<https://gateoverflow.in/1074>

A point is randomly selected with uniform probability in the  $X - Y$  plane within the rectangle with corners at  $(0,0), (1,0), (1,2)$  and  $(0,2)$ . If  $p$  is the length of the position vector of the point, the expected value of  $p^2$  is

- A.  $\left(\frac{2}{3}\right)$
- B. 1
- C.  $\left(\frac{4}{3}\right)$
- D.  $\left(\frac{5}{3}\right)$

[gate2004-cse](#) [probability](#) [uniform-distribution](#) [expectation](#) [normal](#)

[Answer](#)

**7.11.4 Uniform Distribution: GATE CSE 2007 | Question: 24** [top](#)<https://gateoverflow.in/1222>

Suppose we uniformly and randomly select a permutation from the  $20!$  permutations of  $1, 2, 3 \dots, 20$ . What is the probability that 2 appears at an earlier position than any other even number in the selected permutation?

- A.  $\left(\frac{1}{2}\right)$
- B.  $\left(\frac{1}{10}\right)$
- C.  $\left(\frac{9!}{20!}\right)$
- D. None of these

[gate2007-cse](#) [probability](#) [easy](#) [uniform-distribution](#)

[Answer](#)

**7.11.5 Uniform Distribution: GATE CSE 2014 Set 1 | Question: 2** [top](#)<https://gateoverflow.in/1717>

Suppose you break a stick of unit length at a point chosen uniformly at random. Then the expected length of the shorter stick is \_\_\_\_\_.

[gate2014-cse-set1](#) [probability](#) [uniform-distribution](#) [expectation](#) [numerical-answers](#) [normal](#)

[Answer](#)

**7.11.6 Uniform Distribution: GATE CSE 2019 | Question: 47** [top](#)<https://gateoverflow.in/302801>

Suppose  $Y$  is distributed uniformly in the open interval  $(1, 6)$ . The probability that the polynomial  $3x^2 + 6xY + 3Y + 6$  has only real roots is (rounded off to 1 decimal place) \_\_\_\_\_

[gate2019-cse](#) [numerical-answers](#) [engineering-mathematics](#) [probability](#) [uniform-distribution](#)

[Answer](#)

**7.11.7 Uniform Distribution: GATE CSE 2020 | Question: 45** [top](#)<https://gateoverflow.in/333186>

For  $n > 2$ , let  $a \in \{0, 1\}^n$  be a non-zero vector. Suppose that  $x$  is chosen uniformly at random from  $\{0, 1\}^n$ . Then, the probability that  $\sum_{i=1}^n a_i x_i$  is an odd number is \_\_\_\_\_

[gate2020-cse](#) [numerical-answers](#) [probability](#) [uniform-distribution](#)

[Answer](#)

**Answers: Uniform Distribution****7.11.1 Uniform Distribution: GATE CSE 1998 | Question: 3a** [top](#)<https://gateoverflow.in/1694>

- ✓ We are given that both will be reaching the park between 4 : 00 and 5 : 00.

Probability that one friend arrives between 4 : 00 and 4 : 50 =  $\frac{5}{6}$

Probability that one friend arrives between 4 : 00 and 4 : 50 and meets the other arriving in the next 10 minutes  
 $= \frac{5}{6} \times \frac{1}{6} \times 2 = \frac{10}{36} = \frac{5}{18}$ .

(For any time of arrival between 4 : 00 and 4 : 50, we have a 10 minute interval possible for the second friend to arrive, and 2 cases as for choosing which friend arrives first)

Probability that both friend arrives between 4 : 50 and 5 : 00 =  $\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$ .

This covers all possibility of a meet. So, required probability of non-meet

$$\begin{aligned} &= 1 - \left( \frac{5}{18} + \frac{1}{36} \right) \\ &= 1 - \frac{11}{36} \\ &= \frac{25}{36}. \end{aligned}$$

29 votes

-- Arjun Suresh (328k points)

### 7.11.2 Uniform Distribution: GATE CSE 2004 | Question: 78 [top](#)

<https://gateoverflow.in/1072>



✓ Answer - A

there  $n$  binary bits that can differ but only  $d$  should differ in this case,  
ways of choosing these  $d$  bits =  ${}^n C_d$

probability of  $d$  bits differ but,  $n - d$  bits do not differ =  $\left(\frac{1}{2}\right)^d \cdot \left(\frac{1}{2}\right)^{(n-d)}$

no of ways =  $\frac{{}^n C_d}{2^n}$ .

31 votes

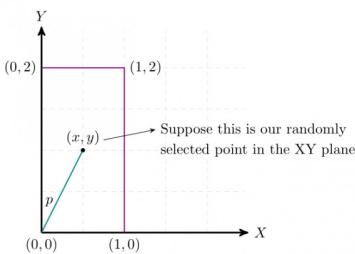
-- Ankit Rokde (6.9k points)

### 7.11.3 Uniform Distribution: GATE CSE 2004 | Question: 80 [top](#)

<https://gateoverflow.in/1074>



✓



Above diagram depicts the scenario of our Question.

The length  $p$  of our point  $(x, y)$  selected randomly in  $XY$  plane, from origin is given by

$$p = \sqrt{x^2 + y^2}$$

$$p^2 = x^2 + y^2$$

Expected value of  $p^2$  is given by

$$E[p^2] = E[x^2 + y^2]$$

By linearity of expectation

$$E[x^2 + y^2] = E[x^2] + E[y^2]$$

Now we need to calculate the probability density function of  $X$  and  $Y$ .

Since, distribution is Uniform

$$X \text{ goes from } 0 \text{ to } 1, \text{ so PDF}(x) = \frac{1}{1-0} = 1$$

$$Y \text{ goes from } 0 \text{ to } 2 \text{ so PDF}(y) = \frac{1}{2-0} = \frac{1}{2}$$

Now we evaluate

$$E[X^2] = \int_0^1 x^2 \cdot 1 dx = \frac{1}{3}$$

$$E[Y^2] = \int_0^2 y^2 \times (1/2) dy = \frac{4}{3}$$

$$E[P^2] = E[X^2] + E[Y^2] = \frac{5}{3}$$

Correct Answer: D

60 votes

-- Ayush Upadhyaya (28.2k points)

#### 7.11.4 Uniform Distribution: GATE CSE 2007 | Question: 24 [top](#)

<https://gateoverflow.in/1222>



- There are 10 even numbers (2, 4, ..., 20) possible as the one in the earliest position and all of these are equally likely. So, the probability of 2 becoming the earliest is simply  $\frac{1}{10}$ .

Correct Answer: B

65 votes

-- Arjun Suresh (328k points)

Total possible permutations = 20!

For 2 coming before any other even number, first we have to fix the positions of 10 even numbers which can be done in  $^{20}C_{10}$  ways. Now even numbers other than 2 can be permuted in 9! ways and 10 odd numbers (they have only 10 places left) can be permuted in 10! ways.

So, number of ways in which 2 comes before any other even number =  $^{20}C_{10} * 10!9!$

$$\text{Required probability} = \frac{^{20}C_{10} \cdot 10! \cdot 9!}{20!} = 1/10.$$

Answer is (B)

58 votes

-- richa07 (751 points)

#### 7.11.5 Uniform Distribution: GATE CSE 2014 Set 1 | Question: 2 [top](#)

<https://gateoverflow.in/1717>



- The length of the shorter stick can be from 0 to 0.5 (because if it is greater than 0.5, it is no longer a shorter stick).

This random variable  $L$  (length of shorter stick) follows a uniform distribution, and hence probability density function of  $L$  is  $\frac{1}{0.5 - 0} = 2$  for all lengths in range 0 to 0.5

$$\text{Now expected value of } L = \int_0^{0.5} L * p(L) dL = \int_0^{0.5} L * 2dL = 2 * \left[ \frac{L^2}{2} \right]_0^{0.5} = 0.25$$

71 votes

-- Happy Mittal (8.2k points)

#### 7.11.6 Uniform Distribution: GATE CSE 2019 | Question: 47 [top](#)

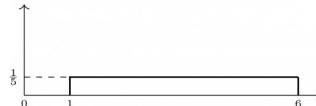
<https://gateoverflow.in/302801>



- Here,  $Y$  is uniformly distributed in (1, 6)

$$\therefore f(Y) = \begin{cases} \frac{1}{b-a} & 1 < Y < 6 \\ 0, & \text{otherwise} \end{cases}$$

$$\implies f(Y) = \frac{1}{b-a} = \frac{1}{6-1} = \frac{1}{5}$$



Now given Polynomial,

$$3x^2 + 6xY + (3Y + 6)$$

For real roots  $b^2 - 4ac \geq 0$

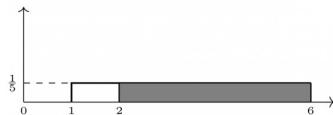
$$\implies (6Y)^2 - 4 \times 3 \times (3Y + 6) \geq 0$$

$$\implies Y^2 - 2Y + Y - 2 \geq 0$$

$$\implies (Y - 2)(Y + 1) \geq 0$$

$$\implies Y \geq 2, Y \geq -1$$

So, we need area of the region in the above graph, for (2, 6)



$$\text{Area} = B \times H$$

$$= (6 - 2) \times \frac{1}{5}$$

$$= \frac{4}{5} = 0.8$$

18 votes

-- Shashi Shekhar (631 points)

#### 7.11.7 Uniform Distribution: GATE CSE 2020 | Question: 45 [top](#)

<https://gateoverflow.in/333186>



- ✓ Although a generalized answer is always good, we can also solve this question quickly by taking an example, say  $n = 3$

Let  $a = (0, 0, 1)$ . Then, for all 8 combinations of 'x' only 4 combinations  $(0, 0, 1), (0, 1, 1), (1, 0, 1), (1, 1, 1)$  will produce odd number (only 1 in this case), so probability will be 0.5.

18 votes

-- Aditya Pradhan (625 points)

## Answer Keys

7.1.1	C	7.1.2	D	7.1.3	A	7.1.4	A	7.1.5	A
7.1.6	A	7.1.7	C	7.2.1	D	7.2.2	N/A	7.2.3	D
7.2.4	A	7.2.5	C	7.2.6	B	7.2.7	B	7.2.8	0.55
7.2.9	A	7.2.10	0.60 : 0.61	7.2.11	0.04 : 0.04	7.2.12	C	7.3.1	0.5
7.4.1	C	7.4.2	D	7.4.3	D	7.4.4	C	7.4.5	C
7.4.6	3.8 : 3.9	7.4.7	D	7.5.1	C	7.6.1	0.93	7.6.2	C
7.6.3	D	7.7.1	A	7.7.2	0	7.8.1	N/A	7.8.2	C
7.8.3	54	7.8.4	B	7.9.1	D	7.9.2	C	7.9.3	D
7.9.4	C	7.9.5	D	7.9.6	B	7.9.7	B	7.9.8	C
7.9.9	A	7.9.10	A	7.9.11	A	7.9.12	A	7.9.13	10
7.9.14	11.85 : 11.95	7.9.15	0.259 : 0.261	7.9.16	0.25	7.9.17	0.33 : 0.34	7.9.18	0.0230 : 0.0232
7.9.19	A	7.9.20	B	7.9.21	B	7.9.22	B	7.9.23	X
7.10.1	C	7.10.2	D	7.10.3	C	7.10.4	0.75	7.10.5	B
7.10.6	0.35 : 0.39	7.10.7	D	7.10.8	15.00 : 16.00	7.11.1	0.69:0.70	7.11.2	A
7.11.3	D	7.11.4	B	7.11.5	0.24 : 0.27	7.11.6	0.8	7.11.7	0.5

## 8

## General Aptitude: Analytical Aptitude (91)



Logic: deduction and induction, Analogy, Numerical relations and reasoning

## Mark Distribution in Previous GATE

Year	2021-1	2021-2	Minimum	Average	Maximum
1 Mark Count	0	0	0	0	0
2 Marks Count	1	1	1	1	1
Total Marks	2	2	2	2	2

## 8.1

Age Relation (1) top ↗8.1.1 Age Relation: GATE2013 CE: GA-10 top ↗<https://gateoverflow.in/40280>

Abhishek is elder to Savar. Savar is younger to Anshul. Which of the given conclusions is logically valid and is inferred from the above statements?

- A. Abhishek is elder to Anshul
- B. Anshul is elder to Abhishek
- C. Abhishek and Anshul are of the same age
- D. No conclusion follows

[gate2013-ce](#) [logical-reasoning](#) [age-relation](#)

Answer

## Answers: Age Relation

8.1.1 Age Relation: GATE2013 CE: GA-10 top ↗<https://gateoverflow.in/40280>

- ✓ D) No conclusion follows as we can not derive any relationship between Abhishek and Anshul with the given data.

1 20 votes

-- vamsi2376 (2.8k points)

## 8.2

Code Words (2) top ↗8.2.1 Code Words: GATE2014 EC-4: GA-7 top ↗<https://gateoverflow.in/41469>

If 'KCLFTSB' stands for 'best of luck' and 'SHSWDG' stands for 'good wishes', which of the following indicates 'ace the exam'?

- A. MCHTX
- B. MXHTC
- C. XMHCT
- D. XMHTC

[gate2014-ec-4](#) [analytical-aptitude](#) [normal](#) [logical-reasoning](#) [code-words](#)

Answer

8.2.2 Code Words: GATE2018 EE: GA-7 top ↗<https://gateoverflow.in/205187>

In a certain code, AMCF is written as EQGJ and NKUF is written as ROYJ. How will DHLP be written in that code?

- A. RSTN
- B. TLPH
- C. HLPT
- D. XSVR

[gate2018-ee](#) [general-aptitude](#) [analytical-aptitude](#) [logical-reasoning](#) [code-words](#)

Answer

## Answers: Code Words

**8.2.1 Code Words: GATE2014 EC-4: GA-7** top ↗<https://gateoverflow.in/41469>

- ✓ Best of luck - KCLFTSB  
If we read it backwards BSTFLCK

Good wishes SHSWDG  
If we read it backwards GDWSHS

Similarly, for "Ace the exam" it should be "MXHTC" which when read backward "CTHXM"

Answer (B) MXHTC

Edit: added by Sonam Vyas  
Just remove the vowels and read from backward to get the answer ☺

14 votes

-- Abhilash Panicker (7.6k points)

**8.2.2 Code Words: GATE2018 EE: GA-7** top ↗<https://gateoverflow.in/205187>

- ✓  $AMFC = EQGJ$

$NKUF = ROYJ$

It is clear from both the words that corresponding alphabets are obtained by incrementing particular letter by 4, for ex:  
 $A + 4 = E, N + 4 = R$ .

So,  $D + 4 = H, H + 4 = L, L + 4 = P, P + 4 = T$

Hence option c) is correct

2 votes

-- Ashwani Kumar (12.8k points)

**8.3****Direction Sense (10)** top ↗**8.3.1 Direction Sense: GATE CSE 2015 Set 2 | Question: GA-7** top ↗<https://gateoverflow.in/8036>

Four branches of a company are located at  $M, N, O$  and  $P$ .  $M$  is north of  $N$  at a distance of 4km;  $P$  is south of  $O$  at a distance of 2 km;  $N$  is southeast of  $O$  by 1km. What is the distance between  $M$  and  $P$  in km?

- A. 5.34
- B. 6.74
- C. 28.5
- D. 45.49

gate2015-cse-set2 analytical-aptitude normal direction-sense

Answer ↗

**8.3.2 Direction Sense: GATE CSE 2017 Set 2 | Question: GA-3** top ↗<https://gateoverflow.in/118417>

There are five buildings called  $V, W, X, Y$  and  $Z$  in a row (not necessarily in that order).  $V$  is to the West of  $W$ .  $Z$  is to the East of  $X$  and the West of  $V$ .  $W$  is to the West of  $Y$ . Which is the building in the middle?

- A.  $V$
- B.  $W$
- C.  $X$
- D.  $Y$

gate2017-cse-set2 analytical-aptitude direction-sense normal

Answer ↗

**8.3.3 Direction Sense: GATE CSE 2019 | Question: GA-10** top ↗<https://gateoverflow.in/302863>

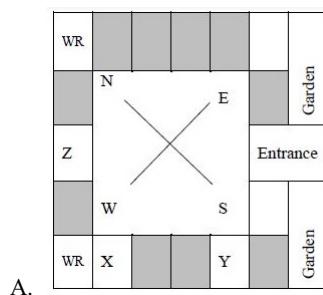
Three of the five students are allocated to a hostel put in special requests to the warden, Given the floor plan of the vacant rooms, select the allocation plan that will accommodate all their requests.

Request by X: Due to pollen allergy, I want to avoid a wing next to the garden.

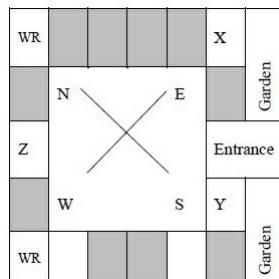
Request by Y: I want to live as far from the washrooms as possible, since I am very much sensitive to smell.

Request by Z: I believe in Vaastu and so I want to stay in South-West wing.

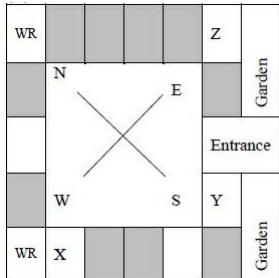
The shaded rooms are already occupied. WR is washroom



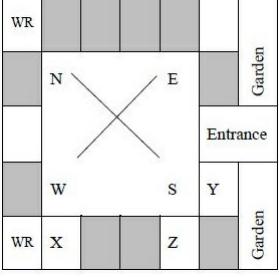
A.



B.



C.



D.

[gate2019-cse](#) [general-aptitude](#) [analytical-aptitude](#) [direction-sense](#)

Answer

#### 8.3.4 Direction Sense: GATE Civil 2021 Set 2 | GA Question: 6

<https://gateoverflow.in/359899>



On a planar field, you travelled 3 units East from a point  $O$ . Next you travelled 4 units South to arrive at point  $P$ . Then you travelled from  $P$  in the North-East direction such that you arrive at a point that is 6 units East of point  $O$ . Next, you travelled in the North-West direction, so that you arrive at point  $Q$  that is 8 units North of point  $P$ . The distance of point  $Q$  to point  $O$ , in the same units, should be \_\_\_\_\_

- A. 3
- B. 4
- C. 5
- D. 6

[gatecivil-2021-set2](#) [analytical-aptitude](#) [direction-sense](#)

Answer

**8.3.5 Direction Sense: GATE Mechanical 2021 Set 1 | GA Question: 2** [top](#)<https://gateoverflow.in/359486>

Ms. X came out of a building through its front door to find her shadow due to the morning sun failing to her right side with the building to her back. From this, it can be inferred that building is facing \_\_\_\_\_

- A. North
- B. East
- C. West
- D. South

[gateme-2021-set1](#) [analytical-aptitude](#) [direction-sense](#)

Answer

**8.3.6 Direction Sense: GATE Mechanical 2021 Set 2 | GA Question: 5** [top](#)<https://gateoverflow.in/359503>

The front door of Mr. X's house faces East. Mr. X leaves the house, walking 50 m straight from the back door that is situated directly opposite to the front door. He then turns to his right, walks for another 50 m and stops. The direction of the point Mr. X is now located at with respect to the starting point is \_\_\_\_\_

- A. South-East
- B. North-East
- C. West
- D. North-West

[gateme-2021-set2](#) [analytical-aptitude](#) [direction-sense](#)

Answer

**8.3.7 Direction Sense: GATE2014 AG: GA-9** [top](#)<https://gateoverflow.in/41673>

X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?

- A. 1
- B.  $\sqrt{2}$
- C.  $\sqrt{3}$
- D. 2

[gate2014-ag](#) [analytical-aptitude](#) [direction-sense](#) [normal](#)

Answer

**8.3.8 Direction Sense: GATE2015 CE-2: GA-4** [top](#)<https://gateoverflow.in/40179>

Mr. Vivek walks 6 meters North-east, then turns and walks 6 meters South-east, both at 60 degrees to east. He further moves 2 meters South and 4 meters West. What is the straight distance in meters between the point he started from and the point he finally reached?

- A.  $2\sqrt{2}$
- B. 2
- C.  $\sqrt{2}$
- D.  $1/\sqrt{2}$

[gate2015-ce-2](#) [analytical-aptitude](#) [general-aptitude](#) [direction-sense](#)

Answer

**8.3.9 Direction Sense: GATE2016 EC-2: GA-9** [top](#)<https://gateoverflow.in/108726>

M and N start from the same location. M travels 10 km East and then 10 km North-East. N travels 5 km South and then 4 km South-East. What is the shortest distance (in km) between M and N at the end of their travel?

- A. 18.60
- B. 22.50
- C. 20.61
- D. 25.00



Moreover X and Y's requests have also been satisfied : X has not been assigned close to the garden.

Y has not been assigned close to the washroom.

12 votes

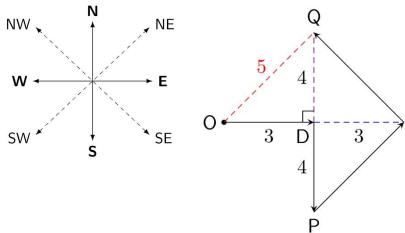
-- Sayan Bose (5k points)

### 8.3.4 Direction Sense: GATE Civil 2021 Set 2 | GA Question: 6 [top](#)

<https://gateoverflow.in/359899>



- ✓ First, we can draw the diagram using the given description.



$\triangle ODQ$  is right angle triangle, so here we can apply Pythagoras's theorem, then we get

$$OQ^2 = OD^2 + DQ^2$$

$$\Rightarrow OQ^2 = 4^2 + 3^2 = 16 + 9 = 25$$

$$\Rightarrow OQ = 5 \text{ units.}$$

$\therefore$  The distance of point Q to point O, in the same units, should be 5.

So, the correct answer is (C).

1 votes

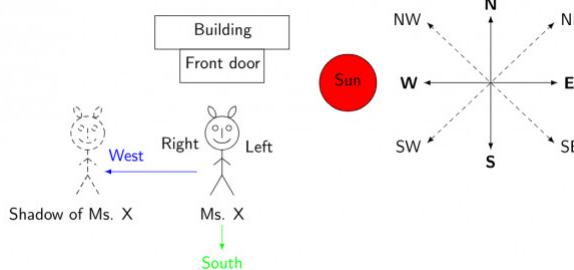
-- Lakshman Patel (63.9k points)

### 8.3.5 Direction Sense: GATE Mechanical 2021 Set 1 | GA Question: 2 [top](#)

<https://gateoverflow.in/359486>



- ✓



from the above diagram, we can conclude that the building is facing south.

So, the correct answer is (D).

1 votes

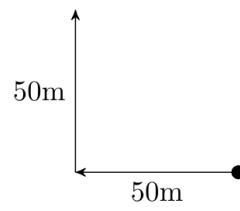
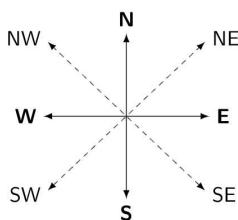
-- Lakshman Patel (63.9k points)

### 8.3.6 Direction Sense: GATE Mechanical 2021 Set 2 | GA Question: 5 [top](#)

<https://gateoverflow.in/359503>



- ✓ The front door of Mr. X's house faces East. Then the back door of Mr. X's house faces West (the back door that is situated directly opposite to the front door).



$\therefore$  The direction of the point Mr. X is now located at with respect to the starting point is North-West.

So, the correct answer is (D).

1 votes

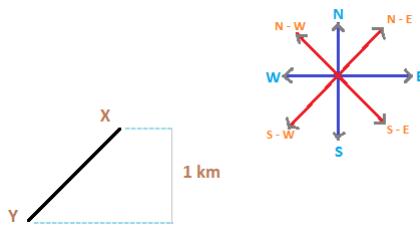
-- Lakshman Patel (63.9k points)

## 8.3.7 Direction Sense: GATE2014 AG: GA-9 top ↵

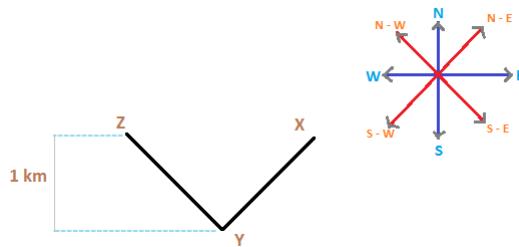
☞ <https://gateoverflow.in/41673>

✓ Let's break the whole thing down :

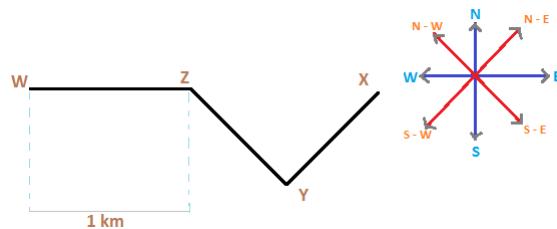
$X$  is 1 km northeast of  $Y$



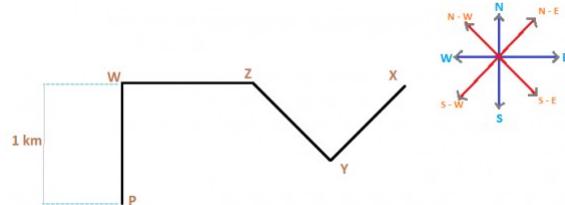
$Y$  is 1 km southeast of  $Z$ .



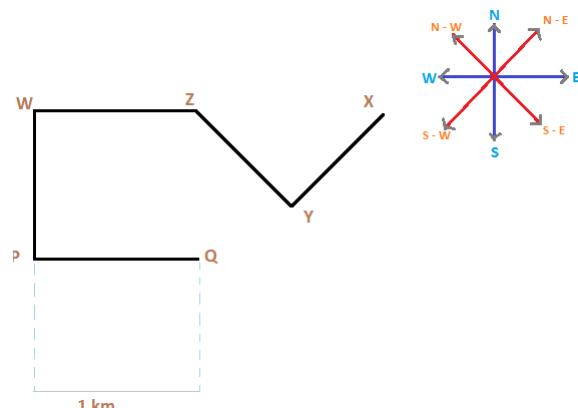
$W$  is 1 km west of  $Z$



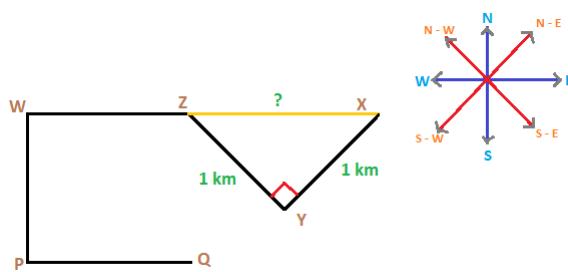
$P$  is 1 km south of  $W$



$Q$  is 1 km east of  $P$



The distance between  $X$  &  $Z$  will be



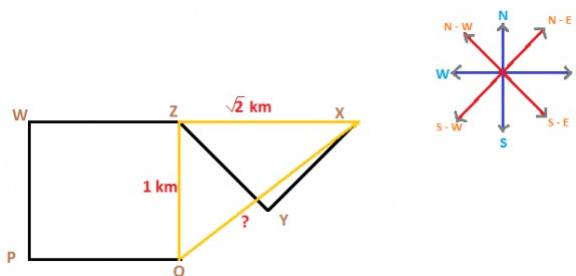
Applying pythagoras theorem on  $\triangle XYZ$  triangle, we get-

$$(XZ)^2 = (XY)^2 + (YZ)^2$$

$$\text{Or, } (XZ)^2 = 1 + 1 \quad [\because XY = 1 \text{ km} \& YZ = 1 \text{ km}]$$

$$\text{Or, } XZ = \sqrt{2} \text{ km}$$

Now, we need to find the distance between  $X$  &  $Q$  in km



By applying Pythagoras Theorem on  $\triangle XQZ$  we get -

$$(XQ)^2 = (QZ)^2 + (ZX)^2$$

$$\text{Or, } (XQ)^2 = 1^2 + (\sqrt{2})^2 \quad [\because QZ = 1 \text{ km} \& ZX = \sqrt{2} \text{ km}]$$

$$\text{Or, } (XQ)^2 = 1 + 2 = 3$$

$$\text{Or, } (XQ) = \sqrt{3} \text{ km}$$

Correct Answer: C

28 votes

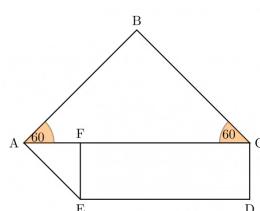
-- Subarna Das (11.3k points)



### 8.3.8 Direction Sense: GATE2015 CE-2: GA-4 top

<https://gateoverflow.in/40179>

✓ Option A  $2\sqrt{2}$



$$AB = 6m, BC = 6m, CD = 2m, ED = 4m$$

$$\angle BAC = 60, \angle BCA = 60$$

$$\text{so, } \angle ABC = (180 - 60 - 60) = 60$$

and  $AC = 6$  (Equilateral triangle)

A is the starting point. Vivek walks 6 meters North-east to point B, then turns and walks 6 meters South-east to point C. He further moves 2 meters South to the point D and 4 meters West to point E and E is the endpoint.

As shown in figure,  $AC = 6m$  and  $ED = FC = 4m$ .

$$\implies AF = AC - FC = 6 - 4 = 2m$$

$$\text{and } EF = CD = 2m \text{ and } \angle AFE = 90^\circ$$

By Pythagoras theorem

$$AE^2 = EF^2 + AF^2$$

$$= 4 + 4 = 8$$

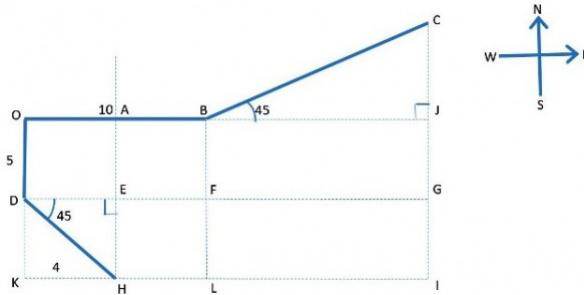
$$\implies AE = 2\sqrt{2}.$$

9 votes

-- khush tak (5.9k points)

### 8.3.9 Direction Sense: GATE2016 EC-2: GA-9 top ↗

☞ <https://gateoverflow.in/108726>



In  $\triangle DEH$

$$\sin 45 = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{EH}{4}$$

$$\Rightarrow EH = 2\sqrt{2}$$

$$\cos 45 = \frac{\text{adjacent side}}{\text{hypotenuse}} = \frac{DE}{4}$$

$$\Rightarrow DE = 2\sqrt{2}$$

In  $\triangle BJC$

$$\sin 45 = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{CJ}{10}$$

$$\Rightarrow CJ = 5\sqrt{2}$$

$$\cos 45 = \frac{\text{adjacent side}}{\text{hypotenuse}} = \frac{BJ}{10}$$

$$\Rightarrow BJ = 5\sqrt{2}$$

Required Shortest Distance  $HC$

Using Pythagoras's theorem in Triangle  $\triangle HIC$

$$HC = \sqrt{(HI)^2 + (CI)^2}$$

Where as ,

$$HI = HL + LI$$

From Figure,  $HL = 10 - 2\sqrt{2}$  and  $LI = 5\sqrt{2}$

$$HI = 10 - 2\sqrt{2} + 5\sqrt{2} = 10 + 3\sqrt{2}$$

$$CI = CJ + JG + GI$$

Fom Figure ,  $CJ = 5\sqrt{2}$  ,  $JG = 5$  ,  $GI = 2\sqrt{2}$

$$CI = 5\sqrt{2} + 5 + 2\sqrt{2} = 5 + 7\sqrt{2}$$

Therefore ,

$$HC = \sqrt{(10 + 3\sqrt{2})^2 + (5 + 7\sqrt{2})^2} = 20.61 \text{ km}$$

Correct Answer: C

#### References



18 votes

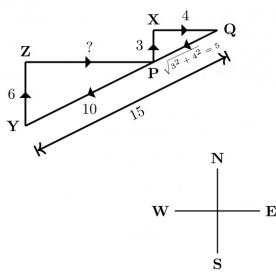
-- Akhil Nadh PC (16.6k points)

### 8.3.10 Direction Sense: GATE2017 EC-2: GA-4 top ↗

☞ <https://gateoverflow.in/313508>



- ✓ Fatima traverses like this:-



Making right angle triangles,  $\triangle PXQ$  & then  $\triangle PZY$ .

So, to reach point  $P$  from  $Y$  she has to travel  $= \sqrt{(10^2 - 6^2)} = 8 \text{ km}$ . (in East direction)

Hence, Correct Answer: A. 8 km, East

5 votes

-- Naveen Kumar (9.9k points)

## 8.4

### Family Relationships (4) [top](#)

#### 8.4.1 Family Relationships: GATE Civil 2021 Set 1 | GA Question: 6 [top](#)

<https://gateoverflow.in/359879>



Statement: Either  $P$  marries  $Q$  or  $X$  marries  $Y$

Among the options below, the logical NEGATION of the above statement is :

- A.  $P$  does not marry  $Q$  and  $X$  marries  $Y$
- B. Neither  $P$  marries  $Q$  nor  $X$  marries  $Y$
- C.  $X$  does not marry  $Y$  and  $P$  marries  $Q$
- D.  $P$  marries  $Q$  and  $X$  marries  $Y$

[gatecivil-2021-set1](#) [analytical-aptitude](#) [logical-reasoning](#) [family-relationships](#)

Answer [¶](#)

#### 8.4.2 Family Relationships: GATE2016 EC-3: GA-3 [top](#)

<https://gateoverflow.in/110827>



$M$  has a son  $Q$  and a daughter  $R$ . He has no other children.  $E$  is the mother of  $P$  and daughter-in-law of  $M$ . How is  $P$  related to  $M$ ?

- A.  $P$  is the son-in-law of  $M$ .
- B.  $P$  is the grandchild of  $M$ .
- C.  $P$  is the daughter-in law of  $M$ .
- D.  $P$  is the grandfather of  $M$ .

[gate2016-ec-3](#) [family-relationships](#) [logical-reasoning](#)

Answer [¶](#)

#### 8.4.3 Family Relationships: GATE2017 EC-2: GA-7 [top](#)

<https://gateoverflow.in/313510>



Each of  $P, Q, R, S, W, X, Y$  and  $Z$  has been married at most once.  $X$  and  $Y$  are married and have two children  $P$  and  $Q$ .  $Z$  is the grandfather of the daughter  $S$  of  $P$ . Further,  $Z$  and  $W$  are married and are parents of  $R$ . Which one of the following must necessarily be FALSE?

- A.  $X$  is the mother-in-law of  $R$
- B.  $P$  and  $R$  are not married to each other
- C.  $P$  is a son of  $X$  and  $Y$
- D.  $Q$  cannot be married to  $R$

[gate2017-ec-2](#) [general-aptitude](#) [logical-reasoning](#) [family-relationships](#)

Answer [¶](#)

#### 8.4.4 Family Relationships: GATE2019 CE-1: GA-10 [top](#)

<https://gateoverflow.in/313448>



$P, Q, R, S$  and  $T$  are related and belong to the same family.  $P$  is the brother of  $S$ ,  $Q$  is the wife of  $P$ .  $R$  and  $T$  are the children of the siblings  $P$  and  $S$  respectively. Which one of the following statement is necessarily FALSE?

- A.  $S$  is the aunt of  $R$
- B.  $S$  is the aunt of  $T$
- C.  $S$  is the sister-in-law of  $Q$
- D.  $S$  is the brother of  $P$

[gate2019-ce-1](#) [general-aptitude](#) [logical-reasoning](#) [family-relationships](#)

Answer 

### Answers: Family Relationships

#### 8.4.1 Family Relationships: GATE Civil 2021 Set 1 | GA Question: 6



- ✓ The given statement is: Either  $P$  marries  $Q$  or  $X$  marries  $Y$ .

The logical NEGATION of the above statement is : Neither  $P$  marries  $Q$  nor  $X$  marries  $Y$ .

We can also write the above statement as  $P$  does not marry  $Q$  and  $X$  does not marry  $Y$ .

So, the correct answer is (B).

 1 votes

-- Lakshman Patel (63.9k points)

#### 8.4.2 Family Relationships: GATE2016 EC-3: GA-3



- ✓  $P$ 's mother is  $E$  and  $E$  is daughter-in-law of  $M$ . So,  $M$  being a man (use of He) is the grand father of  $P$ .

Not relevant to the given question but  $Q$  is the father of  $P$  as  $Q$  is the only son of  $M$ .

Correct Answer: B

 2 votes

-- Arjun Suresh (328k points)

#### 8.4.3 Family Relationships: GATE2017 EC-2: GA-7



- ✓ Let  $\rightarrow$  represent the child relation.

- $\{X, Y\} \rightarrow P, Q$
- $P \rightarrow S$
- $\{Z, W\} \rightarrow R$
- Further either  $P$  or  $P$ 's spouse is the child of  $Z$  so that  $S$  become the grand daughter of  $Z$ .

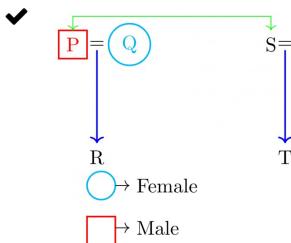
1.  $X$  is the mother-in-law of  $R$  -- possible if  $R$  is married to either  $P$  or  $Q$ .
2.  $P$  and  $R$  are not married to each other --  $P$  has only  $R$  to marry as  $Q$  is a sibling and  $S$  daughter, but  $P$  can also be married to anyone not mentioned in the question. So, this is possible.
3.  $P$  is a son of  $X$  and  $Y$  -- possible as  $P$  can either be a son or daughter of  $X$  and  $Y$ .
4.  $Q$  cannot be married to  $R$  -- FALSE as  $Q$  can be married to  $R$ .

Correct Option: D

 1 votes

-- Arjun Suresh (328k points)

#### 8.4.4 Family Relationships: GATE2019 CE-1: GA-10



- A.  $S$  is the aunt of  $R$ – It may be false as  $S$  can also be the uncle.
- B.  $S$  is the aunt of  $T$ – It must be false, because  $S$  either father of  $T$  or mother of  $T$ .
- C.  $S$  is the sister-in-law of  $Q$ – It may be false as  $S$  can be brother-in-law too.

D.  $S$  is the brother of  $P$ — It may be false as  $S$  can be sister too.

So, the correct answer is (B).

2 votes

-- Lakshman Patel (63.9k points)

8.5

## Logical Reasoning (38) top ↗

### 8.5.1 Logical Reasoning: GATE CSE 2010 | Question: 61 top ↗

<https://gateoverflow.in/2369>



If  $137 + 276 = 435$  how much is  $731 + 672$ ?

- A. 534
- B. 1403
- C. 1623
- D. 1513

gate2010-cse analytical-aptitude normal logical-reasoning

Answer

### 8.5.2 Logical Reasoning: GATE CSE 2010 | Question: 62 top ↗

<https://gateoverflow.in/2370>



Hari(H), Gita(G), Irfan(I) and Saira(S) are siblings (i.e., brothers and sisters). All were born on 1<sup>st</sup> January. The age difference between any two successive siblings (that is born one after another) is less than three years. Given the following facts:

- i. Hari's age + Gita's age > Irfan's age + Saira's age
- ii. The age difference between Gita and Saira is one year. However Gita is not the oldest and Saira is not the youngest.
- iii. There are no twins.

In what order they were born (oldest first)?

- A. HSIG
- B. SGHI
- C. IGSH
- D. IHSG

gate2010-cse analytical-aptitude logical-reasoning normal

Answer

### 8.5.3 Logical Reasoning: GATE CSE 2015 Set 3 | Question: GA-1 top ↗

<https://gateoverflow.in/8298>



If  $ROAD$  is written as  $URDG$ , then  $SWAN$  should be written as:

- A.  $VXDQ$
- B.  $VZDQ$
- C.  $VZDP$
- D.  $UXDQ$

gate2015-cse-set3 analytical-aptitude easy logical-reasoning

Answer

### 8.5.4 Logical Reasoning: GATE CSE 2015 Set 3 | Question: GA-7 top ↗

<https://gateoverflow.in/8308>



The head of newly formed government desires to appoint five of the six selected members  $P, Q, R, S, T$  and  $U$  to portfolios of Home, Power, Defense, Telecom, and Finance.  $U$  does not want any portfolio if  $S$  gets one of the five.  $R$  wants either Home or Finance or no portfolio.  $Q$  says that if  $S$  gets Power or Telecom, then she must get the other one.  $T$  insists on a portfolio if  $P$  gets one.

Which is the valid distribution of portfolios?

- A.  $P$ -Home,  $Q$ -Power,  $R$ -Defense,  $S$ -Telecom,  $T$ -Finance
- B.  $R$ -Home,  $S$ -Power,  $P$ -Defense,  $Q$ -Telecom,  $T$ -Finance
- C.  $P$ -Home,  $Q$ -Power,  $T$ -Defense,  $S$ -Telecom,  $U$ -Finance
- D.  $Q$ -Home,  $U$ -Power,  $T$ -Defense,  $R$ -Telecom,  $P$ -Finance

gate2015-cse-set3 analytical-aptitude normal logical-reasoning

Answer 

### 8.5.5 Logical Reasoning: GATE CSE 2016 Set 1 | Question: GA04 <https://gateoverflow.in/39609>

If 'relftaga' means carefree, 'otaga' means careful and 'fertaga' means careless, which of the following could mean 'aftercare'?

- A. zentaga
- B. tagafer.
- C. tagazzen.
- D. relffer.

gate2016-cse-set1 analytical-aptitude logical-reasoning normal

Answer 

### 8.5.6 Logical Reasoning: GATE CSE 2017 Set 1 | Question: GA-3 <https://gateoverflow.in/118406>

Rahul, Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?

- A. Rahul and Murali
- B. Srinivas and Arul
- C. Srinivas and Murali
- D. Srinivas and Rahul

gate2017-cse-set1 analytical-aptitude logical-reasoning

Answer 

### 8.5.7 Logical Reasoning: GATE CSE 2017 Set 2 | Question: GA-7 <https://gateoverflow.in/118421>

There are three boxes. One contains apples, another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labeled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes?

- A. The box labeled 'Apples'
- B. The box labeled 'Apples and Oranges'
- C. The box labeled 'Oranges'
- D. Cannot be determined

gate2017-cse-set2 analytical-aptitude normal tricky logical-reasoning

Answer 

### 8.5.8 Logical Reasoning: GATE CSE 2021 Set 2 | GA Question: 10 <https://gateoverflow.in/357540>

Six students P, Q, R, S, T and U, with distinct heights, compare their heights and make the following observations.

- Observation I: S is taller than R.
- Observation II: Q is the shortest of all.
- Observation III: U is taller than only one student.
- Observation IV: T is taller than S but is not the tallest

The number of students that are taller than R is the same as the number of students shorter than \_\_\_\_\_.

- A. T
- B. R
- C. S
- D. P

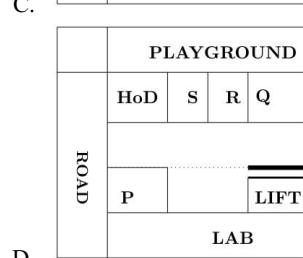
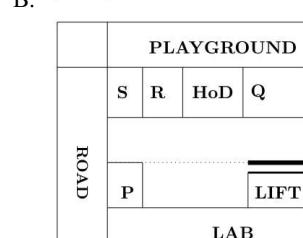
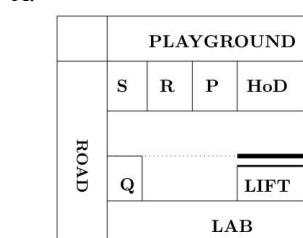
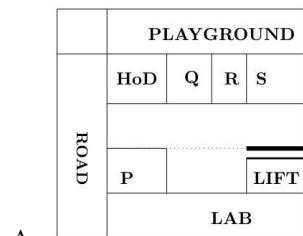
gate2021-cse-set2 analytical-aptitude logical-reasoning

Answer 

8.5.9 Logical Reasoning: GATE Civil 2020 Set 2 | GA Question: 4 [top ↗](#)<https://gateoverflow.in/359840>

After the inauguration of the new building, the Head of the Department (HoD) collated faculty preferences for office space.  $P$  wanted a room adjacent to the lab.  $Q$  wanted to be close to the lift.  $R$  wanted a view of the playground and  $S$  wanted a corner office.

Assuming that everyone was satisfied, which among the following shows a possible allocation?



[gate2020-ce-2](#) [analytical-aptitude](#) [logical-reasoning](#)

Answer

8.5.10 Logical Reasoning: GATE Mechanical 2021 Set 1 | GA Question: 4 [top ↗](#)<https://gateoverflow.in/359482>

If  $\begin{cases} \oplus \text{ means } - \\ \otimes \text{ means } \div \\ \triangle \text{ means } + \\ \nabla \text{ means } \times \end{cases}$

then, the value of the expression  $\triangle 2 \oplus 3\triangle ((4 \otimes 2)\nabla 4) =$

- A. -1
- B. -0.5
- C. 6
- D. 7

[gateme-2021-set1](#) [analytical-aptitude](#) [logical-reasoning](#)

Answer

**8.5.11 Logical Reasoning: GATE Mechanical 2021 Set 2 | GA Question: 4** top ↗<https://gateoverflow.in/359505>

If  $\oplus \div \odot = 2$ ;  $\oplus \div \Delta = 3$ ;  $\odot + \Delta = 5$ ;  $\Delta \times \otimes = 10$ ,

Then, the value of  $(\otimes - \oplus)^2$ , is :

- A. 0
- B. 1
- C. 4
- D. 16

[gateme-2021-set2](#) [analytical-aptitude](#) [logical-reasoning](#)

Answer 

**8.5.12 Logical Reasoning: GATE2011 GG: GA-8** top ↗<https://gateoverflow.in/40209>

Three sisters ( $R$ ,  $S$ , and  $T$ ) received a total of 24 toys during Christmas. The toys were initially divided among them in a certain proportion. Subsequently,  $R$  gave some toys to  $S$  which doubled the share of  $S$ . Then  $S$  in turn gave some of her toys to  $T$ , which doubled  $T$ 's share. Next, some of  $T$ 's toys were given to  $R$ , which doubled the number of toys that  $R$  currently had. As a result of all such exchanges, the three sisters were left with equal number of toys. How many toys did  $R$  have originally?

- A. 8
- B. 9
- C. 11
- D. 12

[gate2011-gg](#) [logical-reasoning](#) [analytical-aptitude](#)

Answer 

**8.5.13 Logical Reasoning: GATE2011 MN: GA-63** top ↗<https://gateoverflow.in/31543>

$L$ ,  $M$  and  $N$  are waiting in a queue meant for children to enter the zoo. There are 5 children between  $L$  and  $M$ , and 8 children between  $M$  and  $N$ . If there are 3 children ahead of  $N$  and 21 children behind  $L$ , then what is the minimum number of children in the queue?

- A. 28
- B. 27
- C. 41
- D. 40

[analytical-aptitude](#) [gate2011-mn](#) [logical-reasoning](#)

Answer 

**8.5.14 Logical Reasoning: GATE2012 AR: GA-8** top ↗<https://gateoverflow.in/40229>

Ravi is taller than Arun but shorter than Iqbal. Sam is shorter than Ravi. Mohan is shorter than Arun. Balu is taller than Mohan and Sam. The tallest person can be

- A. Mohan
- B. Ravi
- C. Balu
- D. Arun

[gate2012-ar](#) [logical-reasoning](#)

Answer 

**8.5.15 Logical Reasoning: GATE2012 CY: GA-9** top ↗<https://gateoverflow.in/40240>

There are eight bags of rice looking alike, seven of which have equal weight and one is slightly heavier. The weighing balance is of unlimited capacity. Using this balance, the minimum number of weighings required to identify the heavier bag is

- A. 2

- B. 3  
C. 4  
D. 8

gate2012-cy analytical-aptitude logical-reasoning

Answer 

### 8.5.16 Logical Reasoning: GATE2014 AE: GA-7

<https://gateoverflow.in/40307>



Anuj, Bhola, Chandan, Dilip, Eswar and Faisal live on different floors in a six-storeyed building (the ground floor is numbered 1, the floor above it 2, and so on) Anuj lives on an even-numbered floor, Bhola does not live on an odd numbered floor. Chandan does not live on any of the floors below Faisal's floor. Dilip does not live on floor number 2. Eswar does not live on a floor immediately above or immediately below Bhola. Faisal lives three floors above Dilip. Which of the following floor-person combinations is correct?

	Anuj	Bhola	Chandan	Dilip	Eswar	Faisal
(A)	6	2	5	1	3	4
(B)	2	6	5	1	3	4
(C)	4	2	6	3	1	5
(D)	2	4	6	1	3	5

gate2014-ae logical-reasoning analytical-aptitude descriptive

Answer 

### 8.5.17 Logical Reasoning: GATE2014 AG: GA-6

<https://gateoverflow.in/41670>



In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?

#### Statements

1. Shiv is younger to Riaz.
  2. Shiv is elder to Som.
- A. Statement 1 by itself determines the eldest child.  
 B. Statement 2 by itself determines the eldest child.  
 C. Statements 1 and 2 are both required to determine the eldest child.  
 D. Statements 1 and 2 are not sufficient to determine the eldest child.

gate2014-ag analytical-aptitude logical-reasoning normal

Answer 

### 8.5.18 Logical Reasoning: GATE2014 EC-2: GA-7

<https://gateoverflow.in/41515>



Lights of four colors (red, blue, green, yellow) are hung on a ladder. On every step of the ladder there are two lights. If one of the lights is red, the other light on that step will always be blue. If one of the lights on a step is green, the other light on that step will always be yellow. Which of the following statements is not necessarily correct?

- A. The number of red lights is equal to the number of blue lights  
 B. The number of green lights is equal to the number of yellow lights  
 C. The sum of the red and green lights is equal to the sum of the yellow and blue lights  
 D. The sum of the red and blue lights is equal to the sum of the green and yellow lights

gate2014-ec-2 analytical-aptitude logical-reasoning normal

Answer 

### 8.5.19 Logical Reasoning: GATE2014 EC-3: GA-5

<https://gateoverflow.in/41144>



In which of the following options will the expression  $P < M$  be definitely true?

- A.  $M < R > P > S$
- B.  $M > S < P < F$
- C.  $Q < M < F = P$
- D.  $P = A < R < M$

[gate2014-ec-3](#) [logical-reasoning](#) [analytical-aptitude](#)

Answer 

#### 8.5.20 Logical Reasoning: GATE2015 EC-1: GA-4 [top](#)

► <https://gateoverflow.in/39492>



Operators  $\square$ ,  $\diamond$  and  $\rightarrow$  are defined by:  $a \square b = \frac{a-b}{a+b}$ ;  $a \diamond b = \frac{a+b}{a-b}$ ;  $a \rightarrow b = ab$ .

Find the value of  $(66 \square 6) \rightarrow (66 \diamond 6)$ .

- A. -2
- B. -1
- C. 1
- D. 2

[gate2015-ec-1](#) [logical-reasoning](#)

Answer 

#### 8.5.21 Logical Reasoning: GATE2015 EC-2: GA- 7 [top](#)

► <https://gateoverflow.in/39508>



Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.

Statements:

- I. All film stars are playback singers.
- II. All film directors are film stars.

Conclusions:

- I. All film directors are playback singers.
- II. Some film stars are film directors.

- A. Only conclusion I follows.
- B. Only conclusion II follows.
- C. Neither conclusion I nor II follows.
- D. Both conclusions I and II follow.

[gate2015](#) [gate2015-ec-2](#) [logical-reasoning](#)

Answer 

#### 8.5.22 Logical Reasoning: GATE2016 CE-2: GA-8 [top](#)

► <https://gateoverflow.in/110918>



Fact 1: Humans are mammals.

Fact 2: Some humans are engineers.

Fact 3: Engineers build houses.

If the above statements are facts, which of the following can be logically inferred?

- I. All mammals build houses.
  - II. Engineers are mammals.
  - III. Some humans are not engineers.
- A. II only.
  - B. III only.
  - C. I, II and III.
  - D. I only.

[gate2016-ce-2](#) [logical-reasoning](#)

**Answer****8.5.23 Logical Reasoning: GATE2016 EC-1: GA-5** top ↗<https://gateoverflow.in/108077>

Michael lives 10 km away from where I live. Ahmed lives 5 km away and Susan lives 7 km away from where I live. Arun is farther away than Ahmed but closer than Susan from where I live. From the information provided here, what is one possible distance (in km) at which I live from Arun's place?

- A. 3.00
- B. 4.99
- C. 6.02
- D. 7.01

[gate2016-ec-1](#) [logical-reasoning](#) [analytical-aptitude](#)**Answer****8.5.24 Logical Reasoning: GATE2016 EC-3: GA-8** top ↗<https://gateoverflow.in/110849>

A flat is shared by four first year undergraduate students. They agreed to allow the oldest of them to enjoy some extra space in the flat. Manu is two months older than Sravan, who is three months younger than Trideep. Pavan is one month older than Sravan. Who should occupy the extra space in the flat?

- A. Manu
- B. Sravan
- C. Trideep
- D. Pavan

[gate2016-ec-3](#) [logical-reasoning](#)**Answer****8.5.25 Logical Reasoning: GATE2017 CE-1: GA-7** top ↗<https://gateoverflow.in/313485>

Students applying for hostel rooms are allotted rooms in order of seniority. Students already staying in a room will move if they get a room in their preferred list. Preferences of lower ranked applicants are ignored during allocation.

Given the data below, which room will Ajit stay in ?

<b>Names</b>	<b>Student seniority</b>	<b>Current room</b>	<b>Room preference list</b>
Amar	1	P	R, S, Q
Akbar	2	None	R, S
Anthony	3	Q	P
Ajit	4	S	Q, P, R

- A. P
- B. Q
- C. R
- D. S

[gate2017-ce-1](#) [logical-reasoning](#) [normal](#)**Answer****8.5.26 Logical Reasoning: GATE2017 CE-2: GA-3** top ↗<https://gateoverflow.in/313414>

Four cards lie on table. Each card has a number printed on one side and a colour on the other. The faces visible on the cards are 2, 3, red, and blue.

Proposition: If a card has an even value on one side, then its opposite face is red.

The card which MUST be turned over to verify the above proposition are

- A. 2, red
- B. 2, 3, red
- C. 2, blue
- D. 2, red, blue

gate2017-ce-2 logical-reasoning propositional-logic

Answer 

### 8.5.27 Logical Reasoning: GATE2017 EC-2: GA-3 top ↗

<https://gateoverflow.in/313507>



A rule states that in order to drink beer, one must be over 18 years old. In a bar, there are 4 people.  $P$  is 16 years old.  $Q$  is 25 years old.  $R$  is drinking milkshake and  $S$  is drinking a beer. What must be checked to ensure that the rule is being followed?

- A. Only  $P$ 's drink
- B. Only  $P$ 's drink and  $S$ 's age
- C. Only  $S$ 's age
- D. Only  $P$ 's drink,  $Q$ 's drink and  $S$ 's age

gate2017-ec-2 general-aptitude analytical-aptitude logical-reasoning

Answer 

### 8.5.28 Logical Reasoning: GATE2017 ME-1: GA-5 top ↗

<https://gateoverflow.in/313666>



$P$ ,  $Q$  and  $R$  talk about  $S'$ s car collection.  $P$  states that  $S$  has at least 3 cars.  $Q$  believes that  $S$  has less than 3 cars.  $R$  indicates that to his knowledge,  $S$  has at least one car. Only one of  $P$ ,  $Q$  and  $R$  is right. The number of cars owned by  $S$  is.

- A. 0
- B. 1
- C. 3
- D. Cannot be determined.

gate2017-me-1 general-aptitude logical-reasoning

Answer 

### 8.5.29 Logical Reasoning: GATE2017 ME-2: GA-5 top ↗

<https://gateoverflow.in/313677>



$P$  looks at  $Q$  while  $Q$  looks at  $R$ .  $P$  is married,  $R$  is not. The number of pairs of people in which a married person is looking at an unmarried person is

- A. 0
- B. 1
- C. 2
- D. Cannot be determined.

gate2017-me-2 analytical-aptitude logical-reasoning

Answer 

### 8.5.30 Logical Reasoning: GATE2017 ME-2: GA-9 top ↗

<https://gateoverflow.in/313681>



All people in a certain island are either 'Knights' or 'Knaves' and each person knows every other person's identity. Knights never lie, and Knaves ALWAYS lie.

$P$  says "Both of us are Knights".  $Q$  says "None of us are Knaves".

Which one of the following can be logically inferred from the above?

- A. Both  $P$  and  $Q$  are knights.
- B.  $P$  is a knight;  $Q$  is a Knave.
- C. Both  $P$  and  $Q$  are Knaves.
- D. The identities of  $P$ ,  $Q$  cannot be determined.

gate2017-me-2 analytical-aptitude logical-reasoning

Answer 

**8.5.31 Logical Reasoning: GATE2018 CE-1: GA-10** top ↗<https://gateoverflow.in/313273>

Each of the letters arranged as below represents a unique integer from 1 to 9. The letters are positioned in the figure such that  $(A \times B \times C)$ ,  $(B \times G \times E)$  and  $(D \times E \times F)$  are equal. Which integer among the following choices cannot be represented by the letters A, B, C, D, E, F or G?

A	D
B	G
C	F

- A. 4
- B. 5
- C. 6
- D. 9

[gate2018-ce-1](#) [general-aptitude](#) [analytical-aptitude](#) [logical-reasoning](#)

Answer

**8.5.32 Logical Reasoning: GATE2018 EE: GA-10** top ↗<https://gateoverflow.in/205190>

P, Q, R, and S crossed a lake in a boat that can hold a maximum of two persons, with only one set of oars. The following additional facts are available.

- i. The boat held two persons on each of the three forward trips across the lake and one person on each of the two return trips.
- ii. P is unable to row when someone else is in the boat.
- iii. Q is unable to row with anyone else except R.
- iv. Each person rowed for at least one trip.
- v. Only one person can row during a trip.

Who rowed twice?

- A. P
- B. Q
- C. R
- D. S

[analytical-aptitude](#) [normal](#) [gate2018-ee](#) [logical-reasoning](#)

Answer

**8.5.33 Logical Reasoning: GATE2019 CE-1: GA-4** top ↗<https://gateoverflow.in/313439>

If  $E = 10$ ,  $J = 20$ ,  $O = 30$ , and  $T = 40$ , what will be  $P + E + S + T$ ?

- A. 51
- B. 82
- C. 120
- D. 164

[gate2019-ce-1](#) [general-aptitude](#) [analytical-aptitude](#) [logical-reasoning](#)

Answer

**8.5.34 Logical Reasoning: GATE2019 CE-2: GA-6** top ↗<https://gateoverflow.in/313380>

Mohan, the manager, wants his four workers to work in pairs. No pair should work for more than 5 hours. Ram and John have worked together for 5 hours. Krishna and Amir have worked as a team for 2 hours. Krishna does not want to work with Ram. Whom should Mohan allot to work with John, if he wants all the workers to continue working?

- A. Amir
- B. Krishna
- C. Ram
- D. None of three

[gate2019-ce-2](#) [general-aptitude](#) [logical-reasoning](#)

**Answer****8.5.35 Logical Reasoning: GATE2019 EC: GA-6**<https://gateoverflow.in/313529>

Four people are standing in a line facing you. They are Rahul, Mathew, Seema and Lohit. One is an engineer, one is a doctor, one a teacher and another a dancer. You are told that:

1. Mathew is not standing next to Seema
2. There are two people standing between Lohit and the engineer
3. Rahul is not a doctor
4. The teacher and the dancer are standing next to each other
5. Seema is turning to her right to speak to the doctor standing next to her

Who among them is an engineer?

- A. Seema
- B. Lohit
- C. Rahul
- D. Mathew

[gate2019-ec](#) [general-aptitude](#) [analytical-aptitude](#) [logical-reasoning](#)

**Answer****8.5.36 Logical Reasoning: GATE2019 EE: GA-10**<https://gateoverflow.in/313749>

Consider five people- Mita, Ganga, Rekha, Lakshmi, and Sana. Ganga is taller than both Rekha and Lakshmi. Lakshmi is taller than Sana. Mita is taller than Ganga.

Which of the following conclusions are true?

1. Lakshmi is taller than Rekha
  2. Rekha is shorter than Mita
  3. Rekha is taller than Sana
  4. Sana is shorter than Ganga
- A. 1 and 3  
B. 3 only  
C. 2 and 4  
D. 1 only

[gate2019-ee](#) [general-aptitude](#) [logical-reasoning](#)

**Answer****8.5.37 Logical Reasoning: GATE2019 IN: GA-4**<https://gateoverflow.in/313547>

Five numbers 10, 7, 5, 4 and 2 are to be arranged in a sequence from left to right following the directions given below:

1. No two odd or even numbers are next to each other.
2. The second number from the left is exactly half of the left-most number.
3. The middle number is exactly twice the right-most number.

Which is the second number from the right?

- A. 2
- B. 4
- C. 7
- D. 10

[gate2019-in](#) [general-aptitude](#) [analytical-aptitude](#) [logical-reasoning](#)

**Answer****8.5.38 Logical Reasoning: GATE2020 Practice Test 2: General Aptitude-4**<https://gateoverflow.in/314539>

Choose the set in which the combinations are logically equivalent.

- i. All flowers are roses.
  - ii. No rose is a flower.
  - iii. No flower is a rose.
  - iv. Some flowers are roses.
  - v. No rose is not a flower.
  - vi. All roses are flowers.
- A. (i), (v)  
 B. (ii), (iv)  
 C. (iii), (iv)  
 D. (v), (vi)

gate2020-practise-2 logical-reasoning

Answer 

### Answers: Logical Reasoning

#### 8.5.1 Logical Reasoning: GATE CSE 2010 | Question: 61 top ↗

<https://gateoverflow.in/2369>



✓ Answer. C.

$$(137)_8 + (276)_8 = (435)_8$$

So basically the number are given in Octal base.

Similarly, addition of 731,672 gives 1623 in octal.

 25 votes

-- shreya ghosh (2.8k points)

#### 8.5.2 Logical Reasoning: GATE CSE 2010 | Question: 62 top ↗

<https://gateoverflow.in/2370>



✓ Given that,

- $H + G > S + I$
- No twins,
- And either  $G = S + 1$  or  $S = G + 1$
- G is not the oldest and S is not the youngest.

Lets analyze each case,

**Case 1:**

$$G = S + 1,$$

It implies,  $H > I - 1$ , Since twins are not possible  $H > I$

**Case 2:**

$$G = S - 1,$$

It implies  $H > I + 1$

Therefore, both cases imply H is older than I, also G and S must be placed successively.

Only **option B** satisfies these implications.

 20 votes

-- Pranav Kant Gaur (1.3k points)

#### 8.5.3 Logical Reasoning: GATE CSE 2015 Set 3 | Question: GA-1 top ↗

<https://gateoverflow.in/8298>



✓ Option B. VZDQ

(every letter is replaced by third letter in alphabetical order)

 15 votes

-- Anoop Sonkar (4.1k points)

#### 8.5.4 Logical Reasoning: GATE CSE 2015 Set 3 | Question: GA-7 top ↗

<https://gateoverflow.in/8308>



✓ "U does not want any portfolio if S gets one of the five"

So, S and U cannot come together. Option C eliminated.

"R wants either Home or Finance or no portfolio"

So, options *A* and *D* eliminated.

**So, answer is B.**

Just to confirm:

*Q* says that if *S* gets Power or Telecom, then she must get the other one

In *B*, *S* gets Power and *Q* gets Telecom

"*T* insists on a portfolio if *P* gets one"

In *B*, *T* is getting a portfolio.

1 21 votes

-- Arjun Suresh (328k points)

#### 8.5.5 Logical Reasoning: GATE CSE 2016 Set 1 | Question: GA04 top ↴

↳ <https://gateoverflow.in/39609>



✓ relf taga = care free

o taga = care full

fer taga = care less

Hence taga means care, and if present in the second part, care comes in the first part in English translation.

For after care, "taga-fer" and "taga-zen" are the options. But "fer" means less.

Hence **answer is C**

1 45 votes

-- ryan sequeira (3k points)

#### 8.5.6 Logical Reasoning: GATE CSE 2017 Set 1 | Question: GA-3 top ↴

↳ <https://gateoverflow.in/118406>



✓ Arup and rahul will sit opposite to each other.

Murali and srinivas will sit opposite to each other in the square table.

Answer: *C*

1 7 votes

-- Arnabi Bej (5.8k points)

#### 8.5.7 Logical Reasoning: GATE CSE 2017 Set 2 | Question: GA-7 top ↴

↳ <https://gateoverflow.in/118421>



✓ B. the box labelled 'Apples and Oranges'.

Reason.

We know that the box labeled "Apples and Oranges" can't contain both, so whatever we pick will be the correct label.

Without the loss of generality say picked item was an orange, what that means is that the box that is labeled "Apples" can't contain just oranges. It also can't contain just apples as it is known to be wrong. So it only can contain combination of oranges and apples. Now the third box labeled "Oranges" contains only apples.

1 30 votes

-- Dhruv Patel (1.6k points)

#### 8.5.8 Logical Reasoning: GATE CSE 2021 Set 2 | GA Question: 10 top ↴

↳ <https://gateoverflow.in/357540>



✓ Let us arrange people in decreasing order of heights:

By looking at each observation, we fill these stars : \* , \* , \* , \* , \* , \* where the left-most star corresponds to the tallest person and the rightmost star corresponds to the shortest person.

i. *S* is taller than *R*.

So,  $S > R$

ii. *Q* is the shortest of all.

So, we have

\* , \* , \* , \* , \* , *Q*

iii. *U* is taller than only one student.

So, *U* is second tallest. Hence,

\* , \* , \* , \* , *U* , *Q*

iv. *T* is taller than *S* but not tallest.

*T* is taller than *S* implies  $T > S$ .

From observations *i* and *iv*, we have  $T > S > R$ .

Thus, we have one of these possibilities:

- \*, T, S, R, U, Q or
- T, \*, S, R, U, Q or
- T, S, \*, R, U, Q or
- T, S, R\*, U, Q

But it is mentioned that  $T$  is not the tallest person.

So we are left with only one possibility:

\*, T, S, R, U, Q

Since, we have only one student  $P$  left, we fill the blank with  $P$

$P, T, S, R, U, Q$

- Number of students taller than  $R = 3$  ( $P, T, S$ )
- Number of students shorter than  $T = 4$
- Number of students shorter than  $R = 2$
- Number of students shorter than  $S = 3$

Hence, option C is the correct answer.

1 5 votes

-- chirudeepnamin (2.9k points)

#### 8.5.9 Logical Reasoning: GATE Civil 2020 Set 2 | GA Question: 4 [top](#)

<https://gateoverflow.in/359840>



✓ Lets number the given requirements

1.  $P$  wanted a room adjacent to the lab.
2.  $Q$  wanted to be close to the lift.
3.  $R$  wanted a view of the playground and
4.  $S$  wanted a corner office.

- Option A  
Requirement numbered 2 is not satisfied.
- Option B  
Requirements numbered 1, 2 are not satisfied.
- Option C  
All requirements are satisfied.
- Option D  
Requirement numbered 4 is not satisfied.

Correct option: C

1 1 votes

-- Arjun Suresh (328k points)

#### 8.5.10 Logical Reasoning: GATE Mechanical 2021 Set 1 | GA Question: 4 [top](#)

<https://gateoverflow.in/359482>



✓ The value of the expression  $\triangle 2 \oplus 3\triangle ((4 \otimes 2) \triangleright 4) = +2 - 3 + ((4 \div 2) \times 4) = -1 + 8 = 7$ .

So, the correct answer is (D).

1 1 votes

-- Lakshman Patel (63.9k points)

#### 8.5.11 Logical Reasoning: GATE Mechanical 2021 Set 2 | GA Question: 4 [top](#)

<https://gateoverflow.in/359505>



✓ Let's suppose  $\oplus = a$ ,  $\odot = b$ ,  $\Delta = c$ , and  $\otimes = d$ .

Then,  $a \div b = 2$ ;  $a \div c = 3$ ;  $b + c = 5$ ;  $c \times d = 10$

Now,  $a = 2b = 3c$ , and  $b + c = 5 \implies c = 2, d = 5, a = 6$

$\therefore$  The value of  $(\otimes - \oplus)^2 = (d - a)^2 = (5 - 6)^2 = (-1)^2 = 1$ .

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

**8.5.12 Logical Reasoning: GATE2011 GG: GA-8** top ↗ <https://gateoverflow.in/40209>

- ✓ We can proceed in reverse order:

R	S	T
8	8	8

and apply the given steps in reverse. We will get,

R	S	T
4	8	12
4	14	6
11	7	6

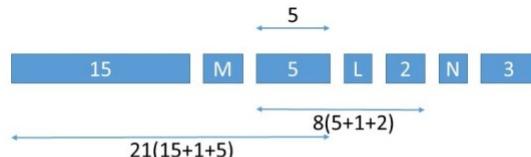
Correct Answer: C

20 votes

-- Deepesh Kataria (1.6k points)

**8.5.13 Logical Reasoning: GATE2011 MN: GA-63** top ↗ <https://gateoverflow.in/31543>

- ✓ L, M and N are waiting in queue that are meant for children, so they are also counted as children.



$$\begin{aligned} \text{Total no. of children} &= 21 + 1 + 2 + 1 + 3 \\ &= 28. \end{aligned}$$

Correct Answer: A

22 votes

-- Praveen Saini (41.9k points)

**8.5.14 Logical Reasoning: GATE2012 AR: GA-8** top ↗ <https://gateoverflow.in/40229>

- ✓ Balu can be the TALLEST.

Ravi cannot be the answer since it is clearly mentioned that he is shorter than Iqbal.

Iqbal and Balu could be the tallest as no comparison is provided where these two are smaller than anyone.

But Iqbal is not mentioned in options. 😊

Hence, Balu (see the usage of 'can' in the question)

9 votes

-- Govind Krishna Tewari (1.5k points)

**8.5.15 Logical Reasoning: GATE2012 CY: GA-9** top ↗ <https://gateoverflow.in/40240>

- ✓ Answer is a) i.e 2

Divide in to 3 – 3 – 2 and then take 3 – 3 pair and then if they are equal then weigh the remaining 1 – 1.

if out of 3 – 3 one is heavier then take the heavier group and divide it 1 – 1 – 1 take any two of these group and weigh again to get the heavier.

21 votes

-- Piyush Kapoor (707 points)

**8.5.16 Logical Reasoning: GATE2014 AE: GA-7** top ↗ <https://gateoverflow.in/40307>

- ✓ Time is less hence, calculating and applying permutations and combinations would be a layman's choice.  
Question says that

Eswar does not live on a floor immediately above or immediately below Bhola

Option (A): Bhola's floor number – 2 and Eswar's floor number – 3

Option (B): Bhola's floor number – 6 and Eswar's floor number – 3

Option (C): Bhola's floor number – 2 and Eswar's floor number – 1

Option (D): Bhola's floor number – 4 and Eswar's floor number – 3

Here, we can clearly see that in options *A, C* and *D* the statement is not followed.

Therefore, the answer is option(B).

11 votes

-- Sumit Kumar Patel (483 points)



#### 8.5.17 Logical Reasoning: GATE2014 AG: GA-6 [top](#)

<https://gateoverflow.in/41670>

✓ I think answer should be *A*. GIVEN

- Som is younger to Riaz .
- Shiv is elder to Ansu.
- Ansu is youngest.

**First Statement :**

Shiv is younger to RIAZ, SOM is also younger to RIAZ, ANSU is the youngest. **So RIAZ would be the eldest.**

8 votes

-- richa07 (751 points)



#### 8.5.18 Logical Reasoning: GATE2014 EC-2: GA-7 [top](#)

<https://gateoverflow.in/41515>

✓ Question says "On every step of ladder there are 2 bulbs".

"If one is Green other must be Yellow". So one pair of lights possible = (*G, Y*)

"If one is Red other must be Blue". Other pair possible = (*R, B*)

So, from the above statements, we can conclude that there will be no pair as (*G, B*) or (*G, R*) or (*R, Y*). But, the pair (*Y, B*) is a possible combination of lights in one of the ladder.

If we consider that there are 3 steps in ladder as (*G, Y*), (*B, Y*) and (*B, Y*).

**NONE OF THE ABOVE OPTION MATCHES** (Official key was D though)

5 votes

-- Manish Joshi (20.5k points)



#### 8.5.19 Logical Reasoning: GATE2014 EC-3: GA-5 [top](#)

<https://gateoverflow.in/41144>

✓ Answer *D*.

As  $P = A$

and  $A < R$  and  $R < M \implies A < M \implies P < M$

4 votes

-- Abhilash Panicker (7.6k points)



#### 8.5.20 Logical Reasoning: GATE2015 EC-1: GA-4 [top](#)

<https://gateoverflow.in/39492>

$$\checkmark (66 \square 6) \rightarrow (66 \diamond 6) = \frac{66}{\cancel{6}} \times \frac{\cancel{6}}{6} = 1.$$

4 votes

-- Arjun Suresh (328k points)



#### 8.5.21 Logical Reasoning: GATE2015 EC-2: GA-7 [top](#)

<https://gateoverflow.in/39508>

✓

1. All film directors are film stars
2. All film stars are playback singers.

$A \implies B$  and  $B \implies C$  means  $A \implies C$ . So All film directors are playback singers.

Conclusion 2 is also true as even if one film director exist, he must be a film star. (We have to assume domain sets to be non-empty here)

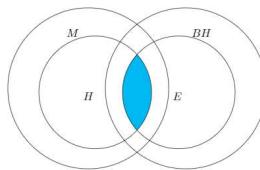
Correct Answer: Option D

3 votes

-- Shreya Roy (3.8k points)

### 8.5.22 Logical Reasoning: GATE2016 CE-2: GA-8 [top](#)

<https://gateoverflow.in/110918>



We can draw a Venn diagrams for the given facts:

Fact 1 says "Humans are mammals" meaning humans is a subset (may or may not be strict - the diagram shows the not strict version) of mammals.

Fact 2 says "Some humans are engineers" meaning intersection of  $H$  and  $E$  is non-empty.

Fact 3 says "Engineers build houses" meaning  $E$  is a subset (may or may not be strict - the diagram shows the not strict version) of  $BH$ .

Now From this diagram we try to get the meaning of given sentences

1. All mammals build houses - False, only if the mammal is a human and he is an engineer he is sure to build a house
2. Engineers are mammals - False, diagram says some engineers are mammals but does not restrict non mammals to be engineer.
3. Some humans are not engineers - actually this also is not True as we can redraw the diagram making  $H$  a subset of  $E$  and no Facts are violated. But GATE official key says this is True (Clearly wrong answer key).

No option is correct but official answer key is option B.

7 votes

-- Bikram (58.3k points)

### 8.5.23 Logical Reasoning: GATE2016 EC-1: GA-5 [top](#)

<https://gateoverflow.in/108077>



Michael  $\xrightarrow[10 \text{ kms}]{}$  I

Ahmed  $\xrightarrow[5 \text{ kms}]{}$  I

Susan  $\xrightarrow[7 \text{ kms}]{}$  I

Susan  $\xrightarrow{}$  Arun  $\xrightarrow{}$  Ahmed  $\xrightarrow{}$  I

So, the distance between Arun and I is between 5 *kms* and 7 *kms*.

Answer C. 6.02

5 votes

-- AKANKSHA DEWANGAN (3k points)

### 8.5.24 Logical Reasoning: GATE2016 EC-3: GA-8 [top](#)

<https://gateoverflow.in/110849>



Manu is two months older than Sravan  
 $\Rightarrow M = 2 + S$

Sravan, is three months younger than Trideep  
 $\Rightarrow T = 3 + S = M + 1$

Pavan is one month older than Sravan  
 $\Rightarrow P = 1 + S = M - 1 = T - 2$

So,  $S < P < M < T$ .

**Option C. Trideep is the oldest.**

3 votes

-- Shobhit (13.5k points)

**8.5.25 Logical Reasoning: GATE2017 CE-1: GA-7** top ↗<https://gateoverflow.in/313485>

- ✓ Ajit has the highest seniority and so his preference has the most value. So, he should get room  $Q$  but this is already taken by Anthony.

As per the passage, "Students already staying in a room will move if they get a room in their preferred list".

So, Anthony will move if he gets room  $P$  which is his preference.

Again  $P$  is occupied by Amar and his preference is  $R$  which as per given data is empty. So, Amar will look for room  $R$  which is also tried by Akbar as first preference. Since Akbar has better seniority, he will get room  $R$  and Amar will now look for his second preference – room  $S$  which will be empty if Ajit gets a preferred room and no one else is looking for it. So,

- Akbar takes room  $R$
- Amar takes room  $S$
- Anthony takes room  $P$
- Ajit takes room  $Q$

Correct option: B.

2 votes

-- Arjun Suresh (328k points)

**8.5.26 Logical Reasoning: GATE2017 CE-2: GA-3** top ↗<https://gateoverflow.in/313414>

If a card has an even value on one side, then its opposite face is red.

to verify this proposition:

- the card with even number must be turned to check whether the opposite face is red or not.
- If the face of the card is other than red colour, its opposite face must not be even number, so this needs to be checked.
- If a card face is of red colour, the opposite side may contain any number, so checking this card is needless.
- If a card face contains an odd number, checking the opposite side colour is needless.

So, a card containing number 2 on one side and colour Blue on opposite, needs to be turned to verify the proposition.

Hence, Option "C" is the correct choice.

3 votes

-- Naveen Kumar (9.9k points)

**8.5.27 Logical Reasoning: GATE2017 EC-2: GA-3** top ↗<https://gateoverflow.in/313507>

- If a person drinking beer, his age should be checked, to verify he's eligible ( $>18$  years old)
- If a person not drinking beer, checking him is useless.
- If a person is younger than 18 years old, his drink must be checked, It should not be beer.
- If a person is older than 18 years old, checking his drink is useless.

So, here Only  $P'$ s drink and  $S'$ s age should be checked to ensure that the rule is being followed.

Correct Answer: B

1 votes

-- Naveen Kumar (9.9k points)

**8.5.28 Logical Reasoning: GATE2017 ME-1: GA-5** top ↗<https://gateoverflow.in/313666>

- ✓ There are 3 possible cases :-

(1)  **$P$  is right,  $Q$  and  $R$  are wrong**

It means  $P$ 's statement " $S$  has at least 3 cars" is true and  $R$ 's statement " $S$  has at least one car" is false which means  $S$  has actually less than one car which is contradicting  $P$ 's statement that  $S$  has at least 3 cars. So, **It is NOT a possible case**.

(2)  **$R$  is right,  $P$  and  $Q$  are wrong**

It means  $P$ 's statement " $S$  has at least 3 cars" is false. So,  $S$  actually has less than 3 cars. Now,  $Q$ 's statement " $S$  has less than 3 cars" is also false which means  $Q$  has actually at least 3 cars. Both statements are contradicting each other. So, **It is NOT a possible case**.

(3)  **$Q$  is right,  $P$  and  $R$  are wrong**

It means  $Q$ 's statement " $S$  has less than 3 cars" is true and  $P$ 's statement " $S$  has at least 3 cars" is false which means  $S$  has

actually less than 3 cars.  $R$ 's statement " $S$  has at least one car" is also false which means  $S$  has actually less than 1 car. All 3 statements are not contradicting each other. So, **It is a possible case**. Since, all 3 statements are true. So, we can conclude from all the 3 statements that " $S$  has less than 1 car" (or) " $S$  has no car".

**So, Answer is (A)**

4 votes

-- ankitgupta.1729 (14.9k points)

#### 8.5.29 Logical Reasoning: GATE2017 ME-2: GA-5 [top](#)



- ✓ Two cases possible Either  $Q$  is married or  $Q$  is unmarried.

If  $Q$  is married,  $Q$  looking at  $R$  counts as 1 required pair.

If  $Q$  is unmarried,  $P$  looking at  $Q$  counts as 1 required pair.

In either cases 1 such pair possible where a married person is looking at an unmarried person.

Correct Answer: **B**

2 votes

-- Naveen Kumar (9.9k points)

#### 8.5.30 Logical Reasoning: GATE2017 ME-2: GA-9 [top](#)



- ✓ There are 4 possible cases :

**(A) Both  $P$  and  $Q$  are knights**

It means both statements "Both of us are Knights" and "None of us are Knaves" are true which is not contradicting our assumption. **So, It is a possible case**.

**(B)  $P$  is knight and  $Q$  is knave**

It means statement "Both of us are Knights" is true but it is contradicting our assumption. **So, It is NOT a possible case**.

**(C)  $P$  is knave and  $Q$  is knight**

It means statement "Both of us are Knights" is false and statement "None of us are Knaves" is true but this statement by  $Q$  is contradicting our assumption. **So, It is NOT a possible case**.

**(D)  $P$  is knave and  $Q$  is knave**

It means statement "Both of us are Knights" is false which means at least one should be knave which is not contradicting our assumption and statement "None of us are Knaves" is false which means at least one should be knave which is also not contradicting our assumption. **So, It is a possible case**.

So, It is possible that both  $P$  and  $Q$  are knights and it is also possible that both  $P$  and  $Q$  are knaves. So, we can't identify them.

**Hence, Answer is D.**

2 votes

-- ankitgupta.1729 (14.9k points)

#### 8.5.31 Logical Reasoning: GATE2018 CE-1: GA-10 [top](#)



- ✓ As per the given conditions,

$$A \times B \times C = B \times G \times E$$

$$A \times C = G \times E$$

If  $A = 5$ , either  $G$  or  $E$  has to be 5 as 5 is a prime number.

But 5 can be considered only once as all the numbers are unique.

$\therefore$  It can be concluded that none of the numbers  $A, B, C, D, E, F$  or  $G$  is 5.

Correct answer is **(B)**.

2 votes

-- Lakshman Patel (63.9k points)

**8.5.32 Logical Reasoning: GATE2018 EE: GA-10** [top](#)<https://gateoverflow.in/205190>

1.  $P$  is unable to row when someone else is in the boat.
2. Each person rowed for at least one trip.

These two statements mean that  $P$  must return at least once. So, one return trip is by  $P$  alone.

1.  $Q$  is unable to row with anyone else except  $R$ .
2. This also means that  $Q$  cannot come back since
  1. if  $P$  comes back in first return, and  $Q$  comes back in second,  $P$  and  $Q$  will be left for third forward trip which is not possible
  2. if  $P$  comes back in second return, it means  $Q$  must have come back in first return, which again means both  $P$  and  $Q$  are left for the final trip.
3. Since  $Q$  cannot come back, it means both  $Q$  and  $R$  must go together in the forward trip .
  - Suppose  $P, S$  goes first and  $S$  rows.
  - $P$  comes back and then  $Q$  and  $R$  returns with  $Q$  rowing.
  - $R$  comes back and takes  $P$  with  $R$  rowing.
  - Other alternative is  $Q$  and  $R$  going first.
  - In both cases  $R$  has to row twice.

Correct Option: C.

1 votes

-- Arjun Suresh (328k points)

**8.5.33 Logical Reasoning: GATE2019 CE-1: GA-4** [top](#)<https://gateoverflow.in/313439>

✓  $A - 2, B - 4, C - 6, D - 8, E - 10, F - 12, G - 14, H - 16,$

$I - 18, J - 20, K - 22, L - 24, M - 26, N - 28, O - 30,$

$P - 32, Q - 34, R - 36, S - 38, T - 40, U - 42, V - 44,$

$W - 46, X - 48, Y - 50, Z - 52$

So,  $P + E + S + T = 32 + 10 + 38 + 40 = 120$

Correct answer is (C).

3 votes

-- Lakshman Patel (63.9k points)

**8.5.34 Logical Reasoning: GATE2019 CE-2: GA-6** [top](#)<https://gateoverflow.in/313380>

✓ Ans B. Ram and John worked together for 5 hours so they need to change their partner. Since Ram cannot work together with Krishna he can only partner with Amir. So the remaining two people, John and Krishna will form a pair.

1 votes

-- Resmi Arjun (619 points)

**8.5.35 Logical Reasoning: GATE2019 EC: GA-6** [top](#)<https://gateoverflow.in/313529>

Lohit	Seema	Rahul	Mathew
↓	↓	↓	↓
Doctor	Teacher	Dancer	Engineer
OR			
↓      ↓			
Dancer   Teacher			

According to the given statements, the positions with the profession of different peoples are shown above. Only Mathew can be the engineer and Lohit the doctor, Seema and Rahul are either teacher or dancer but we cannot identify their exact profession.

So, the correct option is (D).

1 votes

-- Lakshman Patel (63.9k points)

**8.5.36 Logical Reasoning: GATE2019 EE: GA-10** top ↴[➡ https://gateoverflow.in/318749](https://gateoverflow.in/318749)**✓ Answer C.**

It is confirmed that Mita is the tallest girl and Ganga is the 2<sup>nd</sup> tallest girl. No height relationship between Rekha and Lakshmi, so we won't assume anything. Also, Lakshmi is taller than Sana.

1. False because no height relationship given between the two girls.
2. True because Rekha is shorter than Ganga, who in turn is shorter than Mita. Thus, Rekha is shorter than Mita (Transitive relation).
3. False. No height relationship given between the two girls
4. True because Ganga is taller than Lakshmi, who is again taller than Sana. Thus, Ganga is taller than Sana.

2 votes

-- Shalini26 (449 points)

**8.5.37 Logical Reasoning: GATE2019 IN: GA-4** top ↴[➡ https://gateoverflow.in/313547](https://gateoverflow.in/313547)**✓**

1. No two odd or even numbers are next to each other.
2. The second number from the left is exactly half of the left-most number.  
So, the left most number must be even and its half must be odd which comes next. Only options are 10, 5
3. The middle number is exactly twice the right-most number.  
Middle number must be even and only options left are 2 and 4. Since 1 is not there, 4 must be the middle and 2 the right most.

Thus we get

10 5 4 7 2

Required answer is 7.

Option C.

0 votes

-- Arjun Suresh (328k points)

**8.5.38 Logical Reasoning: GATE2020 Practice Test 2: General Aptitude-4** top ↴[➡ https://gateoverflow.in/314539](https://gateoverflow.in/314539)**✓ Let  $x$  : An object** $r(x)$ :  $x$  is a rose and $f(x)$ :  $x$  is a flower

- i. **All flowers are roses.**  $\equiv$  For all  $x$ , if  $x$  is a flower then it has to be a rose  $\equiv \forall x(f(x) \rightarrow r(x)) \equiv \forall x(\sim f(x) \vee r(x))$
- ii. **No rose is a flower.**  $\equiv$  There does not exist an  $x$  such that  $x$  is a rose and it is a flower  $\equiv \sim \exists x(r(x) \wedge f(x)) \equiv \forall x(\sim r(x) \vee \sim f(x))$
- iii. **No flower is a rose.**  $\equiv$  There does not exist  $x$  such that  $x$  is a flower and it is a rose  $\equiv \sim \exists x(f(x) \wedge r(x)) \equiv \forall x(\sim f(x) \vee \sim r(x))$
- iv. **Some flowers are roses**  $\equiv$  There exists some  $x$  such that  $x$  is a flower and it is a rose  $\equiv \exists x(f(x) \wedge r(x))$
- v. **No rose is not a flower.**  $\equiv$  There does not exist  $x$  such that  $x$  is a rose and it is not a flower  $\equiv \sim \exists x(r(x) \wedge \sim f(x)) \equiv \forall x(\sim r(x) \vee f(x))$
- vi. **All roses are flowers.**  $\equiv \forall x$  (if  $x$  is a rose then it is a flower)  $\equiv \forall x(r(x) \rightarrow f(x)) \equiv \forall x(\sim r(x) \vee f(x)) \equiv$

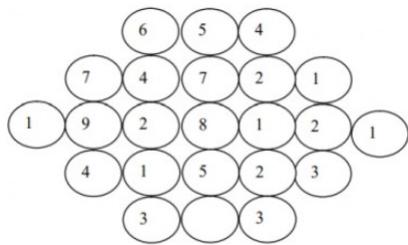
∴ Option D. is the correct answer.

4 votes

-- Satbir Singh (20.9k points)

**8.6****Number Relations (1)** top ↴**8.6.1 Number Relations: GATE2015 EC-1: GA-8** top ↴[➡ https://gateoverflow.in/313226](https://gateoverflow.in/313226)

Fill in the missing value


[gate2015-ec-1](#) [analytical-aptitude](#) [numerical-answers](#) [number-relations](#)

Answer

### Answers: Number Relations

#### 8.6.1 Number Relations: GATE2015 EC-1: GA-8 [top](#)

<https://gateoverflow.in/313226>



✓ Answer 3.

Explanation: middle element of each row= sum of all the elements in that row ,except the middle element divided by 2.

12 votes

-- Arkaprava Paul (1.9k points)

### 8.7

### Number Series (1) [top](#)

#### 8.7.1 Number Series: GATE2014 EC-3: GA-6 [top](#)

<https://gateoverflow.in/41145>



Find the next term in the sequence: 7G, 11K, 13M, \_\_\_\_\_.

- A. 15Q
- B. 17Q
- C. 15P
- D. 17P

[gate2014-ec-3](#) [number-series](#) [logical-reasoning](#) [analytical-aptitude](#)

Answer

### Answers: Number Series

#### 8.7.1 Number Series: GATE2014 EC-3: GA-6 [top](#)

<https://gateoverflow.in/41145>



- ✓ 7G - G is the 7th alphabet
- 11K - K is the 11th alphabet
- 13M - M is the 13th alphabet

15th alphabet is O

17th alphabet is Q

Therefore A,C,D eliminated

Also, 7,11,13 are prime numbers, next prime in the sequence would be 17

Answer **Option B) 17Q**

7 votes

-- Abhilash Panicker (7.6k points)

### 8.8

### Odd One (5) [top](#)

#### 8.8.1 Odd One: GATE CSE 2016 Set 2 | Question: GA-04 [top](#)

<https://gateoverflow.in/39528>



Pick the odd one from the following options.

- A. CADBE
- B. JHKIL
- C. XZYWZ
- D. ONPMQ

gate2016-cse-set2 analytical-aptitude odd-one normal

Answer 

### 8.8.2 Odd One: GATE2014 AE: GA-6 top ↗

<https://gateoverflow.in/40306>



Find the odd one in the following group: ALRVX, EPVZB, ITZDF, OYEIK

- A. ALRVX
- B. EPVZB
- C. ITZDF
- D. OYEIK

gate2014-ae odd-one analytical-aptitude

Answer 

### 8.8.3 Odd One: GATE2014 EC-1: GA-6 top ↗

<https://gateoverflow.in/41495>



Find the odd one from the following group:

W, E, K, O     I, Q, W, A     F, N, T, X     N, V, B, D

- A. W, E, K, O
- B. I, Q, W, A
- C. F, N, T, X
- D. N, V, B, D

gate2014-ec-1 odd-one normal

Answer 

### 8.8.4 Odd One: GATE2014 EC-2: GA-6 top ↗

<https://gateoverflow.in/41513>



Find the odd one in the following group

Q, W, Z, B     B, H, K, M     W, C, G, J     M, S, V, X

- A. Q, W, Z, B
- B. B, H, K, M
- C. W, C, G, J
- D. M, S, V, X

gate2014-ec-2 analytical-aptitude odd-one normal

Answer 

### 8.8.5 Odd One: GATE2016 EC-3: GA-4 top ↗

<https://gateoverflow.in/110830>



The number that least fits this set: (324, 441, 97 and 64) is \_\_\_\_\_.

- A. 324
- B. 441
- C. 97
- D. 64

gate2016-ec-3 odd-one analytical-aptitude

Answer 

## Answers: Odd One

### 8.8.1 Odd One: GATE CSE 2016 Set 2 | Question: GA-04 top ↗

<https://gateoverflow.in/39528>



✓ Option D.

A)  $\underbrace{C A D B}_{3 \ 1 \ 4} E \ 2 \ 5$

- B)  $\overbrace{JHKIL}^{3\ 1\ 4\ 2\ 5}$   
C)  $\overbrace{XVYWZ}^{3\ 1\ 4\ 2\ 5}$

They are all making sequence of  $1 - 2 - 3 - 4 - 5$  and as in alphabetical order

12 votes

-- Praveen Saini (41.9k points)



### 8.8.2 Odd One: GATE2014 AE: GA-6 [top](#)

<https://gateoverflow.in/40306>

- ✓ Answer is D

For all words except D,  $i^{th}$  letter of word and  $i^{th}$  letter of the previous word is differing by 3 letters.

14 votes

-- Sanju Rakonde (319 points)



### 8.8.3 Odd One: GATE2014 EC-1: GA-6 [top](#)

<https://gateoverflow.in/41495>

- ✓ Ans is (D)

the no of alphabet between B,D in N,V,B,D is 1 while in other 3 sets, it is 4. Alphabet sequence in all the sets are obtained by adding 8,6,4 respectively to the previous one in sequence.

19 votes

-- srestha (85k points)



### 8.8.4 Odd One: GATE2014 EC-2: GA-6 [top](#)

<https://gateoverflow.in/41513>

- ✓ Here in each option

$1^{st}$  letter and  $2^{nd}$  letter difference = 6 letters

$2^{nd}$  and  $3^{rd}$  letter diff = 3 letters

$3^{rd}$  and  $4^{th}$  letter diff = 2 letters

but option (C) is not matching these all criteria

**So,Ans is (C)**

12 votes

-- srestha (85k points)



### 8.8.5 Odd One: GATE2016 EC-3: GA-4 [top](#)

<https://gateoverflow.in/110830>

- ✓ Ans. (C)

$$324 = (18)^2$$

$$441 = (21)^2$$

$$64 = (8)^2$$

Where as 97 is not perfect square of any number.

**Therefore, ans is (c)**

8 votes

-- targate2018 (1.2k points)

## 8.9

### Passage Reading (1) [top](#)

#### 8.9.1 Passage Reading: GATE Electrical 2020 | GA Question: 6 [top](#)

<https://gateoverflow.in/359722>



Non-performing Assets (NPAs) of a bank in India is defined as an asset, which remains unpaid by a borrower for a certain period of time in terms of interest, principal, or both. Reserve Bank of India (RBI) has changed the definition of NPA thrice during 1993 – 2004, in terms of the holding period of loans. The holding period was reduced by one quarter each time. In 1993, the holding period was four quarters (360 days).

Based on the above paragraph, the holding period of loans in 2004 after the third revision was \_\_\_\_\_ days.

- A. 45  
B. 90

- C. 135  
D. 180

gate2020-ee analytical-aptitude logical-reasoning passage-reading

Answer 

### Answers: Passage Reading

#### 8.9.1 Passage Reading: GATE Electrical 2020 | GA Question: 6

 <https://gateoverflow.in/359722>



✓ Ans B.

As question says – holding period was reduced by **one quarter** each time. In 2004 – third revision.

In 1993 holding period – 360 days ( four quarters). One quarter –  $\frac{1}{4} \times 360 = 90$ .

[**quarter** – *each of four equal or corresponding parts into which something is or can be divided.* ]

First Time = 360–90 = 270 (reduced by one quarter)

Second Time = 270–90 = 180

Third Time = 180–90 = 90

 2 votes

-- Vijay Purohit (2.8k points)

#### 8.10

#### Round Table Arrangement (2)

 <https://gateoverflow.in/359814>



#### 8.10.1 Round Table Arrangement: GATE Chemical 2020 | GA Question: 7

*P, Q, R, S, T, U, V, and W* are seated around a circular table.

- I. *S* is seated opposite to *W*
- II. *U* is seated at the second place to the right of *R*
- III. *T* is seated at the third place to the left of *R*
- IV. *V* is a neighbour of *S*

Which of the following must be true?

- A. *P* is a neighbour of *R*
- B. *Q* is a neighbour of *R*
- C. *P* is not seated opposite to *Q*
- D. *R* is the left neighbour of *S*

gate2020-ch analytical-aptitude logical-reasoning round-table-arrangement

Answer 

#### 8.10.2 Round Table Arrangement: GATE2017 CE-2: GA-8

 <https://gateoverflow.in/313417>



*P, Q, R, S, T, and U* are seated around a circular table. *R* is seated two places to the right of *Q*. *P* is seated three places to the left of *R*. *S* is seated opposite *U*. If *P* and *U* now switch seats, which of the following must necessarily be true?

- A. *P* is immediately to the right of *R*
- B. *T* is immediately to the left of *P*
- C. *T* is immediately to the left of *P* or *P* is immediately to the right of *Q*
- D. *U* is immediately to the right of *R* or *P* is immediately to the left of *T*

gate2017-ce-2 logical-reasoning round-table-arrangement

Answer 

### Answers: Round Table Arrangement

#### 8.10.1 Round Table Arrangement: GATE Chemical 2020 | GA Question: 7

 <https://gateoverflow.in/359814>

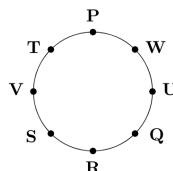


- ✓ Here the most frequently used person is *R* - so we should fill *R* first. That's points 2 and 3. We get

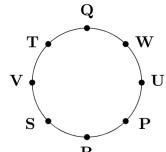
$T\_R\_U\_$  (Assume there is a circular connection between either ends)

After this only one opposite position will be left (positions 3 and 7) -- which is needed for  $(S, W)$  as per given condition 1. So, straight away  $C$  is the answer.

Counter examples for options A, B, and D can be as follows:



For option A:



For options B and D:



-- Lakshman Patel (63.9k points)



### 8.10.2 Round Table Arrangement: GATE2017 CE-2: GA-8 top ↴



✓  $P Q \_ R$

Since  $S$  is seated opposite of  $U$  it means on its left and right side there must be 2 members. So, only option is to be seated to the left of  $P$  and right of  $Q$ . This leaves the space to the immediate right of  $R$  for  $T$ .

$P Q \_ R T \_$

Now,  $P$  and  $U$  switch the seats:

$U Q \_ R T \_$

The gaps are taken by  $P$  and  $S$  but their exact positions are unknown

Now seeing the options:

- (A) is false as  $T$  is immediately to the right of  $R$
- (B) may or may not be true as we have two choices for  $P$
- (C) is TRUE
- (D) is false as  $T$  is immediately to the right of  $R$  and  $R$  is immediately to the left of  $T$

Correct answer: C



-- Arjun Suresh (328k points)



### 8.11 Seating Arrangements (2) top ↴

#### Seating Arrangements (2) top ↴

##### 8.11.1 Seating Arrangements: GATE Civil 2020 Set 1 | GA Question: 7 top ↴

→ <https://gateoverflow.in/359854>



Five friends  $P, Q, R, S$  and  $T$  went camping. At night, they had to sleep in a row inside the tent.  $P, Q$  and  $T$  refused to sleep next to  $R$  since he snored loudly.  $P$  and  $S$  wanted to avoid  $Q$  as he usually hugged people in sleep.

Assuming everyone was satisfied with the sleeping arrangements, what is the order in which they slept?

- $RSPTQ$
- $SPRTQ$
- $QRSPT$
- $QTSPR$

[gate2020-ce-1](#) [analytical-aptitude](#) [logical-reasoning](#) [seating-arrangements](#)

Answer



##### 8.11.2 Seating Arrangements: GATE Electrical 2021 | GA Question: 10 top ↴

→ <https://gateoverflow.in/359737>

Seven cars  $P, Q, R, S, T, U$  and  $V$  are parked in a row not necessarily in that order. The cars  $T$  and  $U$  should be parked next to each other. The cars  $S$  and  $V$  also should be parked next to each other, whereas  $P$  and  $Q$  cannot be parked next to each other.  $Q$  and  $S$  must be parked next to each other.  $R$  is parked to the immediate right of  $V$ .  $T$  is parked to the left of  $U$ .

Based on the above statements, the only INCORRECT option given below is:

- A. There are two cars parked in between  $Q$  and  $V$ .
- B.  $Q$  and  $R$  are not parked together.
- C.  $V$  is the only car parked in between  $S$  and  $R$ .
- D. Car  $P$  is parked at the extreme end.

gateee-2021 analytical-aptitude logical-reasoning seating-arrangements

Answer 

### Answers: Seating Arrangements

#### 8.11.1 Seating Arrangements: GATE Civil 2020 Set 1 | GA Question: 7 top ↗

<https://gateoverflow.in/359854>



- ✓ Five friends  $P, Q, R, S$ , and  $T$  are sleeping together.
  1.  $P, Q$ , and  $T$  refused to sleep next to  $R$  since he snored loudly. That means the only possible neighbor for  $R$  is  $S$  and we should have either  $R, S, -, -, -$  or  $-, -, -, S, R$ .
  2.  $P$  and  $S$  wanted to avoid  $Q$  as he usually hugged people in sleep. That means the only possible neighbor for  $Q$  is  $T$ . Thus we get the two possible orders:  $R, S, P, T, Q$  and  $Q, T, P, S, R$ .

Only satisfying option is A.

So, the correct answer is (A) (question should have mentioned "what could be the order" instead of "what is the order" as there are 2 possibilities)

 1 votes

-- Lakshman Patel (63.9k points)

#### 8.11.2 Seating Arrangements: GATE Electrical 2021 | GA Question: 10 top ↗

<https://gateoverflow.in/359737>



- ✓
  1. The cars  $T$  and  $U$  should be parked next to each other.  
This means we can park these two cars in two ways, either  $TU$  or  $UT$ .
  2. The cars  $S$  and  $V$  also should be parked next to each other.  
This means we can park these cars also in two ways, either  $SV$  or  $VS$ .
  3. The cars  $P$  and  $Q$  cannot be parked next to each other.  
This means we can not park the cars as  $PQ$  or  $QP$ .
  4. The cars  $Q$  and  $S$  must be parked next to each other.  
This means we can park these two cars in two ways, either  $QS$  or  $SQ$ .
  5.  $R$  is parked to the immediate right of  $V$ .  
This means we can park these two cars in only one way  $VR$ .
  6.  $T$  is parked to the left of  $U$ .  
This is not "immediately left" but combining with statement 1, "immediately left" follows. So, we can park these two cars in only one way  $TU$ .

Now we can combine the statements (2) &(4) and get two possible ways for cars  $Q, S$  and  $V$ .

- $QSV$
- $VSQ$

But  $VSQ$  is not possible because it violates statement 5.

Now, using statement 5, we get the possible car parking sequence  $QSVR$ .

Now, we can check each and every option.

- A. There are two cars parked in between  $Q$  and  $V$ , it is incorrect because only  $S$  is in between  $Q$  and  $V$ .
- B.  $Q$  and  $R$  are not parked together, it is correct.
- C.  $V$  is the only car parked in between  $S$  and  $R$ , it is correct.
- D. Car  $P$  is parked at the extreme end.

For this option, we can consider all possible combinations of car parking which are only four as given below. ( $P$  cannot come near  $Q$  due to statement 3)

- $QSVR \textcolor{red}{P} TU$
- $QSVR \textcolor{red}{T} U \textcolor{red}{P}$
- $\textcolor{blue}{T} U QSVR \textcolor{red}{P}$
- $\textcolor{red}{P} \textcolor{blue}{T} U QSVR$

Here, we can see that car  $P$  can be parked at the extreme (either left or right) end in three out of the four possible

combinations. That is, though this is not a guarantee, it is still a possibility.

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

## 8.12

### Sequence Series (8)

#### 8.12.1 Sequence Series: GATE CSE 2020 | Question: GA-7

<https://gateoverflow.in/333234>



If  $P = 3$ ,  $R = 27$ ,  $T = 243$ , then  $Q + S = \underline{\hspace{2cm}}$

- A. 40
- B. 80
- C. 90
- D. 110

[gate2020-cse](#) [analytical-aptitude](#) [logical-reasoning](#) [sequence-series](#)

Answer

#### 8.12.2 Sequence Series: GATE Civil 2020 Set 1 | GA Question: 4

<https://gateoverflow.in/359861>



If  $0, 1, 2, \dots, 7, 8, 9$  are coded as  $O, P, Q, \dots, V, W, X$ , then 45 will be coded as  $\underline{\hspace{2cm}}$ .

- A.  $TS$
- B.  $ST$
- C.  $SS$
- D.  $SU$

[gate2020-ce-1](#) [analytical-aptitude](#) [logical-reasoning](#) [sequence-series](#)

Answer

#### 8.12.3 Sequence Series: GATE Electrical 2020 | GA Question: 7

<https://gateoverflow.in/359719>



Select the next element of the series:  $Z, WV, RQP, \underline{\hspace{2cm}}$

- A. LKJI
- B. JIHG
- C. KJIH
- D. NMLK

[gate2020-ee](#) [analytical-aptitude](#) [logical-reasoning](#) [sequence-series](#)

Answer

#### 8.12.4 Sequence Series: GATE Electrical 2020 | GA Question: 8

<https://gateoverflow.in/359715>



In four-digit integer numbers from 1001 to 9999, the digit group “37” (in the same sequence) appears  $\underline{\hspace{2cm}}$  times.

- A. 270
- B. 279
- C. 280
- D. 299

[gate2020-ee](#) [analytical-aptitude](#) [logical-reasoning](#) [sequence-series](#)

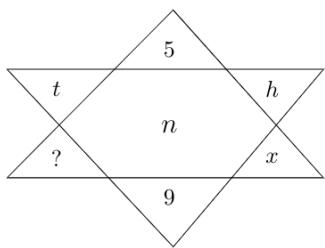
Answer

#### 8.12.5 Sequence Series: GATE Mechanical 2020 Set 2 | GA Question: 7

<https://gateoverflow.in/359544>



Find the missing element in the following figure.



- A. *d*
- B. *e*
- C. *w*
- D. *y*

gateme-2020-set2 analytical-aptitude logical-reasoning sequence-series

Answer

#### 8.12.6 Sequence Series: GATE2010 MN: GA-7 top ↗

<https://gateoverflow.in/312016>



Given the sequence  $A, B, B, C, C, C, D, D, D, D, \dots$  etc., that is one  $A$ , two  $B$ 's, three  $C$ 's, four  $D$ 's, five  $E$ 's and so on, the  $240^{\text{th}}$  latter in the sequence will be :

- A. *V*
- B. *U*
- C. *T*
- D. *W*

general-aptitude logical-reasoning gate2010-mn sequence-series

Answer

#### 8.12.7 Sequence Series: GATE2015 EC-3: GA-4 top ↗

<https://gateoverflow.in/39517>



Find the missing sequence in the letter series below:  
 $A, CD, GHI, ?, UVWXY$

- A. *LMN*
- B. *MNO*
- C. *MNOP*
- D. *NOPQ*

gate2015-ec-3 general-aptitude logical-reasoning sequence-series

Answer

#### 8.12.8 Sequence Series: GATE2018 ME-2: GA-3 top ↗

<https://gateoverflow.in/313639>



Find the missing group of letters in the following series:  
 $BC, FCH, LMNO, \underline{\quad}$

- A. *UVWXY*
- B. *TUVWX*
- C. *STUVW*
- D. *RSTUV*

gate2018-me-2 general-aptitude logical-reasoning sequence-series

Answer

### Answers: Sequence Series

#### 8.12.1 Sequence Series: GATE CSE 2020 | Question: GA-7 top ↗

<https://gateoverflow.in/333234>



- ✓ We can interpret the given order as:

- $P \rightarrow 3^1 = 3$
- $Q \rightarrow 3^2 = 9$
- $R \rightarrow 3^3 = 27$
- $S \rightarrow 3^4 = 81$
- $T \rightarrow 3^5 = 243$

$$Q + S \rightarrow 9 + 81 = 90$$

Hence Option (C) is correct

4 votes

-- Ashwani Kumar (12.8k points)

#### 8.12.2 Sequence Series: GATE Civil 2020 Set 1 | GA Question: 4 top

<https://gateoverflow.in/359861>

- ✓ Given that,  $0 = O, 1 = P, 2 = Q, 3 = R, 4 = S, 5 = T, 6 = U, \dots$

$\therefore 45$  we can be coded as  $ST$ .

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

#### 8.12.3 Sequence Series: GATE Electrical 2020 | GA Question: 7 top

<https://gateoverflow.in/359719>

- ✓ In first place we have one letter, in second place we have two-letters and so on.

Now, we can follow the pattern.

- $Z \xrightarrow{-4} W \xrightarrow{-6} R \xrightarrow{-8} K$
- $V \xrightarrow{-6} Q \xrightarrow{-8} J$
- $P \xrightarrow{-8} I$
- $H$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

#### 8.12.4 Sequence Series: GATE Electrical 2020 | GA Question: 8 top

<https://gateoverflow.in/359715>

- ✓ Ans C

Number of four digit numbers from 1001 to 9999 = 8999. Number of times **digit group** “37” appears is given by:

- $_ \ _ \ 3 \ 7 \rightarrow (1 \text{ to } 9) (0 \text{ to } 9) \rightarrow 9 \cdot 10 = 90$
- $_ \ 3 \ 7 \ _ \rightarrow (1 \text{ to } 9) (0 \text{ to } 9) \rightarrow 9 \cdot 10 = 90$
- $3 \ 7 \ _ \ _ \rightarrow (0 \text{ to } 9) (0 \text{ to } 9) \rightarrow 10 \cdot 10 = 100$

Total count =  $90 + 90 + 100 = 280$ .

Correct option: C

If the question was for finding the number of integers in which “37” appeared then answer would be 279 because in the above counting we double counted for 3737, first in  $_ \ _ \ 3 \ 7$  and second in  $3 \ 7 \ _ \ _$ .

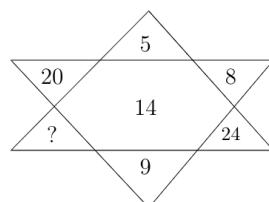
2 votes

-- Vijay Purohit (2.8k points)

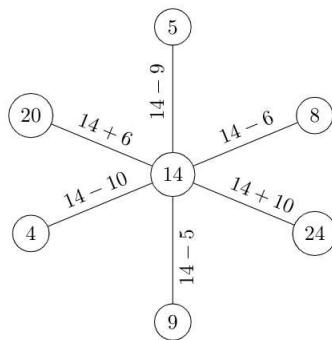
#### 8.12.5 Sequence Series: GATE Mechanical 2020 Set 2 | GA Question: 7 top

<https://gateoverflow.in/359544>

- ✓ First, we can write the numbers corresponding to the alphabet. i.e.,  $h = 8, n = 14, t = 20, x = 24$ .



Now, we can do addition/subtraction, we get.



Here, 4 is denoted by  $d$ .

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

#### 8.12.6 Sequence Series: GATE2010 MN: GA-7 top

<https://gateoverflow.in/312016>



✓ Given Sequence is :

$A, B, B, C, C, C, D, D, D, \dots$  etc.

Here, each alphabet is repeated as many times as its position in the alphabetical order.

Alphabet	Position in alphabetical order	Position in the Given Sequence
$A$	1	$1^{st}$
$B$	2	$2^{nd}$ and $3^{rd}$
$C$	3	$4^{th}, 5^{th}$ and $6^{th}$
$D$	4	$7^{th}, 8^{th}, 9^{th}$ and $10^{th}$
...	...	...
Some Alphabet	$n$	$\left(\frac{n(n+1)}{2} - n + 1\right), \left(\frac{n(n+1)}{2} - n + 2\right), \dots, 240^{th}, \dots, \left(\frac{n(n+1)}{2}\right)$

Here,  $\frac{n(n+1)}{2}$  is the last position in the given sequence for an alphabet whose position is  $n$  in the alphabetical order. So, If we have to find an alphabet whose position is  $i^{th}$  in the given sequence and whose position is  $n$  in the alphabetical order then we have to find smallest integer value of  $n$  such that  $\frac{n(n+1)}{2} \geq i$

For example, if  $i = 5$ , it means we have to find alphabet whose position is  $5^{th}$  in the given sequence, then we have to find minimum value of  $n$  such that  $\frac{n(n+1)}{2} \geq 5$ , So, minimum value of  $n = 3$  means it will be alphabet  $C$ .

Similarly, if  $i = 8$  means we have to find alphabet whose position is  $8^{th}$  in the given sequence, then we have to find minimum value of  $n$  such that  $\frac{n(n+1)}{2} \geq 8$ , So, minimum value of  $n = 4$  means it will be alphabet  $D$ .

Now, in this question, we have to find **smallest** integer value of  $n$  such that

$$\frac{n(n+1)}{2} \geq 240 \quad (\because \text{Sum of first } n \text{ natural numbers} = \frac{n(n+1)}{2})$$

$$\Rightarrow n * (n + 1) \geq 480$$

Options given are  $V, U, T, W$ . So, value of  $n$  can be 22, 21, 20 or 23.

$$22 * 23 = 506 \geq 480 \Rightarrow n = 22.$$

The  $22^{nd}$  alphabet is  $V$ .

$\therefore$  Option (A).  $V$  is the correct answer.

2 votes

-- Satbir Singh (20.9k points)

#### 8.12.7 Sequence Series: GATE2015 EC-3: GA-4 top

<https://gateoverflow.in/39517>



✓ A

Increment 2 positions in alphabet after A → **CD**  
 Increment 3 positions in alphabet after D → **GHI**  
 Increment 4 positions in alphabet after I → **MNOP**  
 Increment 5 positions in alphabet after P → **UVWXYZ**  
 So, option (C)

4 votes

-- Vivek Srivastava (3k points)

#### 8.12.8 Sequence Series: GATE2018 ME-2: GA-3 [top](#)



✓ Obviously, B is correct 😊

We display K characters and then skip K characters. K starts with 2 and increments by 1 at the end of each iteration.  
 Also, we start displaying from Upper-Case "B"

Display 2 Characters: BC

Skip 2 Characters: DE

Display 3 Characters: FGH

Skip 3 Characters: IJK

Display 4 Characters: LMNO

Skip 4 Characters: PQRS

**Display 5 Characters: TUVWX**

3 votes

-- Balaji Jegan (3.5k points)

#### 8.13 Statements Follow (16) [top](#)

#### Statements Follow (16) [top](#)



#### 8.13.1 Statements Follow: GATE CSE 2016 Set 1 | Question: GA08 [top](#)

<https://gateoverflow.in/39617>

Consider the following statements relating to the level of poker play of four players *P, Q, R and S*.

- I. *P* always beats *Q*
- II. *R* always beats *S*
- III. *S* loses to *P* only sometimes.
- IV. *R* always loses to *Q*

Which of the following can be logically inferred from the above statements?

- i. *P* is likely to beat all the three other players
- ii. *S* is the absolute worst player in the set

- A. (i). only
- B. (ii) only
- C. (i) and (ii) only
- D. neither (i) nor (ii)

[gate2016-cse-set1](#) [analytical-aptitude](#) [normal](#) [statements-follow](#)

Answer

#### 8.13.2 Statements Follow: GATE CSE 2016 Set 2 | Question: GA-08 [top](#)

<https://gateoverflow.in/39534>



All hill-stations have a lake. Ooty has two lakes.

Which of the statement(s) below is/are logically valid and can be inferred from the above sentences?

- i. Ooty is not a hill-station.
- ii. No hill-station can have more than one lake.

- A. (i) only.
- B. (ii) only.
- C. Both (i) and (ii)
- D. Neither (i) nor (ii)

[gate2016-cse-set2](#) [analytical-aptitude](#) [easy](#) [statements-follow](#)

**Answer****8.13.3 Statements Follow: GATE CSE 2021 Set 1 | GA Question: 9**[top ↗](https://gateoverflow.in/357468)

Given below are two statements 1 and 2, and two conclusions I and II

- Statement 1: All bacteria are microorganisms.
- Statement 2: All pathogens are microorganisms.
- Conclusion I: Some pathogens are bacteria.
- Conclusion II: All pathogens are not bacteria.

Based on the above statements and conclusions, which one of the following options is logically CORRECT?

- A. Only conclusion I is correct
- B. Only conclusion II is correct
- C. Either conclusion I or II is correct
- D. Neither conclusion I nor II is correct

[gate2021-cse-set1](#) [analytical-aptitude](#) [logical-reasoning](#) [statements-follow](#)

**Answer****8.13.4 Statements Follow: GATE Civil 2021 Set 2 | GA Question: 8**[top ↗](https://gateoverflow.in/359895)

1. Some football players play cricket.
2. All cricket players play hockey.

Among the options given below, the statement that logically follows from the two statements 1 and 2 above, is :

- A. No football player plays hockey
- B. Some football players play hockey
- C. All football players play hockey
- D. All hockey players play football

[gatecivil-2021-set2](#) [analytical-aptitude](#) [logical-reasoning](#) [statements-follow](#)

**Answer****8.13.5 Statements Follow: GATE ECE 2021 | GA Question: 6**[top ↗](https://gateoverflow.in/359795)

Given below are two statements and two conclusions.

- Statement 1: All purple are green.
- Statement 2: All black are green.
- Conclusion I: Some black are purple.
- Conclusion II: No black is purple.

Based on the above statements and conclusions, which one of the following options is logically CORRECT?

- A. Only conclusion I is correct
- B. Only conclusion II is correct
- C. Either conclusion I or II is correct
- D. Both conclusion I and II are correct

[gateec-2021](#) [analytical-aptitude](#) [logical-reasoning](#) [statements-follow](#)

**Answer****8.13.6 Statements Follow: GATE Mechanical 2021 Set 2 | GA Question: 6**[top ↗](https://gateoverflow.in/359499)

Given below are two statements 1 and 2, and two conclusions I and II.

- Statement 1 : All entrepreneurs are wealthy.
- Statement 2 : All wealthy are risk seekers.

- Conclusion I : All risk seekers are wealthy.
- Conclusion II : Only some entrepreneurs are risk seekers.

Based on the above statements and conclusions, which one of the following options is CORRECT?

- Only conclusion I is correct
- Only conclusion II is correct
- Neither conclusion I nor II is correct
- Both conclusions I and II are correct

[gateme-2021-set2](#) [analytical-aptitude](#) [logical-reasoning](#) [statements-follow](#)

Answer 

### 8.13.7 Statements Follow: GATE2013 AE: GA-9 [top](#)

► <https://gateoverflow.in/40250>



- All professors are researchers
- Some scientists are professors

Which of the given conclusions is logically valid and is inferred from the above arguments?

- All scientists are researchers
- All professors are scientists
- Some researchers are scientists
- No conclusion follows

[gate2013-ae](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

### 8.13.8 Statements Follow: GATE2014 EC-1: GA-2 [top](#)

► <https://gateoverflow.in/41491>



Read the statements:

- All women are entrepreneurs.
- Some women are doctors.

Which of the following conclusions can be logically inferred from the above statements?

- All women are doctors
- All doctors are entrepreneurs
- All entrepreneurs are women
- Some entrepreneurs are doctors

[gate2014-ec-1](#) [analytical-aptitude](#) [statements-follow](#) [easy](#)

Answer 

### 8.13.9 Statements Follow: GATE2015 EC-1: GA-10 [top](#)

► <https://gateoverflow.in/39497>



Humpty Dumpty sits on a wall every day while having lunch. The wall sometimes breaks. A person sitting on the wall falls if the wall breaks.

Which one of the statements below is logically valid and can be inferred from the above sentences?

- Humpty Dumpty always falls while having lunch
- Humpty Dumpty does not fall sometimes while having lunch
- Humpty Dumpty never falls during dinner
- When Humpty Dumpty does not sit on the wall, the wall does not break

[gate2015-ec-1](#) [general-aptitude](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

**8.13.10 Statements Follow: GATE2015 ME-3: GA-4** top ↗<https://gateoverflow.in/40169>

1. Tanya is older than Eric.
2. Cliff is older than Tanya.
3. Eric is older than Cliff.

If the first two statements are true, then the third statement is:

- A. True
- B. False
- C. Uncertain
- D. Data insufficient

[gate2015-me-3](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

**8.13.11 Statements Follow: GATE2015 ME-3: GA-7** top ↗<https://gateoverflow.in/40172>

Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.

Statements:

- I. No manager is a leader.
- II. All leaders are executives.

Conclusions:

- I. No manager is an executive.
  - II. No executive is a manager.
- A. Only conclusion I follows.
  - B. Only conclusion II follows.
  - C. Neither conclusion I nor II follows.
  - D. Both conclusions I and II follow.

[gate2015-me-3](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

**8.13.12 Statements Follow: GATE2016 ME-2: GA-4** top ↗<https://gateoverflow.in/108275>

**Fact:** If it rains, then the field is wet.

Read the following statements:

- i. It rains
- ii. The field is not wet
- iii. The field is wet
- iv. It did not rain

Which one of the options given below is NOT logically possible, based on the given fact?

- A. If (iii), then (iv).
- B. If (i), then (iii).
- C. If (i), then (ii).
- D. If (ii), then (iv).

[gate2016-me-2](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

**8.13.13 Statements Follow: GATE2017 CE-1: GA-3** top ↗<https://gateoverflow.in/313487>

Consider the following sentences:

All benches are beds. No bed is bulb. Some bulbs are lamps.

Which of the following can be inferred?

- i. Some beds are lamps.
- ii. Some lamps are beds.

- A. Only i
- B. Only ii
- C. Both i and ii
- D. Neither i nor ii

[gate2017-ce-1](#) [general-aptitude](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

#### 8.13.14 Statements Follow: GATE2017 EC-1: GA-5 [top](#)

<https://gateoverflow.in/313523>



Some tables are shelves. Some shelves are chairs. All chairs are benches. Which of the following conclusion can be deduced from the preceding sentences?

- i. At least one bench is a table
- ii. At least one shelf is a bench
- iii. At least one chair is a table
- iv. All benches are chairs

- A. Only i
- B. Only ii
- C. Only ii and iii
- D. Only iv

[gate2017-ec-1](#) [general-aptitude](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

#### 8.13.15 Statements Follow: GATE2018 ME-1: GA-10 [top](#)

<https://gateoverflow.in/313657>



Consider the following three statements:

- i. Some roses are red.
- ii. All red flowers fade quickly.
- iii. Some roses fade quickly.

Which of the following statements can be logically inferred from the above statements?

- A. If (i) is true and (ii) is false, then (iii) is false.
- B. If (i) is true and (ii) is false, then (iii) is true.
- C. If (i) and (ii) are true, then (iii) is true.
- D. If (i) and (ii) are false, then (iii) is false.

[gate2018-me-1](#) [general-aptitude](#) [analytical-aptitude](#) [statements-follow](#)

Answer 

#### 8.13.16 Statements Follow: GATE2019 IN: GA-2 [top](#)

<https://gateoverflow.in/313551>



Some students were not involved in the strike.

If the above statement is true, which of the following conclusions is/are logically necessary?

1. Some who were involved in the strike were students.
  2. No student was involved in the strike.
  3. At least one student was involved in the strike.
  4. Some who were not involved in the strike were students.
- A. 1 and 2
  - B. 3
  - C. 4
  - D. 2 and 3

gate2019-in general-aptitude analytical-aptitude statements-follow

Answer 

### Answers: Statements Follow

#### 8.13.1 Statements Follow: GATE CSE 2016 Set 1 | Question: GA08 top ↗

 <https://gateoverflow.in/39617>



✓ Answer is (D) because

1.  $P$  is not likely to beat  $S$  because  $S$  only sometimes loses to  $P$
2.  $S$  is not worst player because he is likely to beat  $P$

 45 votes

-- Vaibhav Singh (445 points)

#### 8.13.2 Statements Follow: GATE CSE 2016 Set 2 | Question: GA-08 top ↗

 <https://gateoverflow.in/39534>



✓ All hill stations have a lake  $\Rightarrow \forall x(h(x) \rightarrow (\exists y, l(y) \wedge has(x, y)))$

Ooty has two lakes  $\Rightarrow \exists x(o(x) \wedge \exists y, z(has(x, y, z) \wedge l(y) \wedge l(z) \wedge (z! = y))$

Here,  $h(x) \rightarrow x$  is hill station

- $l(x) \rightarrow x$  is lake
- $has(x, y) \rightarrow x$  has  $y$
- $has(x, y, z) \rightarrow x$  has  $y, z$
- $o(x) \rightarrow x$  is Ooty

- i. Ooty is not a hill station  $\implies$  we can not derive this above arguments, Ooty has two lakes already, if Ooty had 0 lakes only then this can become true.
- ii. No hill station can have more than one lake

All arguments here are saying are if we have hill station, it can have lake. It is nowhere told that how many lakes it has. So, this is false.

**Answer: (D) neither (i) nor (ii)**

 22 votes

-- Akash Kanase (36k points)

#### 8.13.3 Statements Follow: GATE CSE 2021 Set 1 | GA Question: 9 top ↗

 <https://gateoverflow.in/357468>



✓

- Statement 1: All bacteria are microorganisms.
- Statement 2: All pathogens are microorganisms.

- Conclusion I: Some pathogens are bacteria.

Not logically correct as we can draw a Venn diagram satisfying the given statements and where pathogens and bacteria do not intersect.

- Conclusion II: All pathogens are not bacteria.

This statement means some pathogen is there which is not a bacteria. (Alternatively think of the statement “all students are not rich” which means “there is at least one student who is not rich”). Now, this statement is also not logically correct as we can draw a Venn diagram satisfying the given statements and having all pathogens as bacteria.

Now we already showed that options A and B are wrong.

Option C is ambiguous in the sense that it can mean

1. At least one conclusion is correct (does not make sense as this will automatically make at least one of options A or B correct as well)
2. If conclusion I is not true conclusion II is true and vice versa. In other words both the conclusions cannot be false at the same time. This interpretation makes this option CORRECT.

Option D is correct as individually both the conclusions are not logically correct.

Due to the ambiguity of option C marks were given for both options C and D.

 1 votes

-- Arjun Suresh (328k points)

$\text{pathogen}(x) = x \text{ is pathogen}$

$\text{bacteria}(x) = x \text{ is bacteria}$

Conclusion I: Some pathogens are bacteria.

$\exists x(\text{pathogen}(x) \wedge \text{bacteria}(x))$

this means  $\text{pathogen} \cap \text{bacteria} \neq \emptyset$

Conclusion II: All pathogens are not bacteria.

$\forall x(\text{pathogen}(x) \rightarrow \sim \text{bacteria}(x))$

this means  $\text{pathogen} \cap \text{bacteria} = \emptyset$

clearly either conclusion I or conclusion is true.

I think confusion here is in second conclusion,

if the given conclusion II were like

“Not all pathogens are bacteria”,  $\sim (\forall x(\text{pathogen}(x) \rightarrow \text{bacteria}(x)))$

in the case i agree neither is correct answer..

But see the difference between given conclusion and this conclusion..

Correct me if I'm wrong!

22 votes

-- Nikhil Dhama (2.3k points)

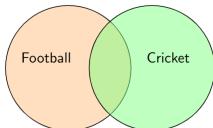
#### 8.13.4 Statements Follow: GATE Civil 2021 Set 2 | GA Question: 8 top ↴

↗ <https://gateoverflow.in/359895>

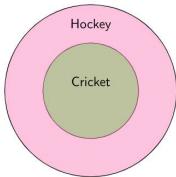


✓ Given statements are:

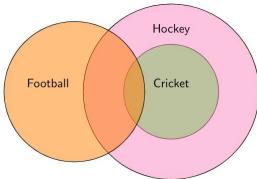
- Some football players play cricket.



- All cricket players play hockey.



- No football player plays hockey – It is not correct. No way we can combine diagrams 1 and 2 to get a diagram for this statement.
- Some football players play hockey – It is correct from the above reasoning. In whichever way we combine the Venn diagrams of the given two statements we'll get an intersection for Football and Hockey.
- All football players play hockey – It can be true but not always and the counterexample is shown in the below Venn diagram which can be obtained by combining the Venn diagrams for the given statements.



- All hockey players play football – It also can be correct but not always. The counterexample shown in the above Venn diagram for option C works here as well.

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

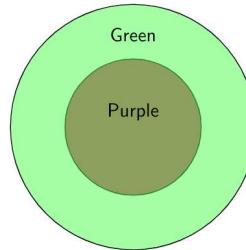
### 8.13.5 Statements Follow: GATE ECE 2021 | GA Question: 6 top

<https://gateoverflow.in/359795>

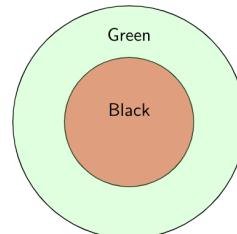


✓ Given statements are:

- Statement 1: All purple are green.

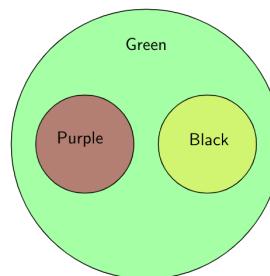


- Statement 2: All black are green.

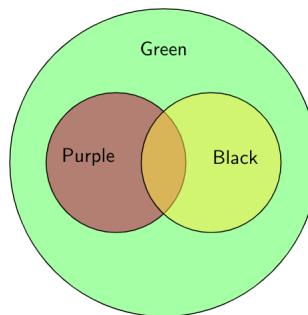


A conclusion “should **always** be true”. We can try to make the complement of the conclusion satisfiable (by drawing a Venn diagram) and if we can’t then the conclusion is VALID or else NOT Valid.

For the first conclusion “Some black are purple” – the **complement** is “No black is purple”. It is possible as shown below. So the given conclusion is **NOT** valid.



For the second conclusion “No black is purple” – the **complement** is “Some black is purple”. It is possible as shown below. So the given conclusion is **NOT** valid.



So, options A, B, and D are false. Option C is correct because we cannot make a Venn diagram making both the conclusions false. If we make conclusion 1 false, the Venn diagram will satisfy conclusion 2 and vice versa.

So, the correct answer is (C).

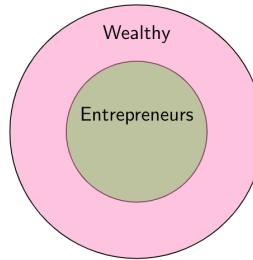
1 votes

-- Lakshman Patel (63.9k points)

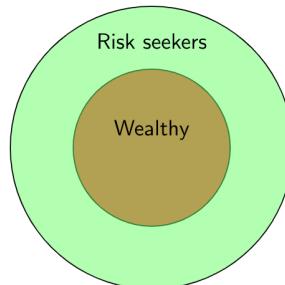
8.13.6 Statements Follow: GATE Mechanical 2021 Set 2 | GA Question: 6 [top](#)<https://gateoverflow.in/359499>

- Given statements are,

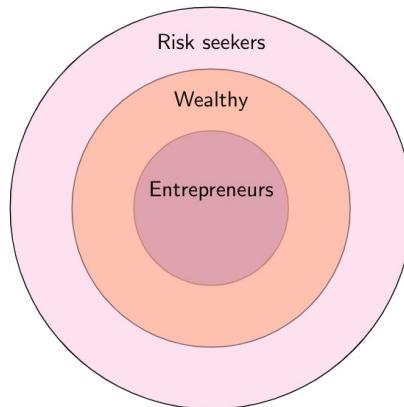
- Statement 1 : All entrepreneurs are wealthy.



- Statement 2 : All wealthy are risk seekers.



- Conclusion I : All risk seekers are wealthy.



From the above Venn diagram, not all risk seekers are wealthy. So, conclusion I is false.

- Conclusion II : Only some entrepreneurs are risk seekers.

From the above Venn diagram, all entrepreneurs are risk seekers. So, conclusion II is also false.

So, the correct answer is (C).

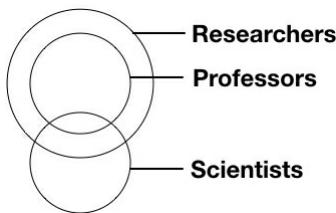
1 votes

-- Lakshman Patel (63.9k points)

8.13.7 Statements Follow: GATE2013 AE: GA-9 [top](#)<https://gateoverflow.in/40250>

- Answer is (C) Some researchers are scientists. For these type of questions we can always follow the Venn diagram approach.

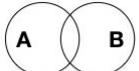
All professors are Researchers. So, we draw a circle inside researchers and name it professors. Some scientists are professors. So, we draw something like below:-



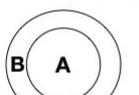
Clearly we can see some researchers are scientists which is option(C)

Below are some useful Venn diagrams for questions of this type:-

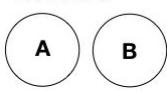
**Some A is B**



**All A's are B**



**No A is B**



14 votes

-- Krishiga2101 (7.9k points)



#### 8.13.8 Statements Follow: GATE2014 EC-1: GA-2 [top](#)

<https://gateoverflow.in/41491>

- ✓ Option D is correct.

"Some Entrepreneurs are Doctor".

PS: In the first statement if we replace "All" by "Some", then none of the options is true.

16 votes

-- Muktinath Vishwakarma (23.9k points)



#### 8.13.9 Statements Follow: GATE2015 EC-1: GA-10 [top](#)

<https://gateoverflow.in/39497>



- ✓ Option B is the answer. The wall sometimes breaks. Sometimes it won't break. So Humpty Dumpty does not fall sometimes, while having lunch. This can be inferred.

4 votes

-- Sreyas S (1.6k points)



#### 8.13.10 Statements Follow: GATE2015 ME-3: GA-4 [top](#)

<https://gateoverflow.in/40169>



- ✓ From first two statements, ERIC < TANYA < CLIFF

So, statement 3 is false if first two statements are TRUE.

OPTION (B)

4 votes

-- Shah Himadri Satishbhai (171 points)



#### 8.13.11 Statements Follow: GATE2015 ME-3: GA-7 [top](#)

<https://gateoverflow.in/40172>



- ✓ Every leader is executive and no manager is leader. So, manager can be other than leader which also includes executive. So (I) is FALSE.

(ii) is also FALSE because some executive who is not a leader can be a manager.

C IS CORRECT

5 votes

-- rajan (4.4k points)



**8.13.12 Statements Follow: GATE2016 ME-2: GA-4** top ↗<https://gateoverflow.in/108275>

- ✓ Option B and D are wrong due to the fact that question asks about which of the given option NOT logically possible .

Option B is given fact .

In Option D, statement (ii) is direct result of statement (iv)

Option A, field may be wet but that does not mean there is a rain . So this logically possible.

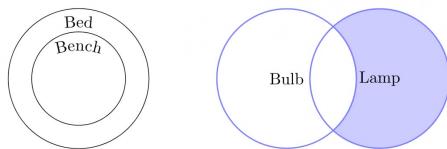
Option C, it is logically not possible, if it rains then field must be wet. Thus option C is only correct option.

8 votes

-- Bikram (58.3k points)

**8.13.13 Statements Follow: GATE2017 CE-1: GA-3** top ↗<https://gateoverflow.in/313487>

- ✓ According to the given data, we can draw the Venn diagram as shown below and all conditions given are satisfied. (We can also draw Venn diagram differently like taking Bed and Bench as same set, but this is just one possibility)



None of the given statement can be inferred according to the Venn diagram. (If any statement can be inferred it must hold true for any Venn diagram)

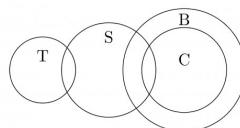
So, Correct answer is (D)

3 votes

-- Lakshman Patel (63.9k points)

**8.13.14 Statements Follow: GATE2017 EC-1: GA-5** top ↗<https://gateoverflow.in/313523>

- ✓ Possible Venn diagram based on the given facts :-



T = Tables  
S = Shelves  
B = Benches  
C = Chairs

Now, according to above Venn diagram,

- At least one bench is a table -- **False**
- At least one chair is a table -- **False**
- All benches are chairs -- **False**

Since, some shelves are chairs and all chairs are benches, at least one shelf must be a bench.

So, **option (B) is correct.**

4 votes

-- ankitgupta.1729 (14.9k points)

**8.13.15 Statements Follow: GATE2018 ME-1: GA-10** top ↗<https://gateoverflow.in/313657>

- ✓ Some roses are red  
and  
All red flowers fade quickly  
implies  
Some roses fade quickly.  
So, if (i) and (ii) are TRUE, (iii) must be TRUE.

Correct Answer: C.

2 votes

-- Arjun Suresh (328k points)

**8.13.16 Statements Follow: GATE2019 IN: GA-2** top ↗ <https://gateoverflow.in/313551>

- ✓ Some students were not involved in the strike.

1. Some who were involved in the strike were students - cannot be inferred from the given statement.
2. No student was involved in the strike - same as above, cannot be inferred.
3. At least one student was involved in the strike - same as above, cannot be inferred.
4. Some who were not involved in the strike were students -- same meaning as the given statement.

So, if the given statement is TRUE statement 4 must be TRUE whereas the other three may or may not be TRUE (not necessary).

Correct Answer: C.

3 votes

-- Arjun Suresh (328k points)

**Answer Keys**

8.1.1	D
8.3.3	D
8.3.8	A
8.4.3	D
8.5.4	B
8.5.9	C
8.5.14	C
8.5.19	D
8.5.24	C
8.5.29	B
8.5.34	B
8.6.1	3
8.8.4	C
8.11.1	A
8.12.4	C
8.13.1	D
8.13.6	C
8.13.11	C
8.13.16	C

8.2.1	B
8.3.4	C
8.3.9	C
8.4.4	B
8.5.5	C
8.5.10	D
8.5.15	A
8.5.20	C
8.5.25	B
8.5.30	D
8.5.35	D
8.7.1	B
8.8.5	C
8.11.2	A
8.12.5	A
8.13.2	D
8.13.7	C
8.13.12	C

8.2.2	C
8.3.5	D
8.3.10	A
8.5.1	C
8.5.6	C
8.5.11	B
8.5.16	B
8.5.21	D
8.5.26	C
8.5.31	B
8.5.36	C
8.8.1	D
8.9.1	B
8.12.1	C
8.12.6	A
8.13.3	C;D
8.13.8	D
8.13.13	D

8.3.1	A
8.3.6	D
8.4.1	B
8.5.2	B
8.5.7	B
8.5.12	C
8.5.17	A
8.5.22	B
8.5.27	B
8.5.32	C
8.5.37	C
8.8.2	D
8.10.1	C
8.12.2	B
8.12.7	C
8.13.4	B
8.13.9	B
8.13.14	B

8.3.2	A
8.3.7	C
8.4.2	B
8.5.3	B
8.5.8	C
8.5.13	A
8.5.18	X
8.5.23	C
8.5.28	A
8.5.33	C
8.5.38	D
8.8.3	D
8.10.2	C
8.12.3	C
8.12.8	B
8.13.5	C
8.13.10	B
8.13.15	C

## 9

## General Aptitude: Quantitative Aptitude (376)



**Syllabus:** Numerical computation, Numerical estimation, Numerical reasoning and data interpretation

## Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Minimum	Average	Maximum
<b>1 Mark Count</b>	1	2	1	2	3	2	3	1	2	1	1.8	3
<b>2 Marks Count</b>	3	2	3	3	4	4	4	3	3	2	3.2	4
<b>Total Marks</b>	7	6	7	8	11	10	11	7	8	6	8.3	11

## 9.1

Absolute Value (6) top ↗<https://gateoverflow.in/1950>

If  $x$  is real and  $|x^2 - 2x + 3| = 11$ , then possible values of  $|-x^3 + x^2 - x|$  include

- A. 2, 4
- B. 2, 14
- C. 4, 52
- D. 14, 52

[gate2014-cse-set2](#) [quantitative-aptitude](#) [normal](#) [absolute-value](#)

Answer

9.1.2 Absolute Value: GATE CSE 2017 Set 1 | Question: GA-8 top ↗<https://gateoverflow.in/118411>

The expression  $\frac{(x+y)-|x-y|}{2}$  is equal to :

- A. The maximum of  $x$  and  $y$
- B. The minimum of  $x$  and  $y$
- C. 1
- D. None of the above

[gate2017-cse-set1](#) [general-aptitude](#) [quantitative-aptitude](#) [maxima-minima](#) [absolute-value](#)

Answer

9.1.3 Absolute Value: GATE2011 AG: GA-7 top ↗<https://gateoverflow.in/312126>

Given that  $f(y) = \frac{|y|}{y}$ , and  $q$  is non-zero real number, the value of  $|f(q) - f(-q)|$  is

- A. 0
- B. -1
- C. 1
- D. 2

[general-aptitude](#) [quantitative-aptitude](#) [gate2011-ag](#) [absolute-value](#)

Answer

9.1.4 Absolute Value: GATE2013 AE: GA-8 top ↗<https://gateoverflow.in/40249>

If  $|-2X + 9| = 3$  then the possible value of  $|-X| - X^2$  would be:

- A. 30
- B. -30
- C. -42
- D. 42

[gate2013-ae](#) [quantitative-aptitude](#) [absolute-value](#)

Answer

**9.1.5 Absolute Value: GATE2013 CE: GA-7** top ↗<https://gateoverflow.in/40275>

If  $|4X - 7| = 5$  then the values of  $2|X| - |-X|$  is:

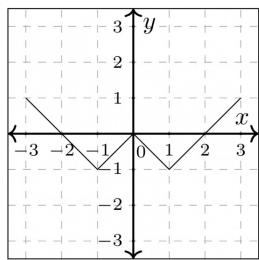
- A.  $2, \left(\frac{1}{3}\right)$
- B.  $\left(\frac{1}{2}\right), 3$
- C.  $\left(\frac{3}{2}\right), 9$
- D.  $\left(\frac{2}{3}\right), 9$

[gate2013-ce](#) [quantitative-aptitude](#) [absolute-value](#)

Answer

**9.1.6 Absolute Value: GATE2018 ME-1: GA-9** top ↗<https://gateoverflow.in/313654>

Which of the following functions describe the graph shown in the below figure?



- A.  $y = ||x| + 1| - 2$
- B.  $y = ||x| - 1| - 1$
- C.  $y = ||x| + 1| - 1$
- D.  $y = ||x - 1| - 1|$

[gate2018-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [functions](#) [absolute-value](#)

Answer

**Answers: Absolute Value****9.1.1 Absolute Value: GATE CSE 2014 Set 2 | Question: GA-8** top ↗<https://gateoverflow.in/1950>

- ✓  $x^2 - 2x + 3 = 11$  OR  $x^2 - 2x + 3 = -11$   
 (Any one of them can be correct because of mod)

Lets take first one:

$$\begin{aligned} x^2 - 2x + 3 &= 11 \\ \implies x^2 - 2x - 8 &= 0 \\ \implies (x - 4)(x + 2) &= 0 \\ \implies x &= 4 \text{ or } x = -2. \end{aligned}$$

Now put these values of  $x$  in the given equation  $|-x^3 + x^2 - x|$

for  $x = 4$ , we will get  $|64 + 16 - 4| = 52$ .  
 for  $x = -2$ , we will get  $|8 + 4 + 2| = 14$ .

So, answer is D.

31 votes

-- Akash Kanase (36k points)

**9.1.2 Absolute Value: GATE CSE 2017 Set 1 | Question: GA-8** top ↗<https://gateoverflow.in/118411>

- ✓ When  $x > y$ ,  $|x - y| = x - y$ , if we substitute in expression we get  $y$ .  
When  $x < y$ ,  $|x - y| = -(x - y)$ , if we substitute in expression we get  $x$ .

Therefore in both the case we get minimum of  $(x, y)$ .

ANS: B

33 votes

-- Vinay Rachapalli (905 points)

**9.1.3 Absolute Value: GATE2011 AG: GA-7** top ↗<https://gateoverflow.in/312126>

$$\checkmark f(y) = \frac{|y|}{y} = \begin{cases} +1 & \text{when } y > 0 \\ -1 & \text{when } y < 0 \end{cases}$$

It is well-known signum function but in the given question, it is not defined for  $y = 0$

Here,  $q$  is a non-zero real number.

So,

- (1) When  $q > 0$ , then  $|f(q) - f(-q)| = |(+1) - (-1)| = 2$  because when  $q > 0$  then  $f(q) = f(> 0) = +1$  and  $q > 0$  means  $-q < 0$  which implies  $f(-q) = f(< 0) = -1$
- (2) When  $q < 0$ , then  $|f(q) - f(-q)| = |(-1) - (+1)| = 2$  because when  $q < 0$  then  $f(q) = f(< 0) = -1$  and  $q < 0$  means  $-q > 0$  which implies  $f(-q) = f(> 0) = +1$

Correct Option: D.

#### References



9 votes

-- ankitgupta.1729 (14.9k points)

**9.1.4 Absolute Value: GATE2013 AE: GA-8** top ↗<https://gateoverflow.in/40249>

- ✓ Given  $|-2X + 9| = 3$ ,

$$\Rightarrow -2X + 9 = 3 \text{ or } -(-2X + 9) = 3,$$

$$\Rightarrow X = 3 \text{ or } X = 6,$$

$$\Rightarrow |-X| - X^2 = |-3| - 3^2 = -6 \text{ or } |-X| - X^2 = |-6| - 6^2 = -30,$$

Thus B is the correct option.

17 votes

-- Anurag Pandey (10.5k points)

**9.1.5 Absolute Value: GATE2013 CE: GA-7** top ↗<https://gateoverflow.in/40275>

- ✓  $|4X - 7| = 5$ , since it is in absolute form the regular form of this equation is given as

$$(4X - 7) = 5$$

$$(4X - 7) = -5$$

By solving the above equations we get the following answer

$$X = \frac{1}{2}, X = 3$$

$$\text{Now } 2|X| - |-X| = 2|X| - |X| = |X|.$$

So, our answer will be B.

14 votes

-- ibia (2.2k points)

**9.1.6 Absolute Value: GATE2018 ME-1: GA-9** top ↴<https://gateoverflow.in/313654>

- ✓ Take  $x = 1$

$$y_A = 0, y_B = -1, y_C = 1, y_D = 1$$

Only  $y_B$  is correct.

So, Option: B.

7 votes

-- Arjun Suresh (328k points)

**9.2****Age Relation (2)** top ↴**9.2.1 Age Relation: GATE2018 CE-1: GA-3** top ↴<https://gateoverflow.in/313272>

Hema's age is 5 years more than twice Hari's age. Suresh's age is 13 years less than 10 times Hari's age. If Suresh is 3 times as old as Hema, how old is Hema?

- A. 14
- B. 17
- C. 18
- D. 19

[gate2018-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [age-relation](#)

Answer

**9.2.2 Age Relation: GATE2019 ME-1: GA-10** top ↴<https://gateoverflow.in/313601>

$M$  and  $N$  had four children  $P, Q, R$  and  $S$ . Of them, only  $P$  and  $R$  were married. They had children  $X$  and  $Y$  respectively. If  $Y$  is a legitimate child of  $W$ , which of the following statements is necessarily FALSE?

- A.  $M$  is the grandmother of  $Y$
- B.  $R$  is the father of  $Y$
- C.  $W$  is the wife of  $R$
- D.  $W$  is the wife of  $P$

[gate2019-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [age-relation](#)

Answer

**Answers: Age Relation****9.2.1 Age Relation: GATE2018 CE-1: GA-3** top ↴<https://gateoverflow.in/313272>

- ✓ Let Hema's age be  $x$ , Hari's age be  $y$  and Suresh's age be  $z$ .

According to the question:

- $x = 5 + 2y \implies x - 2y = 5 \quad \rightarrow (1)$
- $z = 10y - 13 \quad \rightarrow (2)$
- $z = 3x \quad \rightarrow (3)$

From (2) and (3) we get

$$\bullet 3x - 10 = -13 \quad \rightarrow (4)$$

Solving equations (1), (4) and (3) we get  $x = 19$ ,  $y = 7$  and  $z = 57$ .

Hema's age  $x = 19$

So, the correct answer is (D).

4 votes

-- Lakshman Patel (63.9k points)

**9.2.2 Age Relation: GATE2019 ME-1: GA-10** [top](#)<https://gateoverflow.in/313601>

- ✓  $M$  and  $N$  had four children  $P, Q, R$  and  $S$ .

It means  $M$  and  $N$  are couple.

Only  $P$  and  $R$  were married.

They had children  $X$  and  $Y$  respectively.

It means child of  $P$  is  $X$  and child of  $R$  is  $Y$ .

If  $Y$  is a legitimate child of  $W$  we can conclude that  $W$  and  $R$  are couple.

- A.  $M$  is the grandmother of  $Y$ — Possible, can also be grand father.
- B.  $R$  is the father of  $Y$ — Possible, can also be mother.
- C.  $W$  is the wife of  $R$ — Possible, can also be husband.
- D.  $W$  is the wife of  $P$ —**False**,  $W$  is either wife of  $R$  or husband of  $R$ .

So, the correct answer is (D).

7 votes

-- Lakshman Patel (63.9k points)

**9.3****Algebra (5)** [top](#)**9.3.1 Algebra: GATE Civil 2021 Set 1 | GA Question: 4** [top](#)<https://gateoverflow.in/359883>

$\oplus$  and  $\odot$  are two operators on numbers  $p$  and  $q$  such that  $p \oplus q = \frac{p^2 + q^2}{pq}$  and  $p \odot q = \frac{p^2}{q}$ ;

If  $x \oplus y = 2 \odot 2$ , then  $x =$

- A.  $\frac{y}{2}$
- B.  $y$
- C.  $\frac{3y}{2}$
- D.  $2y$

[gatcivil-2021-set1](#) [quantitative-aptitude](#) [algebra](#)

Answer

**9.3.2 Algebra: GATE Civil 2021 Set 2 | GA Question: 4** [top](#)<https://gateoverflow.in/359903>

$\oplus$  and  $\odot$  are two operators on numbers  $p$  and  $q$  such that  $p \odot q = p - q$ , and  $p \oplus q = p \times q$

Then,  $(9 \odot (6 \oplus 7)) \odot (7 \oplus (6 \odot 5)) =$

- A. 40
- B. -26
- C. -33
- D. -40

[gatcivil-2021-set2](#) [quantitative-aptitude](#) [algebra](#)

Answer

**9.3.3 Algebra: GATE ECE 2021 | GA Question: 2** [top](#)<https://gateoverflow.in/359803>

$p$  and  $q$  are positive integers and  $\frac{p}{q} + \frac{q}{p} = 3$ , then,  $\frac{p^2}{q^2} + \frac{q^2}{p^2} =$

- A. 3
- B. 7
- C. 9
- D. 11

[gateec-2021](#) [quantitative-aptitude](#) [algebra](#)

Answer

**9.3.4 Algebra: GATE2011 MN: GA-61** top ↗<https://gateoverflow.in/31536>

If  $\frac{(2y+1)}{(y+2)} < 1$ , then which of the following alternatives gives the CORRECT range of  $y$ ?

- A.  $-2 < y < 2$
- B.  $-2 < y < 1$
- C.  $-3 < y < 1$
- D.  $-4 < y < 1$

[quantitative-aptitude](#) [gate2011-mn](#) [algebra](#)
[Answer ↗](#)
**9.3.5 Algebra: GATE2018 CE-2: GA-3** top ↗<https://gateoverflow.in/313391>

$\underbrace{a + a + a + \dots + a}_{n \text{ times}} = a^2 b$  and  $\underbrace{b + b + b + \dots + b}_{m \text{ times}} = ab^2$ , where  $a, b, n, m$  are natural numbers. What is the value of  $\left( \left( \underbrace{m + m + m + \dots + m}_{n \text{ times}} \right) \right) \left( \left( \underbrace{n + n + n + \dots + n}_{m \text{ times}} \right) \right)$ ?

- A.  $2a^2b^2$
- B.  $a^4b^4$
- C.  $ab(a+b)$
- D.  $a^2 + b^2$

[gate2018-ce-2](#) [algebra](#) [quantitative-aptitude](#)
[Answer ↗](#)
**Answers: Algebra****9.3.1 Algebra: GATE Civil 2021 Set 1 | GA Question: 4** top ↗<https://gateoverflow.in/359883>

- ✓ Given that,  $p \oplus q = \frac{p^2 + q^2}{pq}$ ,  $p \odot q = \frac{p^2}{q}$

Performing these operations we get,

$$\begin{aligned} x \oplus y &= 2 \odot 2 \\ \implies \frac{x^2 + y^2}{xy} &= \frac{2^2}{2} \\ \implies \frac{x^2 + y^2}{xy} &= 2 \\ \implies x^2 + y^2 &= 2xy \\ \implies x^2 + y^2 - 2xy &= 0 \\ \implies (x - y)^2 &= 0 \\ \implies x &= y \end{aligned}$$

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

**9.3.2 Algebra: GATE Civil 2021 Set 2 | GA Question: 4** top ↗<https://gateoverflow.in/359903>

- ✓ Given that,  $p \odot q = p - q$ , and  $p \oplus q = p \times q$

$$\text{Then, } (9 \odot (6 \oplus 7)) \odot (7 \oplus (6 \odot 5)) = (9 \odot 42) \odot (7 \oplus 1) = -33 \odot 7 = -33 - 7 = -40.$$

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

### 9.3.3 Algebra: GATE ECE 2021 | GA Question: 2 top ↴



- ✓ Given that,  $\frac{p}{q} + \frac{q}{p} = 3$

$$\text{Now, } \left( \frac{p}{q} + \frac{q}{p} \right)^2 = 3^3$$

$$\implies \frac{p^2}{q^2} + \frac{q^2}{p^2} + 2 \cdot \frac{p}{q} \cdot \frac{q}{p} = 9 \quad [\because (a+b)^2 = a^2 + b^2 + 2ab]$$

$$\implies \frac{p^2}{q^2} + \frac{q^2}{p^2} + 2 = 9$$

$$\implies \frac{p^2}{q^2} + \frac{q^2}{p^2} = 7$$

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

### 9.3.4 Algebra: GATE2011 MN: GA-61 top ↴



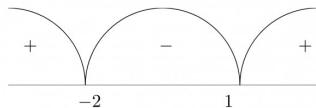
- ✓ In inequality we should not do cross multiplication as we do not know the sign of  $y$  (we know that on multiplying with negative number inequality will change).

$$\frac{2y+1}{y+2} < 1$$

$$\implies \frac{2y+1}{y+2} - 1 < 0$$

$$\implies \frac{y-1}{y+2} < 0$$

We can draw the following number line



Since, we want negative interval  $y \in (-2, 1)$ .

Correct Answer: B

19 votes

-- pawan sahu (8k points)

### 9.3.5 Algebra: GATE2018 CE-2: GA-3 top ↴



- ✓  $\underbrace{a+a+a+\cdots+a}_{n \text{ times}} = a^2b$

$$n \times a = a^2b$$

$$n = ab \implies n^2 = a^2b^2$$

$$\text{and } \underbrace{b+b+b+\cdots+b}_{m \text{ times}} = ab^2$$

$$m \times b = ab^2$$

$$m = ab \implies m^2 = a^2b^2$$

$$\left( \underbrace{m + m + m + \dots + m}_{n \text{ times}} \right) \left( \underbrace{n + n + n + \dots + n}_{m \text{ times}} \right)$$

$$= (m \times n)(n \times m)$$

$$= (m \times n \times n \times m)$$

$$= m^2 \times n^2$$

$$= a^2 b^2 \times a^2 b^2$$

$$= a^4 b^4$$

So, the correct answer is (B).

4 votes

-- Lakshman Patel (63.9k points)

## 9.4

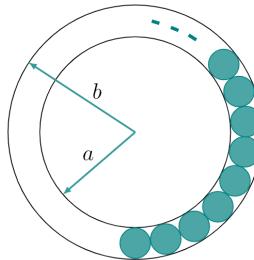
### Area (4) top

#### 9.4.1 Area: GATE CSE 2020 | Question: GA-8 top

<https://gateoverflow.in/333233>



The figure below shows an annular ring with outer and inner radii as  $b$  and  $a$ , respectively. The annular space has been painted in the form of blue colour circles touching the outer and inner periphery of annular space. If maximum  $n$  number of circles can be painted, then the unpainted area available in annular space is \_\_\_\_\_.



- A.  $\pi[(b^2 - a^2) - \frac{n}{4}(b - a)^2]$
- B.  $\pi[(b^2 - a^2) - n(b - a)^2]$
- C.  $\pi[(b^2 - a^2) + \frac{n}{4}(b - a)^2]$
- D.  $\pi[(b^2 - a^2) + n(b - a)^2]$

[gate2020-cse](#) [quantitative-aptitude](#) [geometry](#) [circles](#) [area](#)

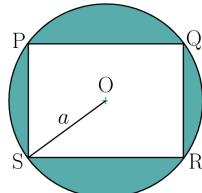
Answer ¶

#### 9.4.2 Area: GATE ECE 2020 | GA Question: 8 top

<https://gateoverflow.in/359764>



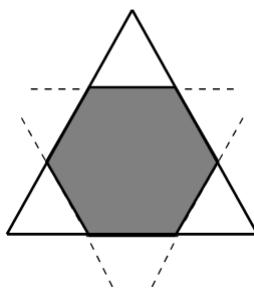
A circle with centre O is shown in the figure. A rectangle PQRS of maximum possible area is inscribed in the circle. If the radius of the circle is  $a$ , then the area of the shaded portion is \_\_\_\_\_.



- A.  $\pi a^2 - a^2$
- B.  $\pi a^2 - \sqrt{2}a^2$
- C.  $\pi a^2 - 2a^2$
- D.  $\pi a^2 - 3a^2$

[gate2020-ece](#) [quantitative-aptitude](#) [geometry](#) [circles](#) [area](#)

Answer ¶

9.4.3 Area: GATE ECE 2021 | GA Question: 10 [top ↗](#)<https://gateoverflow.in/359785>

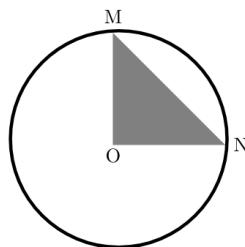
Corners are cut from an equilateral triangle to produce a regular convex hexagon as shown in the figure above.

The ratio of the area of the regular convex hexagon to the area of the original equilateral triangle is

- A. 2 : 3
- B. 3 : 4
- C. 4 : 5
- D. 5 : 6

[gateec-2021](#) [quantitative-aptitude](#) [geometry](#) [triangles](#) [area](#)

Answer

9.4.4 Area: GATE Mechanical 2021 Set 1 | GA Question: 3 [top ↗](#)<https://gateoverflow.in/359484>

In the above figure, O is the center of the circle and, M and N lie on the circle. The area of the right triangle MON is  $50 \text{ cm}^2$ . What is the area of the circle in  $\text{cm}^2$ ?

- A.  $2\pi$
- B.  $50\pi$
- C.  $75\pi$
- D.  $100\pi$

[gateme-2021-set1](#) [quantitative-aptitude](#) [geometry](#) [triangles](#) [circles](#) [area](#)

Answer

## Answers: Area

9.4.1 Area: GATE CSE 2020 | Question: GA-8 [top ↗](#)<https://gateoverflow.in/333233>

- ✓ Answer is Option (A)

We need to find the area of the ring first.

#### Area of Ring

$$\begin{aligned} &= \text{Area of Outer Circle} \\ &- \text{Area of Inner Circle} \end{aligned}$$

$$= \pi b^2 - \pi a^2 = \pi(b^2 - a^2)$$

Now From this ring area we have to subtract the small ' $n$ ' circles

#### Area of $n$ Circles

$$= (\pi d^2/4) * n = (\pi(b-a)^2/4) * n$$

### The Required Unpainted Area

= Ring Area

- Area of Small '

n' such Circles

$$\begin{aligned} &= \pi(b^2 - a^2) - (\pi d^2/4) * n \\ &= \pi[(b^2 - a^2) - n/4(b-a)^2] \end{aligned}$$

6 votes

-- Samarth Joshi (643 points)

## 9.4.2 Area: GATE ECE 2020 | GA Question: 8 [top](#)

<https://gateoverflow.in/359764>



- ✓ Theorem: "A perpendicular from the Centre of a circle to a chord, bisects the chord." (Refer: [Proof](#))

In this case, if a perpendicular is drawn from the center of the circle, it will bisect the base side of the rectangle.

The half-length of this chord would be:  $a \times \cos 45^\circ = \frac{a}{\sqrt{2}}$ .

Hence the length of the rectangle would be  $2 \times \frac{a}{\sqrt{2}} = a\sqrt{2}$

Area of circle :  $\pi a^2$  and the area of rectangle :  $2a^2$

$\therefore$  Area of remaining portion would be :  $\pi a^2 - 2a^2$

Option C is correct.

### References



2 votes

-- haralk10 (1.8k points)

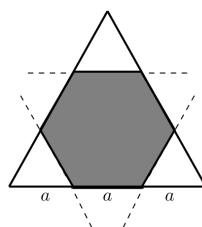
## 9.4.3 Area: GATE ECE 2021 | GA Question: 10 [top](#)

<https://gateoverflow.in/359785>



- ✓ Given that, corners are cut from an equilateral triangle to produce a regular convex hexagon. The smaller triangles cut are equilateral triangles (If we cut off corners to create a regular hexagon, then each angle of the hexagon is  $120^\circ$ , and so each angle of every removed triangle is  $60^\circ$  making these triangles equilateral)

Let the original triangle side be  $3a$ .



The area of regular convex hexagon  $H_1 = \frac{3\sqrt{3}}{2}s^2$ , the area of equilateral triangle  $T_1 = \frac{\sqrt{3}}{4}s^2$ , where  $s$  is the side length.

Now,  $H_1 = \frac{3\sqrt{3}}{2}a^2$ ,  $A_1 = \frac{\sqrt{3}}{4}(3a)^2 = \frac{9\sqrt{3}}{4}a^2$

The required ratio =  $\frac{H_1}{A_1} = \frac{\frac{3\sqrt{3}}{2}a^2}{\frac{9\sqrt{3}}{4}a^2} = \frac{2}{3}$ .

$\therefore$  The ratio of the area of the regular convex hexagon to the area of the original equilateral triangle is  $2 : 3$ .

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

## 9.4.4 Area: GATE Mechanical 2021 Set 1 | GA Question: 3 [top](#)

<https://gateoverflow.in/359484>



- ✓ Let the radius of the circle be  $r$  cm.

The area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$

The area of the right triangle MON =  $\frac{1}{2} \times r \times r = 50$

$$\implies r^2 = 100 \\ \implies r = 10 \text{ cm}$$

Now, the area of circle =  $\pi r^2 = \pi(10)^2 = 100\pi \text{ cm}^2$ .

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

## 9.5

### Arithmetic Series (7) [top](#)

#### 9.5.1 Arithmetic Series: GATE CSE 2013 | Question: 58 [top](#)

<https://gateoverflow.in/1562>



What will be the maximum sum of 44, 42, 40, ... ?

- A. 502
- B. 504
- C. 506
- D. 500

[gate2013-cse](#) [quantitative-aptitude](#) [easy](#) [arithmetic-series](#)

Answer [p](#)

#### 9.5.2 Arithmetic Series: GATE CSE 2015 Set 2 | Question: GA-6 [top](#)

<https://gateoverflow.in/8035>



If the list of letters  $P, R, S, T, U$  is an arithmetic sequence, which of the following are also in arithmetic sequence?

- I.  $2P, 2R, 2S, 2T, 2U$
- II.  $P - 3, R - 3, S - 3, T - 3, U - 3$
- III.  $P^2, R^2, S^2, T^2, U^2$

- A. I only
- B. I and II
- C. II and III
- D. I and III

[gate2015-cse-set2](#) [quantitative-aptitude](#) [normal](#) [arithmetic-series](#)

Answer [p](#)

#### 9.5.3 Arithmetic Series: GATE Chemical 2020 | GA Question: 5 [top](#)

<https://gateoverflow.in/359818>



The difference between the sum of the first  $2n$  natural numbers and the sum of the first  $n$  odd natural numbers is \_\_\_\_\_.

- A.  $n^2 - n$
- B.  $n^2 + n$
- C.  $2n^2 - n$
- D.  $2n^2 + n$

[gate2020-ch](#) [quantitative-aptitude](#) [arithmetic-series](#)

Answer [p](#)

#### 9.5.4 Arithmetic Series: GATE Civil 2020 Set 1 | GA Question: 8 [top](#)

<https://gateoverflow.in/359852>



Insert seven numbers between 2 and 34, such that the resulting sequence including 2 and 34 is an arithmetic progression. The sum of these inserted seven numbers is \_\_\_\_\_.

- A. 120
- B. 124
- C. 126
- D. 130

gate2020-ce-1 quantitative-aptitude arithmetic-series

Answer 

### 9.5.5 Arithmetic Series: GATE Mechanical 2020 Set 1 | GA Question: 8

 <https://gateoverflow.in/359522>



The sum of the first  $n$  terms in the sequence 8, 88, 888, 8888, ... is \_\_\_\_\_.

- A.  $\frac{81}{80}(10^n - 1) + \frac{9}{8}n$
- B.  $\frac{81}{80}(10^n - 1) - \frac{9}{8}n$
- C.  $\frac{80}{81}(10^n - 1) + \frac{9}{8}n$
- D.  $\frac{80}{81}(10^n - 1) - \frac{9}{8}n$

gateme-2020-set1 quantitative-aptitude arithmetic-series

Answer 

### 9.5.6 Arithmetic Series: GATE2011 AG: GA-6

 <https://gateoverflow.in/312125>



The sum of  $n$  terms of the series  $4 + 44 + 444 + \dots$  is

- A.  $\frac{4}{81}[10^{n+1} - 9n - 1]$
- B.  $\frac{4}{81}[10^{n-1} - 9n - 1]$
- C.  $\frac{4}{81}[10^{n+1} - 9n - 10]$
- D.  $\frac{4}{81}[10^n - 9n - 10]$

general-aptitude quantitative-aptitude gate2011-ag arithmetic-series

Answer 

### 9.5.7 Arithmetic Series: GATE2019 EE: GA-6

 <https://gateoverflow.in/313562>



How many integers are there between 100 and 1000 all of whose digits are even?

- A. 60
- B. 80
- C. 100
- D. 90

gate2019-ee general-aptitude quantitative-aptitude arithmetic-series

Answer 

## Answers: Arithmetic Series

### 9.5.1 Arithmetic Series: GATE CSE 2013 | Question: 58

 <https://gateoverflow.in/1562>



- ✓ This is in AP.

Maximum sum means we do not need to consider negative numbers and can stop at 0.

First find number of terms using the formula  $a_n = a + (n - 1)d$

Here,

$$a = 44,$$

$$d = 42 - 44 = -2,$$

$$a_n = 0.$$

Therefore,  $0 = 44 + (n - 1)(-2)$

$$\Rightarrow n = 23.$$

Now, sum of n terms of AP is given by:  $S_n = \frac{n}{2}[a + a_n] = \frac{23}{2}[44 + 0] = 506.$

**Option C is correct!**

17 votes

-- Monanshi Jain (7k points)



⬩ <https://gateoverflow.in/8035>

- ✓ Answer is *B* because If we multiply the terms of an *AP* with a constant, the common difference will get multiplied by the constant and if we subtract the terms of an *AP* with a constant, the common difference will be same but if we make square of *AP* element then difference will not be same.

14 votes

-- Anoop Sonkar (4.1k points)



⬩ <https://gateoverflow.in/359818>

### 9.5.3 Arithmetic Series: GATE Chemical 2020 | GA Question: 5

top ↗

- ✓ Let

- $S_1$  be the sum of the first  $2n$  natural numbers and
- $S_2$  be the sum of the first  $n$  odd numbers.

$$\text{Now, } S_1 = 1 + 2 + 3 + \dots + 2n = \frac{2n(2n+1)}{2} = n(2n+1)$$

$$\text{And, } S_2 = 1 + 3 + 5 + \dots + (2n-1)$$

This is in Arithmetic Progression (each term at constant difference from previous term) and for arithmetic progression, the sum of first  $n$  numbers is given by:

$$S_n = \frac{n}{2}[2a + (n-1)d] \text{ or } S_n = \frac{n}{2}[a + l]$$

where,

- $n$  = number of digits in the series
- $a$  = First term of an A.P
- $d$  = Common difference in an A.P
- $l$  = last term of an A.P.

$$\text{Therefore, } S_2 = \frac{n}{2}[1 + (2n-1)] = \frac{n}{2}[2n] = n^2.$$

$$\therefore S_1 - S_2 = 2n^2 + n - n^2 = n^2 + n.$$

**Shortcut:** We can take the values of  $n = 1, 2, 3, \dots$ , and get the answer.

So, the correct answer is (*B*).

1 votes

-- Lakshman Patel (63.9k points)



⬩ <https://gateoverflow.in/359852>

### 9.5.4 Arithmetic Series: GATE Civil 2020 Set 1 | GA Question: 8

top ↗

- ✓ We can insert the seven numbers in such a way that, so we get the arithmetic progression including 2 and 34.

We get the arithmetic progression 2, 6, 10, 14, 18, 22, 26, 30, 34

The inserted seven numbers are 6, 10, 14, 18, 22, 26, 30

Here,  $a = 6, d = 10 - 6 = 4, l = 30, n = 7$

$\therefore$  The sum of the arithmetic progression  $S_7 = \frac{7}{2}(6 + 30) = 7 \cdot 18 = 126.$

So, the correct answer is (*C*).

1 votes

-- Lakshman Patel (63.9k points)



⬩ <https://gateoverflow.in/359522>

### 9.5.5 Arithmetic Series: GATE Mechanical 2020 Set 1 | GA Question: 8

top ↗

- ✓ Let  $S = 8 + 88 + 888 + \dots + \underbrace{888\dots8}_{n \text{ times}}$

$$\begin{aligned} \Rightarrow S &= 8 \left[ 1 + 11 + 111 + \dots + \underbrace{111\dots1}_{n \text{ times}} \right] \\ \Rightarrow S &= \frac{8}{9} \left[ 9 + 99 + 999 + \dots + \underbrace{999\dots9}_{n \text{ times}} \right] \\ \Rightarrow S &= \frac{8}{9} [(10 - 1) + (10^2 - 1) + (10^3 - 1) + \dots + (10^n - 1)] \\ \Rightarrow S &= \frac{8}{9} \left[ \underbrace{10^1 + 10^2 + 10^3 + \dots + 10^n}_{\text{GP Series}} - n \right] \\ \Rightarrow S &= \frac{8}{9} \left[ \frac{10(10^n - 1)}{10 - 1} - n \right] \quad \left[ \because \text{Sum of GP : } S_n = \frac{a(r^n - 1)}{r - 1}; r > 0 \text{ and } S_n = \frac{a(1 - r^n)}{1 - r}; r < 0 \right] \\ \Rightarrow S &= \frac{8}{9} \left[ \frac{10^{n+1} - 10 - 9n}{9} \right] \\ \Rightarrow S &= \frac{8}{81} [10^{n+1} - 9n - 10] \\ \Rightarrow S &= \frac{8}{81} [10^n \cdot 10 - 9n - 10] \\ \Rightarrow S &= \frac{80}{81}(10^n - 1) - \frac{8}{9}n \end{aligned}$$

**Shortcut:** We can check, by taking the values of  $n = 1, 2, 3, \dots$

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

### 9.5.6 Arithmetic Series: GATE2011 AG: GA-6 top

https://gateoverflow.in/312125



✓ The sum of  $n$  terms of the series  $4 + 44 + 444 + \dots$  is

$$\text{Final sum} = 4(1 + 11 + 111 + 1111 + \dots)$$

$$\text{Let } S_n = \underbrace{1 + 11 + 111 + 1111 + \dots + 1111}_{n \text{ times}}$$

$$\therefore S_0 = 0 \text{ and } S_1 = 1 \text{ and } S_2 = 1 + 11 = 12.$$

$$S_n = (10^0) + (10^1 + 1) + (10^2 + 11) + (10^3 + 111) + \dots + \left( 10^{n-1} + \underbrace{111\dots1}_{n-1 \text{ times}} \right)$$

$$\Rightarrow S_n = (10^0 + 10^1 + 10^2 + 10^3 + \dots + 10^{n-1}) + \left( 1 + 11 + 111 + 1111 + \dots + \underbrace{111\dots1}_{n-1 \text{ times}} \right)$$

$$\bullet \Rightarrow S_n = \left( \frac{10^n - 1}{9} \right) + (S_{n-1}) \rightarrow (1)$$

Recursively substituting, we get

$$S_n = \left( \frac{10^n - 1}{9} \right) + \left( \frac{10^{n-1} - 1}{9} \right) + \left( \frac{10^{n-2} - 1}{9} \right) + \dots + \left( \frac{10^1 - 1}{9} \right) + (S_0)$$

$$\Rightarrow S_n = \frac{1}{9} [(10^n - 1) + (10^{n-1} - 1) + (10^{n-2} - 1) + \dots + (10^1 - 1)]$$

$$\Rightarrow S_n = \frac{1}{9} [10^n + 10^{n-1} + 10^{n-2} + \dots + 10^1 - n \cdot 1]$$

$$\Rightarrow S_n = \frac{1}{9} [10^1 + 10^2 + 10^3 + \dots + 10^n - n]$$

$$\Rightarrow S_n = \frac{1}{9} \left[ 10 \left( \frac{10^n - 1}{9} \right) - n \right] = \frac{1}{9 \times 9} [10^{n+1} - 10 - 9n] = \frac{1}{81} [10^{n+1} - 9n - 10]$$

$$\text{Final SUM} = 4S_n = \frac{4}{81} [10^{n+1} - 10 - 9n] = \frac{4}{81} [10^{n+1} - 9n - 10]$$

Shortcut :-

in the question, they asked for sum of  $n$  terms.

So, let  $n = 3$

$$\Rightarrow \text{Required sum} = 4 + 44 + 444 = 492$$

Put in each option  $n = 3$ , it matches only for Option C.

(If more than one option is matched, then take  $n = 4, n = 5$  until you get only one option is matched!)

Correct Answer: Option C.

13 votes

-- Shaik Masthan (50.2k points)

### 9.5.7 Arithmetic Series: GATE2019 EE: GA-6 top

→ <https://gateoverflow.in/313562>



- ✓ Let the 3 digit even number be ★★★

We can fill ★ with 4 values (2, 4, 6, 8)

We can fill ★ with 5 values (0, 2, 4, 6, 8)

We can fill ★ with 5 values (0, 2, 4, 6, 8).

So total 3 digit even number possible =  $4 * 5 * 5 = 100$

∴ Option C 100 is the correct answer.

9 votes

-- Satbir Singh (20.9k points)

## 9.6

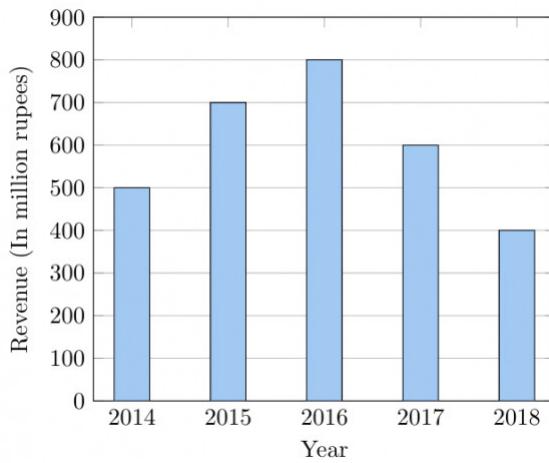
### Bar Graph (11) top

#### 9.6.1 Bar Graph: GATE CSE 2020 | Question: GA-10 top

→ <https://gateoverflow.in/333231>



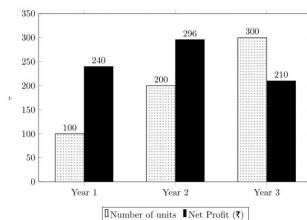
The total revenue of a company during 2014 – 2018 is shown in the bar graph. If the total expenditure of the company in each year is 500 million rupees, then the aggregate profit or loss (in percentage) on the total expenditure of the company during 2014 – 2018 is \_\_\_\_\_.



- A. 16.67% profit
- B. 16.67% loss
- C. 20% profit
- D. 20% loss

gate2020-cse quantitative-aptitude data-interpretation bar-graph

Answer

**9.6.2 Bar Graph: GATE CSE 2021 Set 2 | GA Question: 9** [top ↴](#)<https://gateoverflow.in/357541>

The number of units of a product sold in three different years and the respective net profits are presented in the figure above. The cost/unit in Year 3 was ₹1, which was half the cost/unit in Year 2. The cost/unit in Year 3 was one-third of the cost/unit in Year 1. Taxes were paid on the selling price at 10%, 13%, and 15% respectively for the three years. Net profit is calculated as the difference between the selling price and the sum of cost and taxes paid in that year.

The ratio of the selling price in Year 2 to the selling price in Year 3 is \_\_\_\_\_.

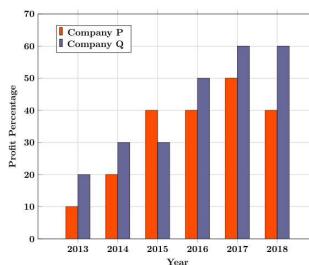
- A. 4 : 3
- B. 1 : 1
- C. 3 : 4
- D. 1 : 2

[gate2021-cse-set2](#) [quantitative-aptitude](#) [data-interpretation](#) [bar-graph](#)

Answer

**9.6.3 Bar Graph: GATE Chemical 2020 | GA Question: 10** [top ↴](#)<https://gateoverflow.in/359808>

The profit shares of two companies  $P$  and  $Q$  are shown in the figure. If the two companies have invested a fixed and equal amount every year, then the ratio of the total revenue of company  $P$  to the revenue of company  $Q$ , during 2013 – 2018 is \_\_\_\_\_.



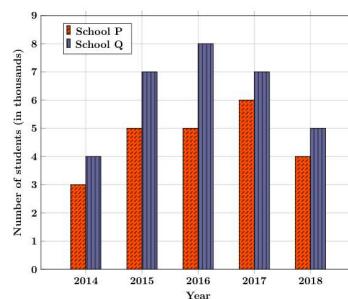
- A. 15 : 17
- B. 16 : 17
- C. 17 : 15
- D. 17 : 16

[gate2020-ch](#) [quantitative-aptitude](#) [data-interpretation](#) [bar-graph](#)

Answer

**9.6.4 Bar Graph: GATE ECE 2020 | GA Question: 10** [top ↴](#)<https://gateoverflow.in/359759>

The following figure shows the data of students enrolled in 5 years (2014 to 2018) for two schools  $P$  and  $Q$ . During this period, the ratio of the average number of the students enrolled in school  $P$  to the average of the difference of the number of students enrolled in schools  $P$  and  $Q$  is \_\_\_\_\_.



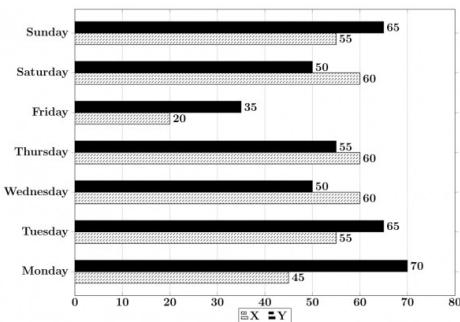
- A. 8 : 23
- B. 23 : 8
- C. 23 : 31
- D. 31 : 23

gate2020-ec quantitative-aptitude data-interpretation bar-graph

Answer 

### 9.6.5 Bar Graph: GATE ECE 2021 | GA Question: 9

 <https://gateoverflow.in/359789>



The number of minutes spent by two students,  $X$  and  $Y$ , exercising every day in a given week are shown in the bar chart above.

The number of days in the given week in which one of the students spent a minimum of 10% more than the other student, on a given day, is

- A. 4
- B. 5
- C. 6
- D. 7

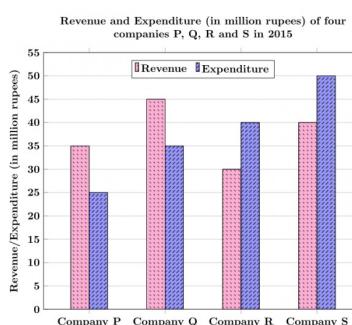
gateec-2021 quantitative-aptitude data-interpretation bar-graph

Answer 

### 9.6.6 Bar Graph: GATE Electrical 2020 | GA Question: 10

 <https://gateoverflow.in/359710>

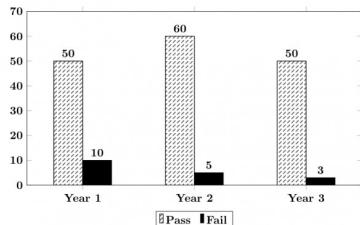
The revenue and expenditure of four different companies P, Q, R and S in 2015 are shown in the figure. If the revenue of company Q in 2015 was 20% more than that in 2014, and company Q had earned a profit of 10% on expenditure in 2014, then its expenditure (in million rupees) in 2014 was \_\_\_\_\_.



- A. 32.7
- B. 33.7
- C. 34.1
- D. 35.1

gate2020-ee quantitative-aptitude data-interpretation bar-graph

Answer 

**9.6.7 Bar Graph: GATE Electrical 2021 | GA Question: 9**<https://gateoverflow.in/359739>

The number of students passing or failing in an exam for a particular subject is presented in the bar chart above. Students who pass the exam cannot appear for the exam again. Students who fail the exam in the first attempt must appear for the exam in the following year. Students always pass the exam in their second attempt.

The number of students who took the exam for the first time in the year 2 and the year 3 respectively, are \_\_\_\_\_.

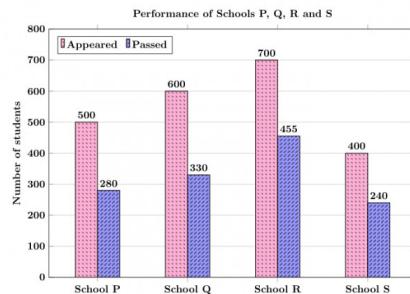
- A. 65 and 53
- B. 60 and 50
- C. 55 and 53
- D. 55 and 48

[gateee-2021](#) [quantitative-apitude](#) [data-interpretation](#) [bar-graph](#)

Answer

**9.6.8 Bar Graph: GATE Mechanical 2020 Set 1 | GA Question: 10**<https://gateoverflow.in/359518>

The bar graph shows the data of the students who appeared and passed in an examination for four schools  $P, Q, R$ , and  $S$ . The average of success rates (in percentage) of these four schools is \_\_\_\_\_.



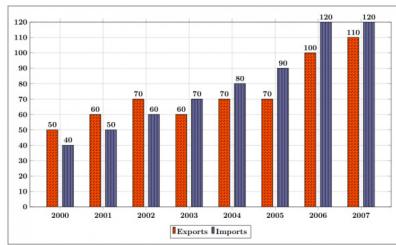
- A. 58.5%
- B. 58.8%
- C. 59.0%
- D. 59.3%

[gateme-2020-set1](#) [quantitative-apitude](#) [data-interpretation](#) [bar-graph](#)

Answer

**9.6.9 Bar Graph: GATE2014 EC-1: GA-9**<https://gateoverflow.in/41498>

The exports and imports (in crores of Rs.) of a country from 2000 to 2007 are given in the following bar chart. If the trade deficit is defined as excess of imports over exports, in which year is the trade deficit  $1/5$ th of the exports?



- A. 2005
- B. 2004
- C. 2007

D. 2006

gate2014-ec-1 quantitative-aptitude data-interpretation bar-graph normal

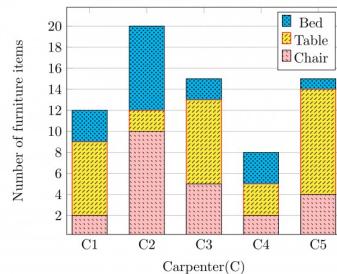
Answer 

### 9.6.10 Bar Graph: GATE2017 CE-1: GA-10

<https://gateoverflow.in/313480>



The bar graph below shows the output of five carpenters over one month. each of whom made different items of furniture: chairs, tables, and beds.



Consider the following statements.

- The number of beds made by carpenter  $C_2$  is exactly the same as the number of tables made by carpenter  $C_3$
- The total number of chairs made by all carpenters is less than the total number of tables.

Which one of the following is true?

- A. Only i
- B. Only ii
- C. Both i and ii
- D. Neither i nor ii

gate2017-ce-1 general-aptitude quantitative-aptitude data-interpretation bar-graph

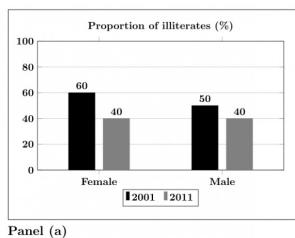
Answer 

### 9.6.11 Bar Graph: GATE2019 EC: GA-7

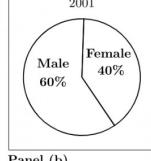
<https://gateoverflow.in/313528>



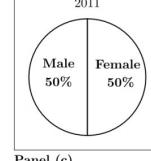
The bar graph in panel (a) shows the proportion of male and female illiterates in 2001 and 2011. The proportions of males and females in 2001 and 2011 are given in Panel (b) and (c), respectively. The total population did not change during this period. The percentage increase in the total number of literates from 2001 to 2011 is \_\_\_\_\_.



Panel (a)



Panel (b)



Panel (c)

- A. 30.43
- B. 33.43
- C. 34.43
- D. 35.43

gate2019-ec quantitative-aptitude data-interpretation bar-graph

Answer 

### Answers: Bar Graph

#### 9.6.1 Bar Graph: GATE CSE 2020 | Question: GA-10

 <https://gateoverflow.in/333231>



- ✓ Total expenditure during each year = 500 million rupees

Total expenditure for 5 years =  $500 \times 5 = 2500$  million rupees

- Revenue in 2014 = 500 million rupees
- Revenue in 2015 = 700 million rupees
- Revenue in 2016 = 800 million rupees
- Revenue in 2017 = 600 million rupees
- Revenue in 2018 = 400 million rupees

Total revenue =  $500 + 700 + 800 + 600 + 400 = 3000$  million rupees

Profit =  $3000 - 2500 = 500$  million rupees

$$\text{Profit percentage} = \left( \frac{500}{2500} \right) \times 100 = 20\%.$$

 8 votes

-- Shaik Masthan (50.2k points)

#### 9.6.2 Bar Graph: GATE CSE 2021 Set 2 | GA Question: 9

 <https://gateoverflow.in/357541>



- ✓ Lets denote  $CP_x$  and  $SP_x$  for per unit Cost Price and Selling Price respectively for year  $x$ . Given that

$$\frac{1}{3}CP_1 = \frac{1}{2}CP_2 = CP_3 = ₹1$$

$$\Rightarrow CP_2 = ₹2, CP_3 = ₹1$$

Net profit for year 2 is given by

$$SP_2 - (200 * CP_2 + 0.13 * SP_2) = 296$$

$$\Rightarrow 0.87 * SP_2 = 296 + 200 * 2 = 696$$

$$\Rightarrow SP_2 = \frac{696}{0.87} = ₹800 \quad \rightarrow (i)$$

Net profit for year 3 is given by

$$SP_3 - (300 * CP_3 + 0.15 * SP_2) = 210$$

$$\Rightarrow 0.85 * SP_3 = 210 + 300 * 1 = 510$$

$$\Rightarrow SP_3 = \frac{510}{0.85} = ₹600 \quad \rightarrow (ii)$$

$$(i) \div (ii) \Rightarrow \frac{SP_2}{SP_3} = \frac{800}{600} = \frac{4}{3}$$

Ans: A. 4 : 3

 3 votes

-- Nikhil Dhama (2.3k points)

#### 9.6.3 Bar Graph: GATE Chemical 2020 | GA Question: 10

 <https://gateoverflow.in/359808>



- ✓ Let us assume both the companies  $P$  and  $Q$  invested ₹ $x$ .

We know that, Revenue = Profit + Investment

Now, company  $P$  revenue,

- 2013 :  $0.1x + x = 1.1x$
- 2014 :  $0.2x + x = 1.2x$
- 2015 :  $0.4x + x = 1.4x$

- 2016 :  $0.4x + x = 1.4x$
- 2017 :  $0.5x + x = 1.5x$
- 2018 :  $0.4x + x = 1.4x$

$\therefore$  Total revenue of company  $P = 1.1x + 1.2x + 1.4x + 1.4x + 1.5x + 1.4x = 8.0x$

And company  $Q$  revenue,

- 2013 :  $0.2x + x = 1.2x$
- 2014 :  $0.3x + x = 1.3x$
- 2015 :  $0.3x + x = 1.3x$
- 2016 :  $0.5x + x = 1.5x$
- 2017 :  $0.6x + x = 1.6x$
- 2018 :  $0.6x + x = 1.6x$

$\therefore$  Total revenue of company  $Q = 1.2x + 1.3x + 1.3x + 1.5x + 1.6x + 1.6x = 8.5x$

Now, the ratio of the total revenue of company  $P$  to the revenue of company  $Q$ , during 2013 – 2018 is  
 $= 8x : 8.5x = 16 : 17$ .

**Short Method:** Let us assume both the companies  $P$  and  $Q$  invested ₹100.

Now, the total revenue of company  $P = 110 + 120 + 140 + 140 + 150 + 140 = 800$

And, the total revenue of company  $Q = 120 + 130 + 130 + 150 + 160 + 160 = 850$

$\therefore$  The required ratio  $= 800 : 850 = 80 : 85 = 16 : 17$ .

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)



#### 9.6.4 Bar Graph: GATE ECE 2020 | GA Question: 10 [top](#)

<https://gateoverflow.in/359759>

- ✓ We can calculate the number of students enrolled in both schools during the given period of time,

- The total number of students enrolled in school  $P$  (in 5 years)  $= (3 + 5 + 5 + 6 + 4) \times 1000 = 23000$
- Average number of students enrolled in school  $P = \frac{23000}{5}$
- And, the total number of students enrolled in school  $Q$  (in 5 years)  $= (4 + 7 + 8 + 7 + 5) \times 1000 = 31000$
- Average number of students enrolled in school  $Q = \frac{31000}{5}$
- Average of the difference of the number of students enrolled in school  $P$  and  $Q = \frac{31000 - 23000}{5} = \frac{8000}{5}$

Now the required ratio  $= \frac{\frac{23000}{5}}{\frac{8000}{5}} = \frac{23}{8}$ .

$\therefore$  The ratio of the average number of the students enrolled in school  $P$  to the average of the difference of the number of students enrolled in schools  $P$  and  $Q = 23 : 8$ .

**Short Method:** While calculating the ratio, common entities are cancelled.

- The total number of students enrolled in school  $P = 3 + 5 + 5 + 6 + 4 = 23$
- The total number of students enrolled in school  $Q = 4 + 7 + 8 + 7 + 5 = 31$

The difference between the number of students enrolled in school  $P$  and school  $Q = 31 - 23 = 8$

Now the required ratio  $= 23 : 8$ .

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)



#### 9.6.5 Bar Graph: GATE ECE 2021 | GA Question: 9 [top](#)

<https://gateoverflow.in/359789>

- ✓ We can calculate the number of days in the given week in which one of the students spent more time than the other.

If  $X$  is more than 10% of  $Y$  then  $Y$  should be minimum and vice-versa.

- On Monday, the required percentage  $= \left( \frac{70 - 45}{45} \right) \times 100\% = 55.55\%$

- On Tuesday, the required percentage =  $\left(\frac{65 - 55}{55}\right) \times 100\% = 18.18\%$
- On Wednesday, the required percentage =  $\left(\frac{60 - 50}{50}\right) \times 100\% = 20\%$
- On Thursday, the required percentage =  $\left(\frac{60 - 55}{55}\right) \times 100\% = 9.09\%$
- On Friday, the required percentage =  $\left(\frac{35 - 20}{20}\right) \times 100\% = 75\%$
- On Saturday, the required percentage =  $\left(\frac{60 - 50}{50}\right) \times 100\% = 20\%$
- On Sunday, the required percentage =  $\left(\frac{65 - 55}{55}\right) \times 100\% = 18.18\%$

$\therefore$  Total 6 days are there, when one of the students spent a minimum of 10% more than the other student.  
So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.6.6 Bar Graph: GATE Electrical 2020 | GA Question: 10 [top](#)

<https://gateoverflow.in/359710>



- Let the revenue of company Q in 2014 be ₹x.

$$\text{Then the revenue of company } Q \text{ in 2015} = x + x \times \frac{20}{100} = \frac{120x}{100} = 1.2x$$

$$\text{Now, } 1.2x = 45$$

$$\implies x = \frac{45}{1.2} = 37.50$$

Given that, the company Q had earned a profit of 10% on expenditure in 2014.

Let the expenditure of company Q in 2014 be ₹y.

The company Q earn 10% profit on its expenditure and this profit adds to the revenue of company Q.

$$\text{Now, } y + y \times \frac{10}{100} = 37.50$$

$$\implies \frac{110y}{100} = 37.50$$

$$\implies \frac{11y}{10} = 37.50$$

$$\implies 11y = 375.0$$

$$\implies y = \frac{375.0}{11} = 34.0909 \approx ₹34.1$$

**Short Method:** Let the revenue of company Q in 2014 be ₹100.

Then the revenue of company Q in 2015 = ₹120

- 120 → 45
- 100 → 37.50

The company Q earn 10% profit on its expenditure and this profit adds to the revenue of company Q.

Let the expenditure of company Q in 2014 be ₹y.

$$\frac{110y}{100} = 37.50$$

$$\implies y = ₹34.1$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.6.7 Bar Graph: GATE Electrical 2021 | GA Question: 9 [top](#)

<https://gateoverflow.in/359739>



- The total number of students in Year 2 = 60(pass) + 5(fail) = 65

The number of students, who failed in the exam in Year 1, and appeared in Year 2 = 10

$\therefore$  The total number of students in Year 2 who appeared for the first time = 65 - 10 = 55

Similarly, the total number of students in Year 3 = 50(pass) + 3(fail) = 53

The number of students, who failed in the exam in Year 2, and appeared in Year 3 = 5

$\therefore$  The total number of students in Year 3 who appeared for the first time =  $53 - 5 = 48$

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.6.8 Bar Graph: GATE Mechanical 2020 Set 1 | GA Question: 10 [top](#)

<https://gateoverflow.in/359518>



- ✓ We can calculate the success rate of every school, then find their average.

$$\text{Success rate} = \frac{\text{Number of students who passed the exams}}{\text{Number of appeared students}}$$

- Success rate of school  $P = \frac{280}{500} \times 100\% = 56\%$ .
- Success rate of school  $Q = \frac{330}{600} \times 100\% = 55\%$ .
- Success rate of school  $R = \frac{455}{700} \times 100\% = 65\%$ .
- Success rate of school  $S = \frac{240}{400} \times 100\% = 60\%$ .

Now, the average success rates of all the schools =  $\frac{56\% + 55\% + 65\% + 60\%}{4} = \frac{236\%}{4} = 59.0\%$ .

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.6.9 Bar Graph: GATE2014 EC-1: GA-9 [top](#)

<https://gateoverflow.in/41498>



- ✓  $(\frac{1}{5})^{th}$  excess of the exports means  
 $(1 + \frac{1}{5}) \times \text{Export} = \text{Import}$

1. Option A

$$(1 + \frac{1}{5}) \times 70 = 84 \neq \text{Import}$$

2. Option B

$$(1 + \frac{1}{5}) \times 70 = 84 \neq \text{Import}$$

3. Option C

$$(1 + \frac{1}{5}) \times 110 = 132 \neq \text{Import}$$

4. Option D

$$(1 + \frac{1}{5}) \times 100 = 120 = \text{Import}$$

So, answers is option D.

9 votes

-- Lokesh Dafale (8.2k points)

#### 9.6.10 Bar Graph: GATE2017 CE-1: GA-10 [top](#)

<https://gateoverflow.in/313480>



- ✓ Number of beds made by carpenter  $C2 = (20 - 12) = 8$

Number of tables made by carpenter  $C3 = (13 - 5) = 8$

Total number of chairs made by all carpenters =  $2 + 10 + 5 + 2 + 4 = 23$

Total number of tables =  $7 + 2 + 8 + 3 + 10 = 30$

So, both statements are correct.

C is correct Answer.

3 votes

-- Naveen Kumar (9.9k points)

**9.6.11 Bar Graph: GATE2019 EC: GA-7** top ↗<https://gateoverflow.in/313528>

- ✓ The graph is for illiterates.

- Percentage of male literates in 2011 =  $100 - 40 = 60$
- Percentage of male literates in 2001 =  $100 - 50 = 50$
- Percentage of female literates in 2011 =  $100 - 40 = 60$
- Percentage of female literates in 2001 =  $100 - 60 = 40$

Let  $X$  be the total population (This remains same in 2001 and 2011 as per question)

$$\text{Number of literates in 2011} = 0.5 \times 0.6 \times X + 0.5 \times 0.6 \times X = 0.6X$$

$$\text{Number of literates in 2001} = 0.6 \times 0.5 \times X + 0.4 \times 0.4 \times X = 0.46X$$

$$\text{So, percentage increase in the literates} = \frac{0.6X - 0.46X}{0.46X} \times 100\% = \frac{700}{23} = 30.43$$

Option A.

5 votes

-- Arjun Suresh (328k points)

**9.7****Calendar (1)** top ↗**9.7.1 Calendar: GATE Civil 2020 Set 2 | GA Question: 7** top ↗<https://gateoverflow.in/359834>

For the year 2019, which of the previous year's calendar can be used?

- A. 2011
- B. 2012
- C. 2013
- D. 2014

[gate2020-ce-2](#) [quantitative-aptitude](#) [calendar](#)

[Answer](#)

**Answers: Calendar****9.7.1 Calendar: GATE Civil 2020 Set 2 | GA Question: 7** top ↗<https://gateoverflow.in/359834>

- ✓ A calendar repeats when the number of days between 2 years is a multiple of 7. Since,  $365 \bmod 7 = 1$  a non leap year adds 1 and a leap year adds 2 to the extra days after an exact multiple of 7. So,  $2019 - 7 + 1 = 2013$  (+1 for leap year 2016) must be the answer here.

Correct Answer: C

More general approach.

Calendars repeat after certain cycles:

- If it is a leap year, after 28 years.
- If it is leap year +1, after 6 years, then 11, and again 11.
- If it is a leap year +2, after 11 years, then 6, and again 11.
- If it is a leap year +3, after 11 years, then 11, and finally 6.

These cycles are valid unless the years span a non-leap century year (e.g. 2100, which is a century year but not a leap year).

Since 2019 is a leap year +3, it will repeat in 2030, 2041, 2047, 2058, 2069, 2075, etc.

Checking all the options, for 2013 it will repeat after 6 years.

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

**9.8****Cartesian Coordinates (5)** top ↗**9.8.1 Cartesian Coordinates: GATE CSE 2020 | Question: GA-9** top ↗<https://gateoverflow.in/333232>

Two straight lines are drawn perpendicular to each other in  $X - Y$  plane. If  $\alpha$  and  $\beta$  are the acute angles the straight lines make with the X-axis, then  $\alpha + \beta$  is \_\_\_\_\_.

- A.  $60^\circ$
- B.  $90^\circ$
- C.  $120^\circ$
- D.  $180^\circ$

[gate2020-cse](#) [quantitative-aptitude](#) [geometry](#) [cartesian-coordinates](#)

Answer 

### 9.8.2 Cartesian Coordinates: GATE2012 AE: GA-9 top ↗

► <https://gateoverflow.in/40220>



Two points  $(4, p)$  and  $(0, q)$  lie on a straight line having a slope of  $3/4$ . The value of  $(p-q)$  is

- A.  $-3$
- B.  $0$
- C.  $3$
- D.  $4$

[gate2012-ae](#) [quantitative-aptitude](#) [cartesian-coordinates](#) [geometry](#)

Answer 

### 9.8.3 Cartesian Coordinates: GATE2014 AE: GA-4 top ↗

► <https://gateoverflow.in/40303>



If  $y = 5x^2 + 3$ , then the tangent at  $x = 0, y = 3$

- A. passes through  $x = 0, y = 0$
- B. has a slope of  $+1$
- C. is parallel to the  $x$ -axis
- D. has a slope of  $-1$

[gate2014-ae](#) [quantitative-aptitude](#) [geometry](#) [cartesian-coordinates](#)

Answer 

### 9.8.4 Cartesian Coordinates: GATE2016 EC-3: GA-10 top ↗

► <https://gateoverflow.in/110855>



A straight line is fit to a data set  $(\ln x, y)$ . This line intercepts the abscissa at  $\ln x = 0.1$  and has a slope of  $-0.02$ . What is the value of  $y$  at  $x = 5$  from the fit?

- A.  $-0.030$
- B.  $-0.014$
- C.  $0.014$
- D.  $0.030$

[gate2016-ec-3](#) [quantitative-aptitude](#) [cartesian-coordinates](#)

Answer 

### 9.8.5 Cartesian Coordinates: GATE2016 EC-3: GA-9 top ↗

► <https://gateoverflow.in/110853>



Find the area bounded by the lines  $3x + 2y = 14, 2x - 3y = 5$  in the first quadrant.

- A.  $14.95$
- B.  $15.25$
- C.  $15.70$
- D.  $20.35$

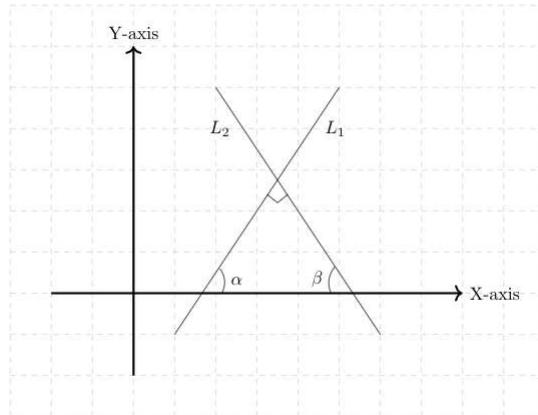
[gate2016-ec-3](#) [cartesian-coordinates](#) [geometry](#) [normal](#)

Answer 

## Answers: Cartesian Coordinates

### 9.8.1 Cartesian Coordinates: GATE CSE 2020 | Question: GA-9 [top](#)

<https://gateoverflow.in/333232>



Here, we can clearly see that Two Lines  $L_1$  and  $L_2$  are intersecting each other at the right angle.

Now we also know that in a triangle, the sum of three angles is

- $\angle A + \angle B + \angle C = 180^\circ$
- $\alpha + \beta + 90^\circ = 180^\circ$
- $\alpha + \beta = 90^\circ$

The answer is (B).

10 votes

-- Samarth Joshi (643 points)

### 9.8.2 Cartesian Coordinates: GATE2012 AE: GA-9 [top](#)

<https://gateoverflow.in/40220>



- ✓ For two points  $(x_1, y_1)$  and  $(x_2, y_2)$  on a line, Slope of line  $= \frac{y_2 - y_1}{x_2 - x_1}$

$$\text{so, } \frac{q-p}{0-4} = \frac{3}{4}$$

$$\therefore (p-q) = 3$$

Correct Answer: C

13 votes

-- Praveen Saini (41,9k points)

### 9.8.3 Cartesian Coordinates: GATE2014 AE: GA-4 [top](#)

<https://gateoverflow.in/40303>



- ✓ Given,  $y = 5x^2 + 3$

Slope  $dy/dx = 10x$

Given point  $x = 0, y = 3 : (0, 3)$

Now, at  $(0, 3)$  we have the slope as  $dy/dx = 10 \times 0 = 0$ , which means no matter how much ever we change 'x', change in y is zero or y is a constant ( $y=3$ , here) i.e line is parallel to  $X$ - axis.

Options B and D eliminated as they have slope as '+1' and '-1'.

Option A is eliminated as given the tangent is at point  $(0, 3)$  and we found  $slope = 0$ , which means it is parallel to  $X$  axis. The equation of line is nothing but  $y = 3$ , which never passes through  $(0, 0)$ . Hence A too eliminated.

Answer: Option C)

18 votes

-- Abhilash Panicker (7,6k points)

### 9.8.4 Cartesian Coordinates: GATE2016 EC-3: GA-10 [top](#)

<https://gateoverflow.in/110855>



- ✓ Interception at  $x$ -axis is ln  $x = 0.1$  and slope  $= -0.02$

Equation fo straight line is given by,

$$y = mx + C$$

According to the question,

$$y = m(\ln x) + C \text{ where } m = -0.02$$

$$y = -0.02(\ln x) + C \rightarrow (1)$$

Abscissa is known as intercept in  $x$ -axis i.e. for  $y = 0, \ln x = 0.1$

From equation (1),

$$0 = -0.02 \times 0.1 + C$$

$$C = 0.002 \rightarrow (2)$$

From equations (1) and (2),

$$y = -0.02(\ln x) + 0.002$$

At  $x = 5$ ,

$$y = -0.02(\ln 5) + 0.002$$

$$y = -0.030$$

So, the correct answer is (A).

6 votes

-- Lakshman Patel (63.9k points)

### 9.8.5 Cartesian Coordinates: GATE2016 EC-3: GA-9 [top](#)

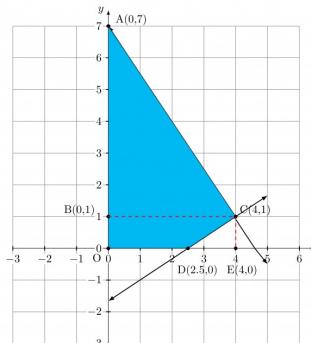
<https://gateoverflow.in/110853>



- $3x + 2y = 14 \rightarrow (1)$
- $2x - 3y = 5 \rightarrow (2)$

To get the intersection point, we solve the equations and get  $x = 4, y = 1$

We can draw the required area like this



From the above diagram,

$$\text{Area} = \triangle ABC + \square OBCE - \triangle CDE$$

$$\text{Area} = \left( \frac{1}{2} \times 4 \times 6 \right) + (1 \times 4) - \left( \frac{1}{2} \times \frac{3}{2} \times 1 \right)$$

$$\text{Area} = 12 + 4 - \frac{3}{4} = 16 - 0.75 = 15.25$$

So, the correct answer is (B).

8 votes

-- Lakshman Patel (63.9k points)

### 9.9 Circles (3) [top](#)

#### Circles (3) [top](#)

##### 9.9.1 Circles: GATE CSE 2018 | Question: GA-3 [top](#)

<https://gateoverflow.in/204064>



The area of a square is  $d$ . What is the area of the circle which has the diagonal of the square as its diameter?

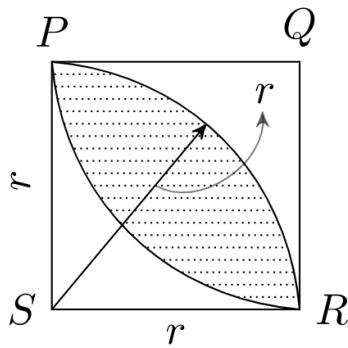
- A.  $\pi d$
- B.  $\pi d^2$
- C.  $\frac{1}{4}\pi d^2$
- D.  $\frac{1}{2}\pi d$

gate2018-cse quantitative-aptitude geometry circles normal

Answer 

### 9.9.2 Circles: GATE Civil 2021 Set 2 | GA Question: 9

<https://gateoverflow.in/359893>



In the figure shown above, PQRS is a square. The shaded portion is formed by the intersection of sectors of circles with radius equal to the side of the square and centers at S and Q.

The probability that any point picked randomly within the square falls in the shaded area is \_\_\_\_\_

- A.  $4 - \frac{\pi}{2}$
- B.  $\frac{1}{2}$
- C.  $\frac{\pi}{2} - 1$
- D.  $\frac{\pi}{4}$

gatcivil-2021-set2 quantitative-aptitude geometry circles

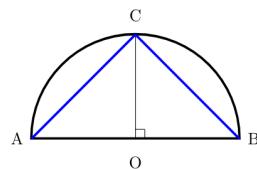
Answer 

### 9.9.3 Circles: GATE Electrical 2020 | GA Question: 9

<https://gateoverflow.in/359713>



Given a semicircle with O as the centre, as shown in the figure, the ratio  $\frac{\overline{AC} + \overline{CB}}{\overline{AB}}$  is \_\_\_\_\_, where  $\overline{AC}$ ,  $\overline{CB}$  and  $\overline{AB}$  are chords.



- A.  $\sqrt{2}$
- B.  $\sqrt{3}$
- C. 2
- D. 3

gate2020-ee quantitative-aptitude geometry circles

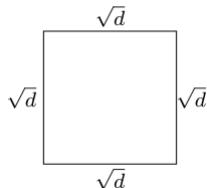
Answer 

## Answers: Circles

9.9.1 Circles: GATE CSE 2018 | Question: GA-3 [top](#)<https://gateoverflow.in/204064>

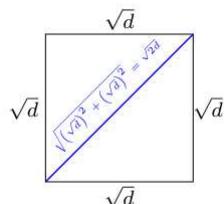
- ✓ The area of a square is  $d$

We know that, if a square has  $a$  units as the length of its side, then its area will be  $a^2$ .

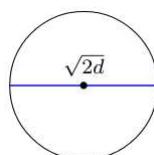


⇒ every side of the square will be  $\sqrt{d}$

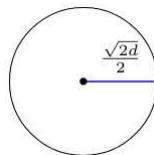
Now, the diagonal of the square will be  $\sqrt{(\sqrt{d})^2 + (\sqrt{d})^2} = \sqrt{2d}$



Now,  $\sqrt{2d}$  is the perimeter of a circle.



∴ Radius of the circle will be  $\frac{\sqrt{2d}}{2}$



We know **Area of the circle** is  $\pi r^2$ , where,  $r$  = radius of the circle

$$\begin{aligned} &= \frac{22}{7} \times \frac{\sqrt{2d}}{2} \times \frac{\sqrt{2d}}{2} \\ &= \frac{22}{7} \times \frac{2d}{2 \times 2} \\ &= \frac{22}{7} \times \frac{d}{2} \\ &= \pi \cdot \frac{d}{2} \end{aligned}$$

Option (D)

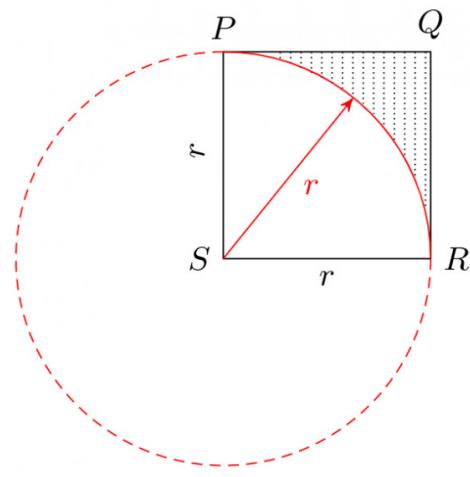
17 votes

-- Subarna Das (11.3k points)

9.9.2 Circles: GATE Civil 2021 Set 2 | GA Question: 9 [top](#)<https://gateoverflow.in/359893>

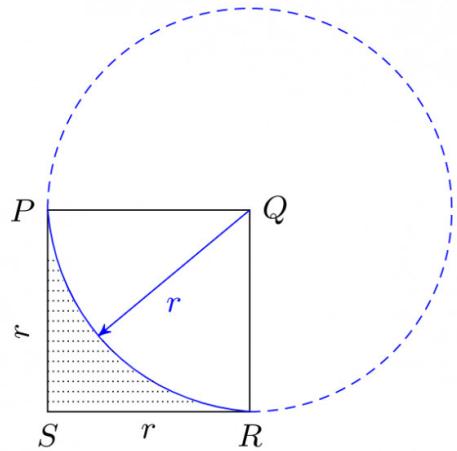
- ✓ Let the side of the square be 1 cm, then  $r = 1$  cm.

From the center  $S$ , we can draw the circle, and only the quarter part is shown in the figure.



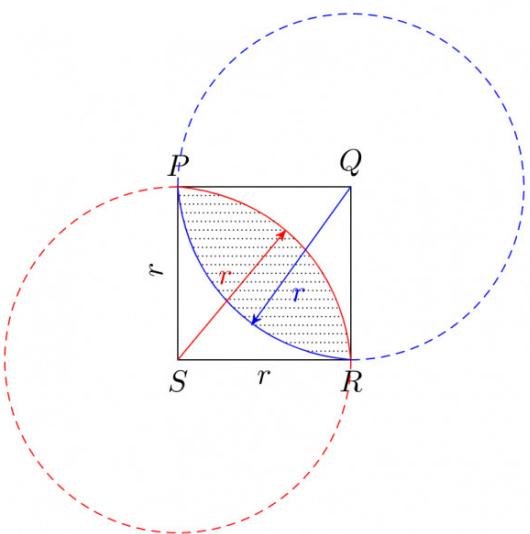
$$\text{The shaded area } A_1 = A_{\text{square}} - A_{\text{quarter circle}} = 1 - \frac{\pi}{4}$$

From the center  $Q$ , we can draw the circle, and only the quarter part is shown in the figure.



$$\text{The shaded area } A_2 = A_{\text{square}} - A_{\text{quarter circle}} = 1 - \frac{\pi}{4}$$

Now, we can combine the above two figures, we get,



$$\text{Now, the shaded area} = A_{\text{square}} - A_1 - A_2$$

$$= 1 - \left(1 - \frac{\pi}{4}\right) - \left(1 - \frac{\pi}{4}\right)$$

$$= -1 + \frac{2\pi}{4} = \frac{\pi}{2} - 1$$

Now, the required probability =  $\frac{\text{Favorable shaded area}}{\text{Total area}} = \frac{\frac{\pi}{2} - 1}{1} = \frac{\pi}{2} - 1$ .

$\therefore$  The probability that any point picked randomly within the square falls in the shaded area =  $\frac{\pi}{2} - 1$ .

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

### 9.9.3 Circles: GATE Electrical 2020 | GA Question: 9 [top](#)



✓ Ans A

Given O as the center. AB is the diameter. Let **Diameter** =  $2r$

Then  $AO = OB = r$ ,  $CO = r$  Semicircle.

$\angle COB = \angle COA = 90^\circ$ , Applying Pythagoras Theorem in  $\triangle COB, \triangle COA$

$$CB = CA = \sqrt{2}r$$

$$\text{Putting in given equation. } \frac{\overline{AC} + \overline{CB}}{\overline{AB}} = \frac{\sqrt{2}r + \sqrt{2}r}{2r} = \frac{2\sqrt{2}r}{2r} = \frac{\sqrt{2}}{1} = \sqrt{2}$$

2 votes

-- Vijay Purohit (2.8k points)

### 9.10

### Clock Time (7) [top](#)



#### 9.10.1 Clock Time: GATE CSE 2014 Set 2 | Question: GA-10 [top](#)

<https://gateoverflow.in/1952>

At what time between 6 a. m. and 7 a. m. will the minute hand and hour hand of a clock make an angle closest to  $60^\circ$ ?

- A. 6 : 22 a.m.
- B. 6 : 27 a.m.
- C. 6 : 38 a.m.
- D. 6 : 45 a.m.

gate2014-cse-set2 quantitative-aptitude normal clock-time

Answer

#### 9.10.2 Clock Time: GATE ECE 2020 | GA Question: 7 [top](#)

<https://gateoverflow.in/359766>



It is quarter past three in your watch. The angle between the hour hand and the minute hand is \_\_\_\_\_.

- A.  $0^\circ$
- B.  $7.5^\circ$
- C.  $15^\circ$
- D.  $22.5^\circ$

gate2020-ec quantitative-aptitude clock-time

Answer

#### 9.10.3 Clock Time: GATE Mechanical 2021 Set 2 | GA Question: 3 [top](#)

<https://gateoverflow.in/359507>



A digital watch X beeps every 30 seconds while watch Y beeps every 32 seconds. They beeped together at 10 AM. The immediate next time that they will beep together is \_\_\_\_\_

- A. 10.08 AM
- B. 10.42 AM
- C. 11.00 AM
- D. 10.00 PM

gateme-2021-set2 quantitative-aptitude clock-time

Answer

**9.10.4 Clock Time: GATE2016 EC-2: GA-8** top ↗<https://gateoverflow.in/108724>

Two and quarter hours back, when seen in a mirror, the reflection of a wall clock without number markings seemed to show 1 : 30. What is the actual current time shown by the clock?

- A. 8 : 15
- B. 11 : 15
- C. 12 : 15
- D. 12 : 45

[gate2016-ec-2](#) [clock-time](#)[Answer ↗](#)**9.10.5 Clock Time: GATE2018 CE-2: GA-7** top ↗<https://gateoverflow.in/313387>

A faulty wall clock is known to gain 15 minutes every 24 hours. It is synchronized to the correct time at 9 AM on 11th July. What will be the correct time to the nearest minute when the clock shows 2 PM on 15th July of the same year?

- A. 12 : 45 PM
- B. 12 : 58 PM
- C. 1 : 00 PM
- D. 2 : 00 PM

[gate2018-ce-2](#) [general-aptitude](#) [quantitative-aptitude](#) [clock-time](#) [normal](#)[Answer ↗](#)**9.10.6 Clock Time: GATE2019 EC: GA-9** top ↗<https://gateoverflow.in/313527>

Two design consultants,  $P$  and  $Q$ , started working from 8 AM for a client. The client budgeted a total of USD 3000 for the consultants.  $P$  stopped working when the hour hand moved by 210 degrees on the clock.  $Q$  stopped working when the hour hand moved by 240 degrees.  $P$  took two tea breaks of 15 minutes each during her shift, but took no lunch break.  $Q$  took only one lunch break for 20 minutes, but no tea breaks. The market rate for consultants is USD 200 per hour and breaks are not paid. After paying the consultants, the client shall have USD \_\_\_\_\_ remaining in the budget.

- A. 000.00
- B. 166.67
- C. 300.00
- D. 433.33

[gate2019-ec](#) [general-aptitude](#) [quantitative-aptitude](#) [clock-time](#)[Answer ↗](#)**9.10.7 Clock Time: GATE2019 ME-1: GA-3** top ↗<https://gateoverflow.in/313597>

A worker noticed that the hour hand on the factory clock had moved by 225 degrees during her stay at the factory. For how long did she stay in the factory?

- A. 3.75 hours
- B. 4 hours and 15 mins
- C. 8.5 hours
- D. 7.5 hours

[gate2019-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [clock-time](#)[Answer ↗](#)**Answers: Clock Time****9.10.1 Clock Time: GATE CSE 2014 Set 2 | Question: GA-10** top ↗<https://gateoverflow.in/1952>

- ✓ At 6 a.m. the hour hand and minute hand are separated by 180 degree. Now,

Speed of hour hand = 360 degree/12 hour (clock is 12 hrs as am/pm is given) = 30 degrees /hr = 0.5 degree per minute

Speed of minute hand = 360 degree per 60 minutes = 6 degrees per minute.

So, we want the relative distance between minute and hour hand to be 60 degree as per question which would mean a relative distance traversal of  $180 - 60 = 120$  degrees. This happens after  $x$  minutes such that

$$6x - 0.5x = 120 \implies x = \frac{120}{5.5} = 21.81$$

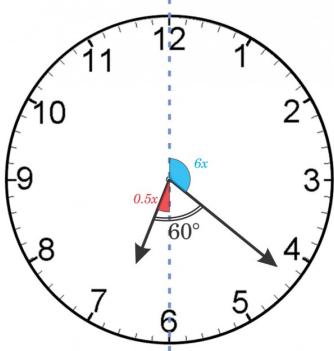
So, closest time is 6 : 22 a.m.

Correct Answer: A

35 votes

-- Arjun Suresh (328k points)

Answer = **option A**



Hour hand moves  $0.5^\circ$  in 1 minute  
Minute hand moves  $6^\circ$  in 1 minute

In  $x$  time minute and hour hand have moved. Now, from the figure it is deducible that:

$$\begin{aligned} 6x + 60 &= 180 + 0.5x \\ \implies 5.5x &= 120 \\ \implies x &= \frac{120}{5.5} = 21.8181 \approx 22. \end{aligned}$$

36 votes

-- Amar Vashishth (25.2k points)

### 9.10.2 Clock Time: GATE ECE 2020 | GA Question: 7 [top](#)

<https://gateoverflow.in/359766>



#### ✓ Method I :

The angle between hour hand and minute hand of a clock at  $H$  hours and  $M$  minutes is given by

$$\theta = 30H - \frac{11M}{2}$$

So, at 03 : 15 we get their difference as  $30 \times 3 - \frac{11(15)}{2}$   
 $= 90 - 82.5 = 7.5^\circ$

#### Method II :

- $1H = \frac{360}{12} = 30^\circ$
- $15M = \frac{1}{4}H = \frac{30^\circ}{4} = 7.5^\circ$

Correct Option: B.

2 votes

-- Madhav kumar (1.5k points)

### 9.10.3 Clock Time: GATE Mechanical 2021 Set 2 | GA Question: 3 [top](#)

<https://gateoverflow.in/359507>



- ✓ Given that, a digital watch X beeps every 30 seconds while watch Y beeps every 32 seconds.

Now, digital watch X and Y beep together every =  $\text{LCM}(30, 32) = 480$  seconds = 8 minutes.

First, they beeped together at 10 AM. Then the immediate next time that they will beep together is = 10 AM + 8 minutes

= 10 : 08 AM.

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.10.4 Clock Time: GATE2016 EC-2: GA-8 [top](#)

<https://gateoverflow.in/108724>



Reflection of time is 1:30

so actual time is ( 11:60 - 1:30 ) = 10:30

here mentioned 2:15 hrs back

so add it to 10:30

we got 12:45

the actual current time shown by the clock is 12:45

Correct Answer: D

11 votes

-- rajukalyadapu (143 points)

#### 9.10.5 Clock Time: GATE2018 CE-2: GA-7 [top](#)

<https://gateoverflow.in/313387>



the clock will gain 1 h in four days.

So, when the correct time on 15 July is 9 AM, the clock will show 10 AM.

Now, since the clock gains 15 minutes in 24 hours, it will gain nearly  $\frac{15}{24} \times 4 = 2.5$  minutes in 4 hours.

So, when clock shows 2 PM on 15 July, then actual time is nearly 1 hour 2.5 minutes behind it. i.e., around 12 : 58 PM

Correct Answer: B

10 votes

-- Naveen Kumar (9.9k points)

#### 9.10.6 Clock Time: GATE2019 EC: GA-9 [top](#)

<https://gateoverflow.in/313527>



360° is covered in 12 hours by a hour hand of a clock.

"P stopped working when the hour hand moved by 210 degrees on the clock. Q stopped working when the hour hand moved by 240 degrees."

It means P stopped working after  $\frac{210}{360} * 12 = 7$  hours and Q stopped working after  $\frac{240}{360} * 12 = 8$  hours.

-- Since, P has taken 2 tea breaks of total 30 minutes, P has worked for total  $(7 - 0.5) = 6.5$  hours

-- Since, Q has taken one lunch break of total 20 minutes, Q has worked for total  
 $7 \text{ hours and } 40 \text{ minute} = (7 + \frac{40}{60}) = (7 + 0.6667) \text{ hours} = 7.6667 \text{ hours}$

So, P and Q are paid total USD  $(6.5 + 7.6667) * 200 = 2834.33$

So, after paying the consultants, the client shall have USD  $(3000 - 2834.33) = 166.67$  remaining in the budget.

Correct Answer: B.

7 votes

-- ankitgupta.1729 (14.9k points)

#### 9.10.7 Clock Time: GATE2019 ME-1: GA-3 [top](#)

<https://gateoverflow.in/313597>



Hour hand of a clock covers 360° in 12 hours.

Since, 360° is covered in 12 hours. So, 225° will be covered in  $\frac{225}{360} \times 12 = 7.5$  hours.

So, Answer is (D)

7 votes

-- ankitgupta.1729 (14.9k points)

**9.11.1 Combinatory: GATE CSE 2010 | Question: 65** top ↗<https://gateoverflow.in/2373>

Given digits 2, 2, 3, 3, 3, 4, 4, 4, 4 how many distinct 4 digit numbers greater than 3000 can be formed?

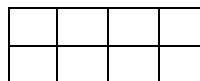
- A. 50
- B. 51
- C. 52
- D. 54

[gate2010-cse](#) [quantitative-aptitude](#) [combinatory](#) [normal](#)

Answer

**9.11.2 Combinatory: GATE CSE 2016 Set 2 | Question: GA-09** top ↗<https://gateoverflow.in/39537>

In a  $2 \times 4$  rectangle grid shown below, each cell is rectangle. How many rectangles can be observed in the grid?



- A. 21
- B. 27
- C. 30
- D. 36

[gate2016-cse-set2](#) [quantitative-aptitude](#) [normal](#) [combinatory](#)

Answer

**9.11.3 Combinatory: GATE CSE 2017 Set 1 | Question: GA-9** top ↗<https://gateoverflow.in/118412>

Arun, Gulab, Neel and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?

- A. 21
- B. 18
- C. 16
- D. 14

[gate2017-cse-set1](#) [combinatory](#) [quantitative-aptitude](#)

Answer

**9.11.4 Combinatory: GATE2011 MN: GA-59** top ↗<https://gateoverflow.in/31531>

In how many ways 3 scholarships can be awarded to 4 applicants, when each applicant can receive any number of scholarships?

- A. 4
- B. 12
- C. 64
- D. 81

[quantitative-aptitude](#) [gate2011-mn](#) [combinatory](#)

Answer

**9.11.5 Combinatory: GATE2012 AR: GA-5** top ↗<https://gateoverflow.in/40226>

Ten teams participate in a tournament. Every team plays each of the other teams twice. The total number of matches to be played is

- A. 20
- B. 45
- C. 60
- D. 90

gate2012-ar quantitative-aptitude combinatorial

Answer 

### 9.11.6 Combinatory: GATE2014 EC-4: GA-10 top ↗

<https://gateoverflow.in/41472>



A five digit number is formed using the digits 1, 3, 5, 7 and 9 without repeating any of them. What is the sum of all such possible five digit numbers?

- A. 6666660
- B. 6666600
- C. 6666666
- D. 6666606

gate2014-ec-4 quantitative-aptitude normal combinatorial

Answer 

### 9.11.7 Combinatory: GATE2015 CE-2: GA-8 top ↗

<https://gateoverflow.in/40183>



How many four digit numbers can be formed with the 10 digits 0, 1, 2, ..., 9 if no number can start with 0 and if repetitions are not allowed?

gate2015-ce-2 quantitative-aptitude combinatorial

Answer 

### 9.11.8 Combinatory: GATE2015 ME-3: GA-5 top ↗

<https://gateoverflow.in/40170>



Five teams have to compete in a league, with every team playing every other team exactly once, before going to the next round. How many matches will have to be held to complete the league round of matches?

- A. 20
- B. 10
- C. 8
- D. 5

gate2015-me-3 quantitative-aptitude combinatorial

Answer 

### 9.11.9 Combinatory: GATE2017 EC-2: GA-9 top ↗

<https://gateoverflow.in/313512>



The number of 3-digit numbers such that the digit 1 is never to the immediate right of 2 is

- A. 781
- B. 791
- C. 881
- D. 891

gate2017-ec-2 quantitative-aptitude combinatorial

Answer 

### 9.11.10 Combinatory: GATE2017 ME-2: GA-8 top ↗

<https://gateoverflow.in/313680>



There are 4 women  $P, Q, R, S$  and 5 men  $V, W, X, Y, Z$  in a group. We are required to form pairs each consisting of one woman and one man.  $P$  is not to be paired with  $Z$ , and  $Y$  must necessarily be paired with someone. In how many ways can 4 such pairs be formed?

- A. 74
- B. 76
- C. 78
- D. 80

gate2017-me-2 quantitative-aptitude combinatorial

**Answer****9.11.11 Combinatory: GATE2018 CE-2: GA-4** top ↗<https://gateoverflow.in/313393>

A three-member committee has to be formed from a group of 9 people. How many such distinct committees can be formed?

- A. 27
- B. 72
- C. 81
- D. 84

[gate2018-ce-2](#) [quantitative-aptitude](#) [combinatory](#)**Answer****9.11.12 Combinatory: GATE2019 EC: GA-4** top ↗<https://gateoverflow.in/313530>

Five different books ( $P, Q, R, S, T$ ) are to be arranged on a shelf. The books  $R$  and  $S$  are to be arranged first and second, respectively from the right side of the shelf. The number of different orders in which  $P, Q$  and  $T$  may be arranged is \_\_\_\_\_.

- A. 2
- B. 6
- C. 12
- D. 120

[gate2019-ec](#) [quantitative-aptitude](#) [combinatory](#)**Answer****Answers: Combinatory****9.11.1 Combinatory: GATE CSE 2010 | Question: 65** top ↗<https://gateoverflow.in/2373>

- ✓ first place should be occupied by either 3 or 4.

**Case 1 :** First place is occupied by the digit 4

4

now in the set from where we can pick numbers is left with = {2, 2, 3, 3, 3, 4, 4, 4}  
if we got 3 of each digit(which are 2, 3 and 4) then number of ways by **each** of those blanks can be

filled in are 3 coz we have 3 choices of digits: pick 2, 3 or 4.

But we do not have just enough 2's to fill all those 3 spaces with the digit 2.

∴ we need to subtract this case where number would be 4222.

So, total numbers obtained using the numbers in our current set =  $1 \times 3 \times 3 \times 3 - 1 = 26$ .

The first one is for the digit 4, coz its fixed for this case; the subtracted one is for the case 4222 that can't be made possible.

**Case 2:** First place is occupied by the digit 3

3

now in the set from where we can pick numbers is left with = {2, 2, 3, 3, 4, 4, 4}  
we have enough 4's here but lack 3's and 2's ∴, the cases we need to subtract are 3222 and 3333  
So, total numbers obtained using the numbers in our current set =  $1 \times 3 \times 3 \times 3 - 2 = 25$

both cases are independently capable of giving us the answer, we have =  $26 + 25 = 51$ .

Hence answer is **option B**.

95 votes

-- Amar Vashishth (25.2k points)

**9.11.2 Combinatory: GATE CSE 2016 Set 2 | Question: GA-09** top ↗<https://gateoverflow.in/39537>

- ✓ To form a rectangle, we must choose two horizontal sides and two vertical sides. Since there are three horizontal lines,

We can choose the horizontal sides in  ${}^3C_2$  ways.

Similarly, to choose 2 vertical lines out of 5 vertical lines is  ${}^5C_2$ .

So, answer is  $\binom{5}{2} \times \binom{3}{2}$ .

Correct Answer: C

62 votes

-- rajan (4.4k points)

### 9.11.3 Combinatory: GATE CSE 2017 Set 1 | Question: GA-9 top ↴

► <https://gateoverflow.in/118412>



- ✓ Total possibilities =  $4! = 24$ .

No. of ways 'Arun chooses red' or 'Shwetha chooses white'

$$\begin{aligned} &= (\text{no.of ways 'Arun chooses red'}) \\ &+ (\text{no.of ways 'Shwetha chooses white'}) \\ &- (\text{no.of ways 'Arun chooses red' and 'Shwetha chooses white'}) \end{aligned}$$

$$= 6 + 6 - 2 = 10$$

$$\text{required} = 24 - 10 = 14.$$

Correct Answer: D

49 votes

-- Vinay Rachapalli (905 points)

### 9.11.4 Combinatory: GATE2011 MN: GA-59 top ↴

► <https://gateoverflow.in/31531>



- ✓ One scholarship can be awarded to 4 applicants in 4 ways. Three scholarship can be awarded to 4 applicants in  $4^3 = 64$  ways.

**(All scholarship are independent, any student can get any no of scholarships between 0 and 3)**

Correct Answer: C

11 votes

-- Akash Kanase (36k points)

### 9.11.5 Combinatory: GATE2012 AR: GA-5 top ↴

► <https://gateoverflow.in/40226>



- ✓ Let 1.2.3.4.5.6.7.8.9.10 be the teams.

First team can play with any team in 9 ways.

Similarly second can play with any in 8 ways, 3rd team can play 7 games and so on.

$$\text{So, total number of games possible} = 9 + 8 + 7 \dots + 1 = \frac{n(n-1)}{2} = \frac{10 \times 9}{2} = 45$$

Since, each team plays 2 games against each other, total games =  $45 \times 2 = 90$

Correct Answer: D

9 votes

-- Deepesh Kataria (1.6k points)

### 9.11.6 Combinatory: GATE2014 EC-4: GA-10 top ↴

► <https://gateoverflow.in/41472>



- ✓ (B)

Consider the digits 1, 2, 3.

The possible numbers are {123, 132, 213, 231, 312, 321}, count =  $3! = 6$ .

- Consider the cases where the digit 3 is at the unit position. The number of such numbers (fix 3 at unit, permute the rest) will be  $(3-1)! = 2!$ . In all such cases, the 3 digit will contribute a 3 to the final sum. Total =  $2! \times 3$
- Consider the cases where the digit 3 is at the decimal position. The number of such numbers (fix 3 at decimal, permute the rest) will be  $(3-1)! = 2!$ . In all such cases, the 3 digit will contribute a 30 to the final sum. Total =  $2! \times 30$
- Consider the cases where the digit 3 is at the hundreds position. The number of such numbers (fix 3 at hundreds, permute the rest) will be  $(3-1)! = 2!$ . In all such cases, the 3 digit will contribute a 300 to the final sum. Total =  $2! \times 300$

In total, the digit 3 contributes  $2! \times (3 + 30 + 300) = 2! \times 333$  to the final sum.

The same happens for all other digits.

Hence, the net sum (for the original question) will be:

$$(5 - 1)! \times (11111 + 33333 + 55555 + 77777 + 99999)$$

Note:  $(5 - 1)!$  = the number of permutations after fixing 1 digit. 11111... because the digit 1 contributes a 1, 10, 100, 1000, 10000 to the final sum.

Required Answer = 6666600.

Hence, option B is correct.

21 votes

-- Pragy Agarwal (18.3k points)

<https://gateoverflow.in/40183>



#### 9.11.7 Combinatory: GATE2015 CE-2: GA-8 top ↴

-----

Since, number of digits is 4 the number cannot start with 0.

At first place all number can appear except 0. So, number of possibilities = 9.

9 \_ \_ \_

Since, repetition is not allowed, second place can be occupied by 8 different numbers. But here 0 may appear so total possibilities is 9.

9 × 9 \_ \_

Similarly, remaining two places can be filled in

$$9 \times 9 \times 8 \times 7 = 4536.$$

4 votes

-- ppateriya (97 points)

<https://gateoverflow.in/40170>



#### 9.11.8 Combinatory: GATE2015 ME-3: GA-5 top ↴

Answer (B) 10

We have to select number of ways of choosing 2 teams out of 5 =  ${}^5C_2 = 10$ .

We can also do like follows:

- Team 1: Can pick another team in 4 ways
- Team 2: Can pick another team (excluding team 1) in 3 ways
- Team 3: Can pick other teams in 2 ways
- Teams 4 and 5 can play in 1 way
- So, totally,  $4 + 3 + 2 + 1 = 10$  ways.

5 votes

-- Dhananjay Kumar Sharma (18.8k points)

<https://gateoverflow.in/313512>



#### 9.11.9 Combinatory: GATE2017 EC-2: GA-9 top ↴

Answer C

The total number of three digit numbers is  $9 \times 10 \times 10$  as the first place can be filled with 9 ways (1 – 9) and next two places can be filled with 10 digits (0 – 9) in  $10 \times 10$  ways.

Now the total number of three digit number with 1 immediate right of 2 are

- $(210 - 219) \implies 10$
- $_ 2 1 \implies$  this blank can be filled from 1 – 9 so total 9 numbers here
- Thus  $10 + 9 = 19$  numbers are having 1 to the immediate right of 2.

So, total number of three digit numbers not having 1 to the immediate right of 2 =  $900 - 19 = 881$ .

6 votes

-- Ajay kumar soni (10.6k points)

**9.11.10 Combinatory: GATE2017 ME-2: GA-8** top ↴<https://gateoverflow.in/313680>

- ✓ Required number of ways = Total number of possible ways –  $n(P \text{ is paired with } Z) - n(Y \text{ is not paired}) + n(Y \text{ is not paired AND also } P \text{ and } Z \text{ are paired together})$

Total number of ways =  $5 \times 4 \times 3 \times 2 = 120$

$$n(P \text{ is paired with } Z) = 4 \times 3 \times 2 = 24$$

$$n(Y \text{ is not paired}) = 4 \times 3 \times 2 \times 1 = 24$$

$$n(Y \text{ is not paired AND also } P \text{ and } Z \text{ are paired together}) = 3 \times 2 \times 1 = 6$$

$$\text{So, required number of ways} = 120 - 24 - 24 + 6 = 78.$$

Correct Answer: C

5 votes

-- Naveen Kumar (9.9k points)

**9.11.11 Combinatory: GATE2018 CE-2: GA-4** top ↴<https://gateoverflow.in/313393>

- ✓ Number of people in the committee = 3

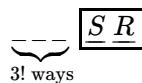
Number of people in the group = 9

$$\text{Out of 9 people, number of ways to form three-member committee} = \binom{n}{r} = \binom{9}{3} = 84$$

Hence, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

**9.11.12 Combinatory: GATE2019 EC: GA-4** top ↴<https://gateoverflow.in/313530>

As positions of  $R$  and  $S$  are fixed at first and second from right, so  $P, Q$ , and  $T$  can be arranged in three possible places.

Hence, the total possible arrangements =  $3! = 6$

Correct option is (B).

1 votes

-- Lakshman Patel (63.9k points)

**9.12****Conditional Probability (6)** top ↴**9.12.1 Conditional Probability: GATE CSE 2012 | Question: 63** top ↴<https://gateoverflow.in/2211>

An automobile plant contracted to buy shock absorbers from two suppliers  $X$  and  $Y$ .  $X$  supplies 60% and  $Y$  supplies 40% of the shock absorbers. All shock absorbers are subjected to a quality test. The ones that pass the quality test are considered reliable. Of  $X$ 's shock absorbers, 96% are reliable. Of  $Y$ 's shock absorbers, 72% are reliable.

The probability that a randomly chosen shock absorber, which is found to be reliable, is made by  $Y$  is

- A. 0.288
- B. 0.334
- C. 0.667
- D. 0.720

[gate2012-cse](#) [quantitative-aptitude](#) [probability](#) [normal](#) [conditional-probability](#)

Answer

**9.12.2 Conditional Probability: GATE Mechanical 2021 Set 2 | GA Question: 7** top ↴<https://gateoverflow.in/359497>

A box contains 15 blue balls and 45 black balls. If 2 balls are selected randomly, without replacement, the probability of an outcome in which the first selected is a blue ball and the second selected is a black ball, is \_\_\_\_\_

- A.  $\frac{3}{16}$
- B.  $\frac{45}{236}$

- C.  $\frac{1}{4}$   
 D.  $\frac{3}{4}$

gateme-2021-set2 quantitative-aptitude probability conditional-probability

Answer 

### 9.12.3 Conditional Probability: GATE2013 AE: GA-10 top ↗

► <https://gateoverflow.in/40251>



In a factory, two machines  $M_1$  and  $M_2$  manufacture 60% and 40% of the autocomponents respectively. Out of the total production, 2% of  $M_1$  and 3% of  $M_2$  are found to be defective. If a randomly drawn autocomponent from the combined lot is found defective, what is the probability that it was manufactured by  $M_2$ ?

- A. 0.35  
 B. 0.45  
 C. 0.5  
 D. 0.4

gate2013-ae quantitative-aptitude conditional-probability

Answer 

### 9.12.4 Conditional Probability: GATE2014 AG: GA-10 top ↗

► <https://gateoverflow.in/41674>



10% of the population in a town is  $HIV^+$ . A new diagnostic kit for HIV detection is available; this kit correctly identifies  $HIV^+$  individuals 95% of the time, and  $HIV^-$  individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is \_\_\_\_\_.

gate2014-ag quantitative-aptitude probability conditional-probability normal numerical-answers

Answer 

### 9.12.5 Conditional Probability: GATE2014 EC-1: GA-10 top ↗

► <https://gateoverflow.in/41499>



You are given three coins: one has heads on both faces, the second has tails on both faces, and the third has a head on one face and a tail on the other. You choose a coin at random and toss it, and it comes up heads. The probability that the other face is tails is

- A.  $\frac{1}{4}$   
 B.  $\frac{1}{3}$   
 C.  $\frac{1}{2}$   
 D.  $\frac{2}{3}$

gate2014-ec-1 quantitative-aptitude probability conditional-probability

Answer 

### 9.12.6 Conditional Probability: GATE2015 ME-3: GA-10 top ↗

► <https://gateoverflow.in/40174>



A coin is tossed thrice. Let  $X$  be the event that head occurs in each of the first two tosses. Let  $Y$  be the event that a tail occurs on the third toss. Let  $Z$  be the event that two tails occur in three tosses.

Based on the above information, which one of the following statements is TRUE?

- A.  $X$  and  $Y$  are not independent  
 B.  $Y$  and  $Z$  are dependent  
 C.  $Y$  and  $Z$  are independent  
 D.  $X$  and  $Z$  are independent

gate2015-me-3 conditional-probability probability quantitative-aptitude

Answer 

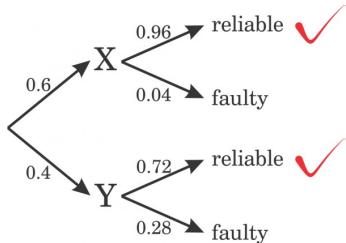
## Answers: Conditional Probability

### 9.12.1 Conditional Probability: GATE CSE 2012 | Question: 63 top ↗

<https://gateoverflow.in/2211>



✓ B.



Then by using Bayes' Theorem :

$$\text{Probability of Y given R} = \frac{\text{Probability of Y and R}}{\text{Probability of R}}$$

$$= \frac{0.4 \times 0.72}{0.4 \times 0.72 + 0.6 \times 0.96}$$

$$= \frac{1}{3} = 0.33$$

31 votes

-- shreya ghosh (2.8k points)

### 9.12.2 Conditional Probability: GATE Mechanical 2021 Set 2 | GA Question: 7 top ↗

<https://gateoverflow.in/359497>



✓ It is given that from a box containing 15 blue balls and 45 black balls, 2 balls are selected randomly without replacement.

Probability that, the first selected is a blue ball and the second selected is a black ball

$$= \frac{^{15}C_1}{60} \times \frac{^{45}C_1}{59}$$

$$= \frac{15}{60} \times \frac{45}{59} = \frac{45}{236}.$$

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

### 9.12.3 Conditional Probability: GATE2013 AE: GA-10 top ↗

<https://gateoverflow.in/40251>



✓ (C) 0.5

Let  $P(M_i)$  denote the probability that the component is manufactured by machine  $M_i$ , and  $P(def)$  denote the probability that the component is defective.

We have to find  $P(M_2|def)$ .

$$P(M_2 | def) = P(M_2 \cap def)/P(def) = \frac{0.4 \times 0.03}{(0.4 \times 0.03) + (0.6 \times 0.02)} = 0.5$$

Drawing probability tree diagram for such questions makes them easier to solve. Please refer [link1](#) and [link2](#) for more details.

#### References



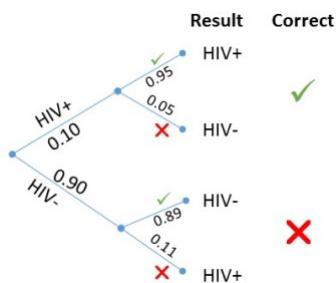
8 votes

-- Gaurav Sharma (1.8k points)

## 9.12.4 Conditional Probability: GATE2014 AG: GA-10 top

<https://gateoverflow.in/41674>

- ✓ If you don't like Bayes theorem then use this **TREE METHOD:**



$$\text{Probability} = \frac{0.10 \times 0.95}{0.10 \times 0.95 + 0.90 \times 0.11} = 0.4896$$

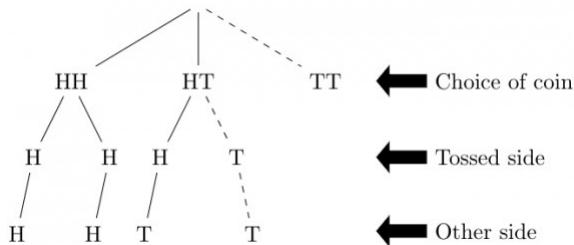
22 votes

-- Bhagirathi Nayak (11.7k points)

## 9.12.5 Conditional Probability: GATE2014 EC-1: GA-10 top

<https://gateoverflow.in/41499>

- ✓



We are given 3 coins out of which 1 coin ( $TT$ ) is automatically removed from the total cases as we have already got a  $H$ .

Now when we toss any of two coins ( $HH, HT$ ), the cases for the front side are:  $(H, H, H, T)$  and each of these are **equally likely**. It is given that the tossed side is  $H$ , so fourth option is also removed from the total cases.

Now as we have one coin with  $HH$  and another coin with  $HT$  and one  $H$  side is present, the choices for another side are  $(H, H, T)$ .

Now we want the  $T$  side as favourable outcome out of total 3 outcomes.

According to Bayes theorem or conditional probability

$$p(\text{another side is } T) = \frac{\# \text{ favourable outcomes}}{\# \text{total outcomes}}$$

$$\therefore p = \frac{1}{3}$$

So, answer is **B**.

**Reference link:** <https://www.khanacademy.org/math/precalculus/prob-comb/dependent-events-precalc/v/bayes-theorem-visualized>

### References



27 votes

-- Sheshang M. Ajwalia (2.6k points)

## 9.12.6 Conditional Probability: GATE2015 ME-3: GA-10 top

<https://gateoverflow.in/40174>

- ✓ ans should be B

event  $X = HH$  \_

event  $Y = _T$  so  $X$  and  $Y$  are independent so option A is out

event Z = 2T 1 H (any order TTH,THT,HTT) so if X occurs Z can not occur hence X and Z are dependent events so option D is out

event Z = 2T 1 H ( TTH(event Y is not possible hence Y and Z are dependent) ,THT(event Y is possible) ,HTT (event Y is possible)

consider choice C and D the question is asked about 2 (exactly 2) tails occur in 3 tosses now if there is a tail in 3rd toss then we need only one tail in first 2 tosses else we need 2 tails hence they are dependent on each other

12 votes

-- sanjay (36.7k points)

### 9.13

### Cones (1) top

#### 9.13.1 Cones: GATE ECE 2021 | GA Question: 8 top

<https://gateoverflow.in/359791>



Consider a square sheet of side 1 unit. In the first step, it is cut along the main diagonal to get two triangles. In the next step. one of the cut triangles is revolved about its short edge to form a solid cone. The volume of the resulting cone, in cubic units, is \_\_\_\_\_

- A.  $\frac{\pi}{3}$
- B.  $\frac{2\pi}{3}$
- C.  $\frac{3\pi}{2}$
- D.  $3\pi$

gateec-2021 quantitative-aptitude mensuration cones

Answer

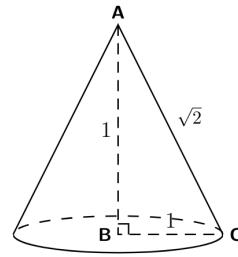
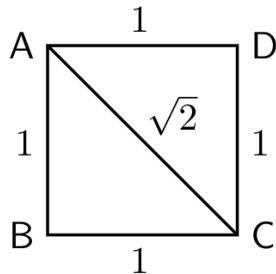
### Answers: Cones

#### 9.13.1 Cones: GATE ECE 2021 | GA Question: 8 top

<https://gateoverflow.in/359791>



✓ Given that:



The volume of a cone is  $\frac{1}{3}\pi r^2 h$ , where  $r$  denotes the radius of the base of the cone, and  $h$  denotes the height of the cone.

Here,  $h = r = 1$ .

$\therefore$  The volume of cone  $= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(1)^2(1) = \frac{\pi}{3}$  cubic units.

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

### 9.14

### Contour Plots (3) top

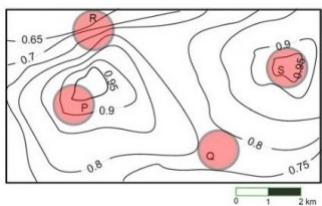
#### 9.14.1 Contour Plots: GATE CSE 2017 Set 2 | Question: GA-10 top

<https://gateoverflow.in/118424>



An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air pressure contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.

If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region, which of the following regions is most likely to have a thunderstorm?



- A.  $P$
- B.  $Q$
- C.  $R$
- D.  $S$

gate2017-cse-set2 quantitative-aptitude data-interpretation normal contour-plots

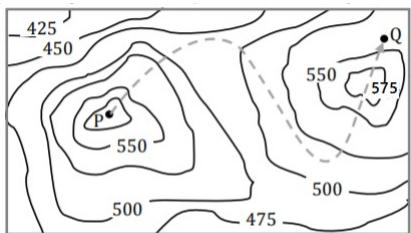
Answer

#### 9.14.2 Contour Plots: GATE2017 EC-1: GA-10

<https://gateoverflow.in/313596>



A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot.



The path from  $P$  to  $Q$  is best described by

- A. Up-Down-Up-Down
- B. Down-Up-Down-Up
- C. Down-Up-Down
- D. Up-Down-Up

gate2017-ec-1 general-aptitude quantitative-aptitude data-interpretation contour-plots

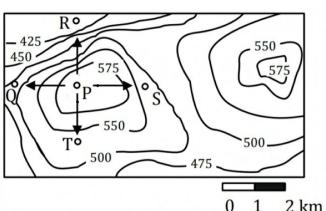
Answer

#### 9.14.3 Contour Plots: GATE2017 EC-2: GA-10

<https://gateoverflow.in/313513>



A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot.



Which of the following is the steepest path leaving from  $P$ ?

- A.  $P$  to  $Q$
- B.  $P$  to  $R$
- C.  $P$  to  $S$
- D.  $P$  to  $T$

gate2017-ec-2 general-aptitude quantitative-aptitude data-interpretation contour-plots

Answer

### Answers: Contour Plots

### 9.14.1 Contour Plots: GATE CSE 2017 Set 2 | Question: GA-10 [top](#)

<https://gateoverflow.in/118424>



- More Pressure gradient (variation of pressure) causes more thunderstorm possibility. In the region,  $R$  contour lines are very dense and giving more pressure gradient (notice two of them are very close). ( $\frac{\partial P}{\partial x}, \frac{\partial P}{\partial y}$ , one of these values will be very high in comparison to other regions).

$R$  is the answer.

#### References



19 votes

-- Debashish Deka (40.7k points)

### 9.14.2 Contour Plots: GATE2017 EC-1: GA-10 [top](#)

<https://gateoverflow.in/313596>



- The line starts from  $P$  which is inside 575 contour line.

Then line crosses the contour lines  $575 \rightarrow 550 \rightarrow 525 \rightarrow 500$ . **Down**

Then it crosses the contour lines of  $500 \rightarrow 525 \rightarrow 550 \rightarrow 575$  **Up**

Then it crosses the contour lines  $575 \rightarrow 550$  and then stops at  $Q$  which is inside the contour line 525. **Down**

$\therefore$  Option C Down up Down is the correct answer.

7 votes

-- Satbir Singh (20.9k points)

### 9.14.3 Contour Plots: GATE2017 EC-2: GA-10 [top](#)

<https://gateoverflow.in/313513>



- From the given contour plot of a geographical region, we get

- Height of point  $P > 575$  m
- Height of point  $R < 425$  m
- Height of point  $Q$  is in between 475 m to 500 m
- Height of point  $S$  is in between 500 m to 525 m
- Height of point  $T$  is in between 500 m to 525 m

among PQ, PR, PS and PT the one with largest height difference will be the steepest path.

since R is at lowest height , so path from P to R will be steepest path.

Correct Answer: **B.  $P$  to  $R$**

5 votes

-- Naveen Kumar (9.9k points)

## 9.15

### Cost Market Price (4) [top](#)

#### 9.15.1 Cost Market Price: GATE CSE 2011 | Question: 63 [top](#)

<https://gateoverflow.in/2173>



The variable cost ( $V$ ) of manufacturing a product varies according to the equation  $V = 4q$ , where  $q$  is the quantity produced. The fixed cost ( $F$ ) of production of same product reduces with  $q$  according to the equation  $F = \frac{100}{q}$ . How many units should be produced to minimize the total cost ( $V + F$ )?

- 5
- 4
- 7
- 6

gate2011-cse quantitative-aptitude cost-market-price normal

Answer

#### 9.15.2 Cost Market Price: GATE CSE 2012 | Question: 56 [top](#)

<https://gateoverflow.in/2193>



The cost function for a product in a firm is given by  $5q^2$ , where  $q$  is the amount of production. The firm can sell the product at a market price of ₹50 per unit. The number of units to be produced by the firm such that the profit is maximized is

- A. 5
- B. 10
- C. 15
- D. 25

gate2012-cse quantitative-aptitude cost-market-price normal

Answer 

### 9.15.3 Cost Market Price: GATE CSE 2019 | Question: GA-4

 <https://gateoverflow.in/302869>



Ten friends planned to share equally the cost of buying a gift for their teacher. When two of them decided not to contribute, each of the other friends had to pay Rs. 150 more. The cost of the gift was Rs. \_\_\_\_\_

- A. 666
- B. 3000
- C. 6000
- D. 12000

gate2019-cse general-aptitude quantitative-aptitude cost-market-price

Answer 

### 9.15.4 Cost Market Price: GATE2014 AE: GA-5

 <https://gateoverflow.in/40304>



A foundry has a fixed daily cost of Rs 50,000 whenever it operates and a variable cost of RS  $800Q$ , where  $Q$  is the daily production in tonnes. What is the cost of production in Rs per tonne for a daily production of 100 tonnes.

gate2014-ae quantitative-aptitude cost-market-price numerical-answers

Answer 

## Answers: Cost Market Price

### 9.15.1 Cost Market Price: GATE CSE 2011 | Question: 63

 <https://gateoverflow.in/2173>



✓ Total Cost,  $T = 4q + \frac{100}{q}$

When total cost becomes minimum, first derivative of  $T$  becomes 0 and second derivative at the minimum point will be positive.

Differentiating  $T$  with respect to  $q$  and equating to 0,

$$4 - \frac{100}{q^2} = 0 \Rightarrow q = +5 \text{ or } -5. \text{ Since, we can't have negative number of product, } q = 5.$$

Taking second derivative, at  $q = 5$  gives  $\frac{200}{125} = \frac{8}{5} > 0$ , and hence 5 is the minimum point.

Correct Answer: A

 29 votes

-- Arjun Suresh (328k points)



### 9.15.2 Cost Market Price: GATE CSE 2012 | Question: 56

 <https://gateoverflow.in/2193>



✓ Answer is A.

The equation for profit is Profit =  $SP - CP$ ,

Here,  $SP = Q \times 50$  and  $CP = 5Q^2$ .

So, when a function attains its maximum value its first order differentiation is zero.

Hence,  $50 - 5 \times 2 \times Q = 0 \therefore Q = 5$ .

For example :

5 units =  $CP = 125$   $SP = 250 \therefore Profit = 125$

**10 units =  $CP = 500$   $SP = 500$**   $\therefore Profit = 0$  and so forth..

Therefore, its maximum is at unit = 5

33 votes

-- kireeti (1k points)

### 9.15.3 Cost Market Price: GATE CSE 2019 | Question: GA-4 top ↗

► <https://gateoverflow.in/302869>



- ✓ Let us suppose each of the 10 friends were supposed to contribute Rs  $x$ .

Hence total cost for gift = Rs  $10x$ .

Now since 2 friends won't contribute , hence 8 friends would have to contribute  $(x + 150)$  each.

By the sum,

$$10x = 8x + 1200$$

$$2x = 1200$$

$$x = 600$$

Hence total cost of the gift =  $10x$  = Rs. 6000

23 votes

-- Sayan Bose (5k points)

### 9.15.4 Cost Market Price: GATE2014 AE: GA-5 top ↗

► <https://gateoverflow.in/40304>



- ✓ Answer: 1300

For a daily production of 100 tonnes, the daily cost of foundry would be Rs  $50,000 + (800 \times 100) =$  Rs 130,000.

Hence cost of production in Rs per tonne =  $\frac{130,000}{100} =$  Rs 1,300.

13 votes

-- Anurag Pandey (10.5k points)

## 9.16

### Counting (4) top ↗

#### 9.16.1 Counting: GATE Electrical 2020 | GA Question: 5 top ↗

► <https://gateoverflow.in/359724>



If P, Q, R, S are four individuals, how many teams of size exceeding one can be formed, with Q as a member?

- A. 5
- B. 6
- C. 7
- D. 8

[gate2020-ee](#) [quantitative-aptitude](#) [counting](#)

Answer

#### 9.16.2 Counting: GATE2017 EC-1: GA-9 top ↗

► <https://gateoverflow.in/313518>



There are 3 Indians and 3 Chinese in a group of 6 people. How many subgroups of this group can we choose so that every subgroup has at least one Indian?

- A. 56
- B. 52
- C. 48
- D. 44

[gate2017-ec-1](#) [general-aptitude](#) [quantitative-aptitude](#) [counting](#)

Answer

**9.16.3 Counting: GATE2018 CH: GA-8** top ↗<https://gateoverflow.in/205090>

To pass a test, a candidate needs to answer at least 2 out of 3 questions correctly. A total of 6,30,000 candidates appeared for the test. Question *A* was correctly answered by 3,30,000 candidates. Question *B* was answered correctly by 2,50,000 candidates. Question *C* was answered correctly by 2,60,000 candidates. Both questions *A* and *B* were answered correctly by 1,00,000 candidates. Both questions *B* and *C* were answered correctly by 90,000 candidates. Both questions *A* and *C* were answered correctly by 80,000 candidates. If the number of students answering all questions correctly is the same as the number answering none, how many candidates failed to clear the test?

- A. 30,000
- B. 2,70,000
- C. 3,90,000
- D. 4,20,000

[gate2018-ch](#) [general-aptitude](#) [quantitative-aptitude](#) [counting](#)

[Answer ↗](#)

**9.16.4 Counting: GATE2018 EE: GA-6** top ↗<https://gateoverflow.in/205186>

An e-mail password must contain three characters. The password has to contain one numeral from 0 to 9, one upper case and one lower case character from the English alphabet. How many distinct passwords are possible?

- A. 6,760
- B. 13,520
- C. 40,560
- D. 1,05,456

[gate2018-ee](#) [general-aptitude](#) [quantitative-aptitude](#) [normal](#) [combinatory](#) [counting](#)

[Answer ↗](#)

**Answers: Counting****9.16.1 Counting: GATE Electrical 2020 | GA Question: 5** top ↗<https://gateoverflow.in/359724>

✓ Ans C = 7.

Number of Individuals = 4, team Size greater than 1, Q is premium member.

\_\_\_ Q. (max three positions left to be filled and three members left: P, R, S)

By raw counting we can get 7 : {PQ, RQ, SQ, PRQ, PSQ, RSQ, PQRS}.

Alternatively we can do as follows:

As four individuals are defined distinct, and we just have to select them for the three remaining positions.

Selecting 1 person out of three, selecting 2 persons out of three and selecting all 3 persons, we get

$$\begin{aligned} {}^3C_1 + {}^3C_2 + {}^3C_3 \\ = 3 + 3 + 1 = 7 \end{aligned}$$

3 votes

-- Vijay Purohit (2.8k points)

**9.16.2 Counting: GATE2017 EC-1: GA-9** top ↗<https://gateoverflow.in/313518>

✓ Number of Indian people = 3

Number of Chinese people = 3

Total number of people,  $n = 6$

Total number of groups is basically any non-empty subset of this group of  $6 = 2^n - 1 = 2^6 - 1 = 63$

Number of groups having no Indian people = Select a group out of remaining 3 people  $= 2^3 - 1 = 7$ .

∴ the number of sub-groups having at least one Indian  $= 63 - 7 = 56$ .

Correct answer is option (A).

8 votes

-- Lakshman Patel (63.9k points)

**9.16.3 Counting: GATE2018 CH: GA-8** top ↗<https://gateoverflow.in/205090>

- ✓ Answer D)

Say there are  $x$  students who answered all correctly

So, according to condition there are  $x$  student who answered none

Equation using inclusion exclusion principle

$$630000 - x = 330000 + 250000 + 260000 - 100000 - 90000 - 80000 + x$$

$$x = 30000$$

Now, it is given that to pass u need to answer atleast 2 out of 3 questions

So, those who answered one answer correctly also considered to be fail

$$\text{Only A answered correctly } 330000 - 100000 - 80000 + 30000 = 180000$$

$$\text{Only B answered correctly } 250000 - 100000 - 90000 + 30000 = 90000$$

$$\text{Only C answered correctly } 260000 - 80000 - 90000 + 30000 = 120000$$

$$\text{So, total failed student } 180000 + 90000 + 120000 + 30000 = 420000$$

7 votes

-- srestha (85k points)

**9.16.4 Counting: GATE2018 EE: GA-6** top ↗<https://gateoverflow.in/205186>

- ✓ Select any digit from 10 digits, one uppercase alphabet from 26 alphabets and one lowercase alphabets from 26 alphabet, each combination can permute  $3!$  times for ex:  $5Ab, 5bA, A5b, Ab5, bA5, b5A$

$$\text{So, total possible passwords} = (10C1 * 26C1 * 26C1) * 3!$$

$$= 40560$$

**Hence option c) is correct**

7 votes

-- Ashwani Kumar (12.8k points)

**9.17****Cube (1)** top ↗**9.17.1 Cube: GATE CSE 2021 Set 2 | GA Question: 3** top ↗<https://gateoverflow.in/357547>

If  $\theta$  is the angle, in degrees, between the longest diagonal of the cube and any one of the edges of the cube, then,  $\cos \theta =$

- A.  $\frac{1}{2}$
- B.  $\frac{1}{\sqrt{3}}$
- C.  $\frac{1}{\sqrt{2}}$
- D.  $\frac{\sqrt{3}}{2}$

[gate2021-cse-set2](#) [quantitative-aptitude](#) [mensuration](#) [cube](#)

Answer

**Answers: Cube****9.17.1 Cube: GATE CSE 2021 Set 2 | GA Question: 3** top ↗<https://gateoverflow.in/357547>

- ✓ Option B

The longest diagonal would be from one corner vertex to the diagonally opposite corner vertex.

$$\text{Length of diagonal of a side} = \sqrt{a^2 + a^2} = \sqrt{2}a$$

The diagonal of a square face of cube, a side of the cube and the longest diagonal will form a right angled triangle with longest diagonal as the hypotenuse.

$$\therefore \text{Length of the longest diagonal} = \sqrt{a^2 + (\sqrt{2}a)^2} = \sqrt{3}a$$

$$\cos \theta = \frac{\text{Base}}{\text{Hypotenuse}} = \frac{a}{\sqrt{3}a} = \frac{1}{\sqrt{3}}$$

6 votes

-- zxy123 (2.5k points)

9.18

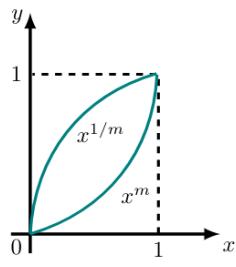
Curves (1) top

**9.18.1 Curves: GATE Mechanical 2020 Set 1 | GA Question: 9** top

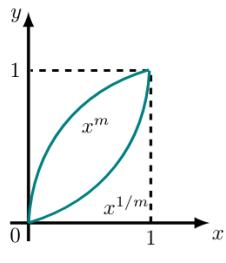
<https://gateoverflow.in/359520>



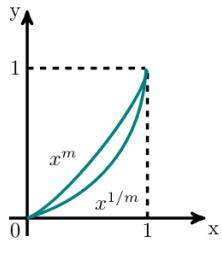
Select the graph that schematically represents BOTH  $y = x^m$  and  $y = x^{1/m}$  properly in the interval  $0 \leq x \leq 1$ , for integer values of  $m$ , where  $m > 1$ .



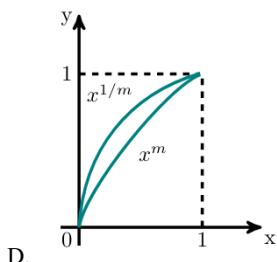
A.



B.



C.



D.

[gateme-2020-set1](#) [quantitative-aptitude](#) [functions](#) [curves](#)

Answer

Answers: Curves

9.18.1 Curves: GATE Mechanical 2020 Set 1 | GA Question: 9 [top](#)<https://gateoverflow.in/359520>

- ✓ Given that  $y_1 = x^m$ ;  $0 \leq x \leq 1$ ,  $m > 1$

For simplicity we can take  $m = 2$ , differentiate the function and get the slope.

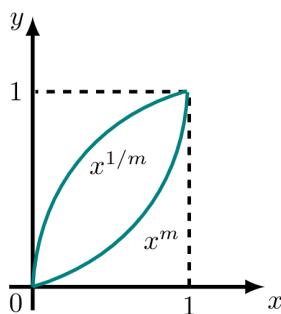
For  $y = x^2$  we get  $m_1 = \frac{dy}{dx} = 2x$ .

Similarly for  $y_2 = x^{1/2}$  we get  $m_2 = \frac{dy}{dx} = \frac{1}{2\sqrt{x}}$

At  $x = 0$ ,  $m_1 = 0$ ,  $m_2 = \infty$

At  $x = 1$ ,  $m_1 = 2$ ,  $m_2 = 0.5$

Only for option, A slope of  $y_1$  is increasing and slope of  $y_2$  is decreasing.



So, the correct answer is (A).

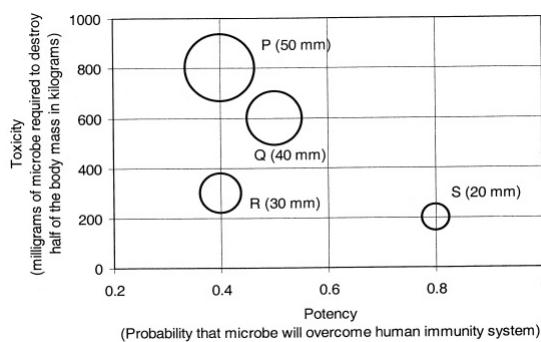
1 votes

-- Lakshman Patel (63.9k points)

## 9.19

Data Interpretation (13) [top](#)9.19.1 Data Interpretation: GATE CSE 2011 | Question: 62 [top](#)<https://gateoverflow.in/2172>

$P$ ,  $Q$ ,  $R$  and  $S$  are four types of dangerous microbes recently found in a human habitat. The area of each circle with its diameter printed in brackets represents the growth of a single microbe surviving human immunity system within 24 hours of entering the body. The danger to human beings varies proportionately with the toxicity, potency and growth attributed to a microbe shown in the figure below:



A pharmaceutical company is contemplating the development of a vaccine against the most dangerous microbe. Which microbe should the company target in its first attempt?

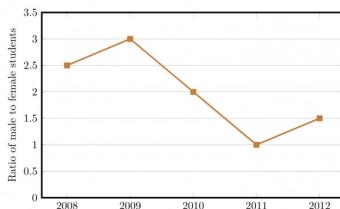
- A.  $P$
- B.  $Q$
- C.  $R$
- D.  $S$

[gate2011-cse](#) [quantitative-aptitude](#) [data-interpretation](#) [normal](#)

Answer

9.19.2 Data Interpretation: GATE CSE 2014 Set 2 | Question: GA-9 [top](#)<https://gateoverflow.in/1951>

The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students doubled in 2009, by what percent did the number of male students increase in 2009?

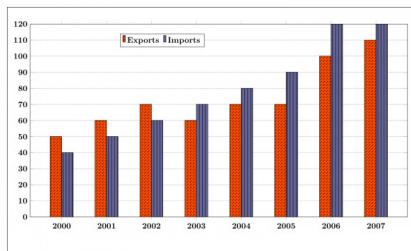

[gate2014-cse-set2](#) [quantitative-aptitude](#) [data-interpretation](#) [numerical-answers](#) [normal](#)

Answer

### 9.19.3 Data Interpretation: GATE CSE 2015 Set 3 | Question: GA-10 [top ↗](#)

<https://gateoverflow.in/8389>

The exports and imports (in crores of *Rs.*) of a country from the year 2000 to 2007 are given in the following bar chart. In which year is the combined percentage increase in imports and exports the highest?


[gate2015-cse-set3](#) [quantitative-aptitude](#) [data-interpretation](#) [normal](#) [numerical-answers](#)

Answer

### 9.19.4 Data Interpretation: GATE CSE 2016 Set 1 | Question: GA06 [top ↗](#)

<https://gateoverflow.in/39616>

A shaving set company sells 4 different types of razors- Elegance, Smooth, Soft and Executive.

Elegance sells at Rs. 48, Smooth at Rs. 63, Soft at Rs. 78 and Executive at Rs. 173 per piece. The table below shows the numbers of each razor sold in each quarter of a year.

Quarter/Product	Elegance	Smooth	Soft	Executive
Q1	27300	20009	17602	9999
Q2	25222	19392	18445	8942
Q3	28976	22429	19544	10234
Q4	21012	18229	16595	10109

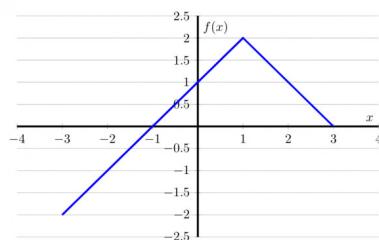
Which product contributes the greatest fraction to the revenue of the company in that year?

- A. Elegance
- B. Executive
- C. Smooth
- D. Soft

[gate2016-cse-set1](#) [quantitative-aptitude](#) [data-interpretation](#) [easy](#)

Answer

### 9.19.5 Data Interpretation: GATE CSE 2016 Set 2 | Question: GA-10 [top ↗](#)

<https://gateoverflow.in/39535>

- A.  $f(x) = 1 - |x - 1|$   
 B.  $f(x) = 1 + |x - 1|$   
 C.  $f(x) = 2 - |x - 1|$   
 D.  $f(x) = 2 + |x - 1|$

gate2016-cse-set2 quantitative-aptitude data-interpretation normal

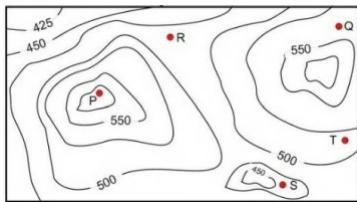
Answer 

### 9.19.6 Data Interpretation: GATE CSE 2017 Set 1 | Question: GA-10

<https://gateoverflow.in/118413>



A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. If in a flood, the water level rises to 525 m, which of the villages  $P, Q, R, S, T$  get submerged?



- A.  $P, Q$   
 B.  $P, Q, T$   
 C.  $R, S, T$   
 D.  $Q, R, S$

gate2017-cse-set1 general-aptitude quantitative-aptitude data-interpretation normal

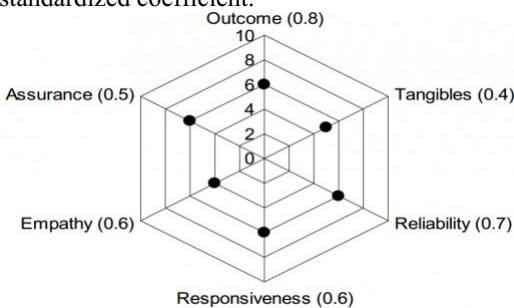
Answer 

### 9.19.7 Data Interpretation: GATE2011 GG: GA-9

<https://gateoverflow.in/40210>



The quality of services delivered by a company consists of six factors as shown below in the radar diagram. The dots in the figure indicate the score for each factor on a scale of 0 to 10. The standardized coefficient for each factor is given in the parentheses. The contribution of each factor to the overall service quality is directly proportional to the factor score and its standardized coefficient.



The lowest contribution among all the above factors to the overall quality of services delivered by the company is

- A. 10%  
 B. 20%  
 C. 24%  
 D. 40%

gate2011-gg difficult quantitative-aptitude data-interpretation

Answer 

### 9.19.8 Data Interpretation: GATE2018 CE-1: GA-5

<https://gateoverflow.in/313271>



The temperature  $T$  in a room varies as a function of the outside temperature  $T_0$  and the number of persons in the room  $p$ , according to the relation  $T = K(\theta p + T_0)$ , where  $\theta$  and  $K$  are constants. What would be the value of  $\theta$  given the following data?

$T_0$	$p$	$T$
25	2	32.4
30	5	42.0

- A. 0.8  
 B. 1.0  
 C. 2.0  
 D. 10.0

gate2018-ce-1 general-aptitude quantitative-aptitude data-interpretation

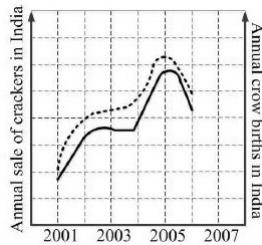
Answer ↗

### 9.19.9 Data Interpretation: GATE2018 CH: GA-10 top ↗

☞ <https://gateoverflow.in/205091>



In a detailed study of annual crow births in India, it was found that there was relatively no growth during the period 2002 to 2004 and a sudden spike from 2004 to 2005. In another unrelated study, it was found that the revenue from cracker sales in India which remained fairly flat from 2002 to 2004, saw a sudden spike in 2005 before declining again in 2006. The solid line in the graph below refers to annual sale of crackers and the dashed line refers to the annual crow births in India. Choose the most appropriate inference from the above data.



- A. There is a strong correlation between crow birth and cracker sales.  
 B. Cracker usage increases crow birth rate.  
 C. If cracker sale declines, crow birth will decline.  
 D. Increased birth rate of crows will cause an increase in the sale of crackers.

gate2018-ch general-aptitude quantitative-aptitude data-interpretation

Answer ↗

### 9.19.10 Data Interpretation: GATE2018 EC: GA-9 top ↗

☞ <https://gateoverflow.in/205213>



A cab was involved in a hit and run accident at night. You are given the following data about the cabs in the city and the accident.

- i. 85% of cabs in the city are green and the remaining cabs are blue.
- ii. A witness identified the cab involved in the accident as blue.
- iii. It is known that a witness can correctly identify the cab colour only 80% of the time.

Which of the following options is closest to the probability that the accident was caused by a blue cab?

- A. 12%  
 B. 15%  
 C. 41%  
 D. 80%

gate2018-ec general-aptitude quantitative-aptitude normal data-interpretation

Answer ↗

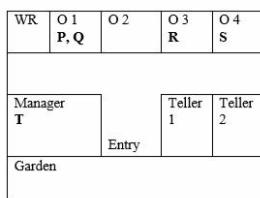
### 9.19.11 Data Interpretation: GATE2019 EC: GA-10 top ↗

☞ <https://gateoverflow.in/313539>

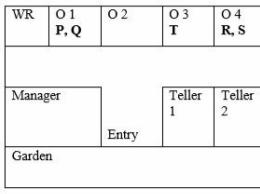


Five people  $P, Q, R, S$  and  $T$  work in a bank.  $P$  and  $Q$  don't like each other but have to share an office till  $T$  gets a promotion and moves to the big office next to the garden.  $R$ , who is currently sharing an office with  $T$  wants to move

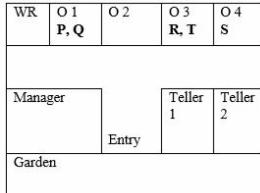
to the adjacent office with  $S$ , the handsome new intern. Given the floor plan, what is the current location of  $Q$ ,  $R$  and  $T$ ? (O=Office, WR=Washroom)



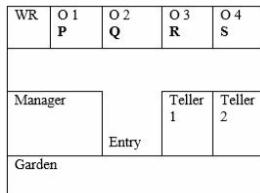
A.



B.



C.



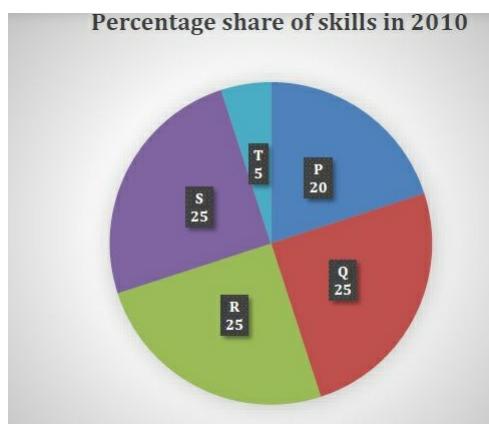
D.

[gate2019-ec](#) [general-aptitude](#) [data-interpretation](#)
Answer 

### 9.19.12 Data Interpretation: GATE2019 ME-1: GA-9 top ↗

<https://gateoverflow.in/313600>


A firm hires employees at five different skill levels P, Q, R, S, T. The shares of employment at these skill levels of total employment in 2010 is given in the pie chart as shown. There were a total of 600 employees in 2010 and the total employment increased by 15% from 2010 to 2016. The total employment at skill levels P, Q and R remained unchanged during this period. If the employment at skill level S increased by 40% from 2010 to 2016, how many employees were there at skill level T in 2016?



- A. 30
- B. 35
- C. 60
- D. 72

[gate2019-me-1](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[data-interpretation](#)
Answer


### 9.19.13 Data Interpretation: GATE2019 ME-2: GA-9 [top](#)

<https://gateoverflow.in/313581>


Mola is a digital platform for taxis in a city. It offers three types of rides – Pool, Mini and Prime. The table below presents the number of rides for the past four months. The platform earns one US dollar per ride. What is the percentage share of the revenue contributed by Prime to the total revenues of Mola, for the entire duration?

Type	Month			
	January	February	March	April
Pool	170	320	215	190
Mini	110	220	180	70
Prime	75	180	120	90

- A. 16.24
- B. 23.97
- C. 25.86
- D. 38.74

[gate2019-me-2](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[data-interpretation](#)
Answer


### Answers: Data Interpretation

#### 9.19.1 Data Interpretation: GATE CSE 2011 | Question: 62 [top](#)

<https://gateoverflow.in/2172>


✓ Answer is D.

As per the question, it is quite clear that the danger of a microbe to human being will be directly proportional to potency and growth. At the same time it is inversely proportional to toxicity, defined as( more dangerous will a microbe be if lesser of its milligram is required).

So, Level Of Danger (D)  $\propto$  Growth (G)  $\propto$  Potency (P)  $\frac{1}{\propto}$  Toxicity (T)

$$D = \frac{KGP}{T}$$

where K is constant of proportionality.

So level of danger will be maximum for S.

Given by,

$$D_S = \frac{0.8 \times \pi(10)^2}{200} \\ = 1.256$$

Similar calculations for  $D_P, D_Q, D_R$  can be done. Which will consequently lead to  $D_S$  being the most dangerous and hence will be targeted first.

35 votes

-- Gate Keeda (16k points)

#### 9.19.2 Data Interpretation: GATE CSE 2014 Set 2 | Question: GA-9 [top](#)

<https://gateoverflow.in/1951>


✓ In 2008  $\frac{M}{F}$  ratio is 2.5

Assume 250 Males, 100 Females.

In 2009  $\frac{M}{F}$  ratio is 3. Also total no of females doubled

Females =  $100 \times 2 = 200$ .

$$\text{So, } \frac{M}{F} = 3 \implies \frac{M}{200} = 3$$

$$\implies M = 200 \times 3 = 600.$$

$$\text{Increase in Male Students} = 600 - 250 = 350$$

$$\text{Increase} = \left( \frac{350}{250} \right) \times 100\% = 140\%$$

23 votes

-- Akash Kanase (3.6k points)

### 9.19.3 Data Interpretation: GATE CSE 2015 Set 3 | Question: GA-10 top ↗

<https://gateoverflow.in/8389>



- ✓ Answer is 2006

No need to do any calculations, just observe the bar chart.

Here %increase is asked, so just check for previous year & next year pair, where you can find maximum positive change.

Consider year 2006.

Red Bar is above 3 steps than 2005 AND Blue Bar is 3 steps more than 2005, total = 3 + 3 = 6, it's maximum.

25 votes

-- Rohan Mundhey (2.5k points)

### 9.19.4 Data Interpretation: GATE CSE 2016 Set 1 | Question: GA06 top ↗

<https://gateoverflow.in/39616>



- ✓ To calculate the revenue generated by each product in a year we need to first calculate total units of each category sold, and then multiply it with the cost per unit.

Revenue generated by products			
	Total units sold	Price per unit	Total revenue
Elegance	102,510	48	4,920,480
Smooth	80,059	63	5,043,717
Soft	72,186	78	5,630,508
Executive	39,284	173	6,796,132

From the table above we can see that the max revenue is generated by Executive.

Hence answer is B.

14 votes

-- ryan sequeira (3k points)

### 9.19.5 Data Interpretation: GATE CSE 2016 Set 2 | Question: GA-10 top ↗

<https://gateoverflow.in/39535>



- ✓ Answer is Option C

The equation of line, from coordinates (1, 2) to (3, 0), where  $|x - 1| = (x - 1)$

$$(y - 2) = \frac{(0 - 2)}{(3 - 1)}(x - 1)$$

$$y = 2 - (x - 1)$$

$$y = 2 - |x - 1|$$

The equation of line, from coordinates (-3, -2) to (1, 2), where  $|x - 1| = -(x - 1)$

$$(y - (-2)) = \frac{(2 - (-2))}{(1 - (-3))}(x - (-3))$$

$$y = x + 1$$

$$y = 2 - (-(x - 1))$$

$$y = 2 - |x - 1|$$

**Note :** Equation of line when two coordinates  $(x_2, y_2)$  and  $(x_1, y_1)$  are given is  $(y - y_1) = \frac{(y_2 - y_1)}{(x_2 - x_1)}(x - x_1)$

17 votes

-- Praveen Saini (41.9k points)

**9.19.6 Data Interpretation: GATE CSE 2017 Set 1 | Question: GA-10** [www.gateoverflow.in/118413](https://gateoverflow.in/118413)

- ✓ Height of each place will be ( in meters)

$$600 > P > 550, \quad 550 > Q > 525, \quad 500 > R > 450, \quad 450 > S > 425, \quad 525 > T > 500$$

Only  $R, S, T < 525$

Hence most suitable answer will be (c) R,S,T

These places will definitely be submerged if water level rises to 525m

24 votes

-- VIPIN NARAYAN (24.8k points)

**9.19.7 Data Interpretation: GATE2011 GG: GA-9** [www.gateoverflow.in/40210](https://gateoverflow.in/40210)

- ✓ Answer should be A.

As given in question

The contribution of each factor to the overall service quality is directly proportional to the factor score and its standardized coefficient.

So, contribution  $\propto$  factor score  $\times$  standardized coefficient

$$\begin{aligned} \text{1. Contribution of outcome factor} &= Q \times \text{factor score} \times \text{standardized coefficient} = Q \times 6 \times 0.8 \\ &= 4.8Q = 4.8 \text{ (Here, } Q \text{ the proportional constant assumed to be } 1\ldots) \end{aligned}$$

Similarly,

2. Contribution of tangibles  $= 5 \times 0.4 = 2$
3. Contribution of reliability  $= 6 \times 0.7 = 4.2$
4. Contribution of responsiveness  $= 6 \times 0.6 = 3.6$
5. Contribution of empathy  $= 4 \times 0.6 = 2.4$
6. Contribution of assurance  $= 6 \times 0.5 = 3$

So, we can see here lowest contribution is "2" and total contribution is " $4.8 + 2 + 4.2 + 3.6 + 2.4 + 3 = 20$ "

The lowest contribution among all the above factors to the overall quality of services delivered by the company

$$= \left( \frac{2}{20} \right) \times 100 = 10\%$$

9 votes

-- minal (13k points)

**9.19.8 Data Interpretation: GATE2018 CE-1: GA-5** [www.gateoverflow.in/313271](https://gateoverflow.in/313271)

- ✓  $T = K(\theta \cdot p + T_0)$

- $32.4 = K(2\theta + 25) \rightarrow (1)$
- $42.0 = K(5\theta + 30) \rightarrow (2)$

Divide the equation (1) by equation (2), and we get

$$\frac{32.4}{42.0} = \frac{K(2\theta + 25)}{K(5\theta + 30)}$$

$$\Rightarrow \frac{324}{420} = \frac{2\theta + 25}{5\theta + 30}$$

$$\Rightarrow \frac{27}{35} = \frac{2\theta + 25}{5\theta + 30}$$

$$\Rightarrow 27(5\theta + 30) = 35(2\theta + 25)$$

$$\Rightarrow 135\theta + 810 = 70\theta + 875$$

$$\Rightarrow 135\theta - 70\theta = 875 - 810$$

$$\Rightarrow 65\theta = 65$$

$$\Rightarrow \theta = 1$$

So, correct answer is (B).

2 votes

-- Lakshman Patel (63.9k points)

### 9.19.9 Data Interpretation: GATE2018 CH: GA-10 top ↴

<https://gateoverflow.in/205091>

- ✓ In the above graph, we can clearly see that,

During the period 2002 to 2004, there was relatively no crow birth.

Whereas, cracker sales also remain flat from 2002 to 2004.

In between 2004 to 2005, there was a sudden spike in crow birth.

& in this period, cracker sales also increase.

In 2006, crow birth decreases, cracker sale also decreases.

So, we can say that there was a strong correlation between crow birth and cracker sales

Hence, the answer is option A)

3 votes

-- Sukanya Das (9.9k points)

### 9.19.10 Data Interpretation: GATE2018 EC: GA-9 top ↴

<https://gateoverflow.in/205213>

- ✓ Probability that the cab is a green cab = 0.85

Probability that the cab is a blue cab = 0.15

The witness can correctly identify the cab colour only 80% of the time

So, probability when the witness is correct means when the witness identifies blue cab = 0.8

& Probability when witness is wrong = 0.2

We know,  $P(E) = \frac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes}}$

The probability that the accident was caused by a blue cab =  $\frac{0.15 * 0.8}{(0.15 * 0.8) + (0.85 * 0.2)}$

$$= \frac{1.2}{2.9} \\ = 0.41 \\ = 41\%$$

**Option (C)**

8 votes

-- Sukanya Das (9.9k points)

### 9.19.11 Data Interpretation: GATE2019 EC: GA-10 top ↴

<https://gateoverflow.in/313539>

- ✓ "R, who is currently sharing an office with T"

This is happening only in option C.

Correct option C.

1 votes

-- Arjun Suresh (328k points)

**9.19.12 Data Interpretation: GATE2019 ME-1: GA-9** top ↗<https://gateoverflow.in/313600>

- ✓ Number of employees in 2010 = 600.

Number of employees in 2016 =  $1.15 \times 600 = 690$ .

So, increase in 90 employments is by  $S$  and  $T$  as other 3 remained constant.

Original  $S$  value =  $0.25 \times 600 = 150$ .

New  $S$  value =  $1.4 \times 150 = 210$ .

So, increase in  $S$  is 60 and so increase in  $T = 90 - 60 = 30$ .

Original  $T$  value =  $0.05 \times 600 = 30$ .

So, new  $T$  value =  $30 + 30 = 60$ .

Correct Option: C.

5 votes

-- Arjun Suresh (328k points)

**9.19.13 Data Interpretation: GATE2019 ME-2: GA-9** top ↗<https://gateoverflow.in/313581>

- ✓ Percentage share of the revenue contributed by Prime to the total revenues of Mola for the entire duration of 4 months

$$\begin{aligned} &= \left( \frac{1 \times \text{Rides given by Prime in 4 months duration}}{1 \times \text{Total number of rides in the 4 month duration}} \right) \times 100\% \\ &= \left( \frac{75+180+120+90}{170+320+215+190+110+220+180+70+75+180+120+90} \right) \times 100\% \\ &= \left( \frac{465}{1940} \right) \times 100\% \\ &= 23.97\% \end{aligned}$$

∴ Option B 23.97

1 votes

-- Satbir Singh (20.9k points)

**9.20****Factors (5)** top ↗**9.20.1 Factors: GATE CSE 2013 | Question: 62** top ↗<https://gateoverflow.in/1566>

Out of all the 2-digit integers between 1 and 100, a 2-digit number has to be selected at random. What is the probability that the selected number is not divisible by 7?

- A.  $\left( \frac{13}{90} \right)$
- B.  $\left( \frac{12}{90} \right)$
- C.  $\left( \frac{78}{90} \right)$
- D.  $\left( \frac{77}{90} \right)$

[gate2013-cse](#) [quantitative-aptitude](#) [easy](#) [probability](#) [factors](#)

Answer

**9.20.2 Factors: GATE CSE 2014 Set 2 | Question: GA-4** top ↗<https://gateoverflow.in/1941>

What is the average of all multiples of 10 from 2 to 198?

- A. 90
- B. 100

- C. 110  
D. 120

gate2014-cse-set2 quantitative-aptitude easy numerical-computation factors

Answer 

### 9.20.3 Factors: GATE CSE 2018 | Question: GA-4

<https://gateoverflow.in/204065>



What would be the smallest natural number which when divided either by 20 or by 42 or by 76 leaves a remainder of 7 in each case?

- A. 3047  
B. 6047  
C. 7987  
D. 63847

gate2018-cse quantitative-aptitude factors

Answer 

### 9.20.4 Factors: GATE2010 MN: GA-8

<https://gateoverflow.in/312017>



Consider the set of integers  $\{1, 2, 3, \dots, 5000\}$ . The number of integers that is divisible by neither 3 nor 4 is :

- A. 1668  
B. 2084  
C. 2500  
D. 2916

general-aptitude quantitative-aptitude gate2010-mn factors

Answer 

### 9.20.5 Factors: GATE2018 EC: GA-3

<https://gateoverflow.in/205207>



If the number 715 ■ 423 is divisible by 3 (■ denotes the missing digit in the thousandths place), then the smallest whole number in the place of ■ is \_\_\_\_\_.

- A. 0  
B. 2  
C. 5  
D. 6

gate2018-ec general-aptitude quantitative-aptitude easy factors

Answer 

## Answers: Factors

### 9.20.1 Factors: GATE CSE 2013 | Question: 62

<https://gateoverflow.in/1566>



- ✓ The number of 2 digit multiples of 7 = 13

$$\text{not divisible by } 7 = \frac{(90 - 13)}{90} = \frac{77}{90} \text{ Answer}(D)$$

20 votes

-- Bhagirathi Nayak (11.7k points)

### 9.20.2 Factors: GATE CSE 2014 Set 2 | Question: GA-4

<https://gateoverflow.in/1941>



- ✓  $a = 10, l = 190$

$$s = \frac{n(a+l)}{2} = \frac{19 \times (200)}{2} = 1900$$

$$\text{Average} = \frac{1900}{19} = 100$$

**Ans. is 100**

Correct Answer: *B*

18 votes

-- aditi (265 points)

### 9.20.3 Factors: GATE CSE 2018 | Question: GA-4 top ↵

→ <https://gateoverflow.in/204065>



- ✓ Let  $n$  be the smallest number which is divisible by  $x, y$  and  $z$  and leaves remainder  $r$  in each case.

$$\text{So, } n = LCM(x, y, z) + r$$

According to Question

$$x = 20, y = 42, z = 76 \text{ and } r = 7$$

$$\text{Smallest number, } n = LCM(20, 42, 76) + 7$$

$$\implies n = 7980 + 7 = 7987$$

So, option (C) is the right choice

15 votes

-- Lakshman Patel (63.9k points)

### 9.20.4 Factors: GATE2010 MN: GA-8 top ↵

→ <https://gateoverflow.in/312017>



- ✓  $S = \{1, 2, 3, \dots, 4999, 5000\}$

Let 'A' be the set of integers divisible by 3  $\implies A = \{3, 6, 9, 12, 15, \dots, 4998\}$

Let 'B' be the set of integers divisible by 4  $\implies B = \{4, 8, 12, 16, \dots, 5000\}$

Let 'C' be the set of integers divisible by both 3 and 4  $\implies C = \{12, 24, 36, \dots, 4992\}$

$$|A| = 3 + (n - 1)3 = 4998 \implies n = 4998/3 = 1666$$

$$|B| = 4 + (n - 1)4 = 5000 \implies n = 5000/4 = 1250$$

$$|C| = 12 + (n - 1)12 = 4992 \implies n = 4992/12 = 416$$

$$\text{Divisible by 3 or 4 : } \{3, 4, 6, 8, \dots, 5000\} : |D| = |A| + |B| - |C|$$

$$= 1666 + 1250 - 416$$

$$= 2500$$

Number of integers that is divisible by neither 3 nor 4

$$= |S| - |D|$$

$$= 5000 - 2500$$

$$= 2500$$

So, C is the correct answer.

5 votes

-- Abhishek Tiwari (3.4k points)

### 9.20.5 Factors: GATE2018 EC: GA-3 top ↵

→ <https://gateoverflow.in/205207>



- ✓ **Divisibility rule of 3:**

A number is divisible by 3 if sum of its digits is divisible by 3.

Let the digit in thousands place be  $x$ .

$$7 + 1 + 5 + x + 4 + 2 + 3 = 22 + x$$

Smallest possible value of  $x$  so that the sum is divisible by 3 is 2 ( $24 \bmod 3 = 0$ )

**Hence option (B) is correct answer**

7 votes

-- Ashwani Kumar (12.8k points)

## 9.21

### Fractions (2) top ↵

**9.21.1 Fractions: GATE CSE 2018 | Question: GA-6**<https://gateoverflow.in/204067>

In appreciation of the social improvements completed in a town, a wealthy philanthropist decided to gift *Rs* 750 to each male senior citizen in the town and *Rs* 1000 to each female senior citizen. Altogether, there were 300 senior citizens eligible for this gift. However, only  $\frac{8}{9}$  of the eligible men and  $\frac{2}{3}$  of the eligible women claimed the gift. How much money (in Rupees) did the philanthropist give away in total?

- A. 1,50,000
- B. 2,00,000
- C. 1,75,000
- D. 1,51,000

[gate2018-cse](#) [quantitative-aptitude](#) [fractions](#) [normal](#)

Answer

**9.21.2 Fractions: GATE2016 EC-1: GA-9**<https://gateoverflow.in/108093>

If  $q^{-a} = \frac{1}{r}$  and  $r^{-b} = \frac{1}{s}$  and  $s^{-c} = \frac{1}{q}$ , the value of  $abc$  is \_\_\_\_\_.

- A.  $(rqs)^{-1}$
- B. 0
- C. 1
- D.  $r + q + s$

[gate2016-ec-1](#) [quantitative-aptitude](#) [fractions](#)

Answer

**Answers: Fractions****9.21.1 Fractions: GATE CSE 2018 | Question: GA-6**<https://gateoverflow.in/204067>

- ✓ Let no. of senior male be  $x$   
Let no. of senior female be  $y$   
 $x + y = 300$

$$\text{Total money given} = \left( \frac{8x}{9} \times 750 = \frac{2000x}{3} \right) + \left( \frac{2y}{3} \times 1000 = \frac{2000y}{3} \right)$$

$$\begin{aligned} &= \frac{2000}{3} \times (x + y) \\ &= \frac{2000}{3} \times 300 \\ &= 200000. \end{aligned}$$

So,  $B$  is correct.

PS: Some people are assuming the number of senior male and female is same, which is wrong. Do not assume anything not mentioned.

37 votes

-- Subham Mishra (11.3k points)

**9.21.2 Fractions: GATE2016 EC-1: GA-9**<https://gateoverflow.in/108093>

- ✓ Multiply all terms, we will get more faster than above method.

$$q^{-a} \times r^{-b} \times s^{-c} = \frac{1}{r} \times \frac{1}{s} \times \frac{1}{q}$$

$$q^{-a} \times r^{-b} \times s^{-c} = q^{-1} \times r^{-1} \times s^{-1}$$

Compare the terms

$$a = 1, b = 1, c = 1$$

So,  $abc = 1$

---

Suppose they ask  $a + b + c = ?$

We can simply put the values of  $a, b$  and  $c$  and get the answer

$$a + b + c = 1 + 1 + 1 = 3$$

Correct Answer: C

6 votes

-- Rahul Lalitkumar Jain (7.4k points)

## 9.22

### Functions (12) top ↗

#### 9.22.1 Functions: GATE CSE 2015 Set 2 | Question: GA-9 top ↗

<https://gateoverflow.in/8040>



If  $p, q, r, s$  are distinct integers such that:

$$f(p, q, r, s) = \max(p, q, r, s)$$

$$g(p, q, r, s) = \min(p, q, r, s)$$

$$h(p, q, r, s) = \text{remainder of } \frac{(p \times q)}{(r \times s)} \text{ if } (p \times q) > (r \times s) \\ \text{or remainder of } \frac{(r \times s)}{(p \times q)} \text{ if } (r \times s) > (p \times q)$$

Also a function  $fgh(p, q, r, s) = f(p, q, r, s) \times g(p, q, r, s) \times h(p, q, r, s)$

Also the same operations are valid with two variable functions of the form  $f(p, q)$

What is the value of  $fg(h(2, 5, 7, 3), 4, 6, 8)$ ?

[gate2015-cse-set2](#) [functions](#) [normal](#) [numerical-answers](#)

Answer

#### 9.22.2 Functions: GATE CSE 2015 Set 3 | Question: GA-5 top ↗

<https://gateoverflow.in/8303>



A function  $f(x)$  is linear and has a value of 29 at  $x = -2$  and 39 at  $x = 3$ . Find its value at  $x = 5$ .

- A. 59
- B. 45
- C. 43
- D. 35

[gate2015-cse-set3](#) [quantitative-aptitude](#) [normal](#) [functions](#)

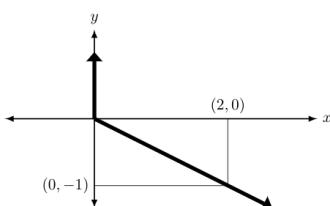
Answer

#### 9.22.3 Functions: GATE CSE 2015 Set 3 | Question: GA-8 top ↗

<https://gateoverflow.in/8385>



Choose the most appropriate equation for the function drawn as thick line, in the plot below.



- A.  $x = y - |y|$
- B.  $x = -(y - |y|)$
- C.  $x = y + |y|$
- D.  $x = -(y + |y|)$

gate2015-cse-set3 quantitative-aptitude normal functions

Answer 

#### 9.22.4 Functions: GATE Civil 2020 Set 2 | GA Question: 5 top ↗

► <https://gateoverflow.in/359838>



If  $f(x) = x^2$  for each  $x \in (-\infty, \infty)$ , then  $\frac{f(f(f(x)))}{f(x)}$  is equal to \_\_\_\_\_.

- A.  $f(x)$
- B.  $(f(x))^2$
- C.  $(f(x))^3$
- D.  $(f(x))^4$

gate2020-ce-2 quantitative-aptitude functions

Answer 

#### 9.22.5 Functions: GATE Civil 2021 Set 1 | GA Question: 9 top ↗

► <https://gateoverflow.in/359873>



A function,  $\lambda$ , is defined by

$$\lambda(p, q) = \begin{cases} (p - q)^2, & \text{if } p \geq q, \\ p + q, & \text{if } p < q. \end{cases}$$

The value of the expression  $\frac{\lambda(-(-3+2), (-2+3))}{(-(-2+1))}$  is:

- A.  $-1$
- B.  $0$
- C.  $\frac{16}{3}$
- D.  $16$

gatcivil-2021-set1 quantitative-aptitude functions

Answer 

#### 9.22.6 Functions: GATE ECE 2020 | GA Question: 5 top ↗

► <https://gateoverflow.in/359771>



A superadditive function  $f(\cdot)$  satisfies the following property

$$f(x_1 + x_2) \geq f(x_1) + f(x_2)$$

Which of the following functions is a superadditive function for  $x > 1$ ?

- A.  $e^x$
- B.  $\sqrt{x}$
- C.  $1/x$
- D.  $e^{-x}$

gate2020-ec quantitative-aptitude functions

Answer 

#### 9.22.7 Functions: GATE Mechanical 2020 Set 1 | GA Question: 5 top ↗

► <https://gateoverflow.in/359528>



Define  $[x]$  as the greatest integer less than or equal to  $x$ , for each  $x \in (-\infty, \infty)$ . If  $y = [x]$ , then area under  $y$  for  $x \in [1, 4]$  is \_\_\_\_\_.

- A. 1
- B. 3
- C. 4
- D. 6

gateme-2020-set1 quantitative-aptitude functions

Answer 

**9.22.8 Functions: GATE2010 MN: GA-10** top ↗<https://gateoverflow.in/312019>

Given the following four functions  $f_1(n) = n^{100}$ ,  $f_2(n) = (1.2)^n$ ,  $f_3(n) = 2^{n/2}$ ,  $f_4(n) = 3^{n/3}$  which function will have the largest value for sufficiently large values of  $n$  (*i.e.*  $n \rightarrow \infty$ )?

- A.  $f_4$
- B.  $f_3$
- C.  $f_2$
- D.  $f_1$

[general-aptitude](#) [quantitative-aptitude](#) [gate2010-mn](#) [functions](#)

Answer

**9.22.9 Functions: GATE2012 AR: GA-7** top ↗<https://gateoverflow.in/40228>

Let  $f(x) = x - [x]$ , where  $x \geq 0$  and  $[x]$  is the greatest integer not larger than  $x$ . Then  $f(x)$  is a

- A. monotonically increasing function
- B. monotonically decreasing function
- C. linearly increasing function between two integers
- D. linearly decreasing function between two integers

[gate2012-ar](#) [quantitative-aptitude](#) [functions](#) [normal](#)

Answer

**9.22.10 Functions: GATE2015 EC-3: GA-5** top ↗<https://gateoverflow.in/39518>

If  $x > y > 1$ , which of the following must be true?

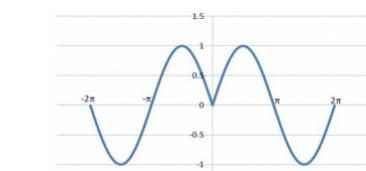
- i.  $\ln x > \ln y$
  - ii.  $e^x > e^y$
  - iii.  $y^x > x^y$
  - iv.  $\cos x > \cos y$
- A. (i) and (ii)
  - B. (i) and (iii)
  - C. (iii) and (iv)
  - D. (ii) and (iv)

[gate2015-ec-3](#) [general-aptitude](#) [quantitative-aptitude](#) [functions](#)

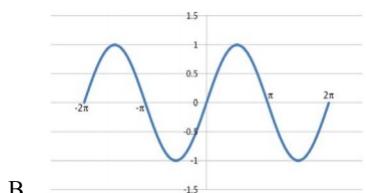
Answer

**9.22.11 Functions: GATE2016 ME-2: GA-10** top ↗<https://gateoverflow.in/108309>

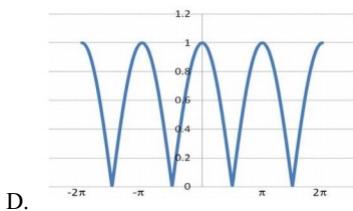
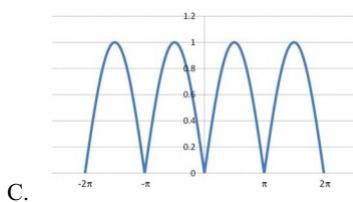
Which of the following curves represents the function  $y = \ln(|e^{[\sin(|x|)]}|)$  for  $|x| < 2\pi$ ? Here,  $x$  represents the abscissa and  $y$  represents the ordinate.



A.



B.



gate2016-me-2 functions quantitative-aptitude

Answer ↗

### 9.22.12 Functions: GATE2018 EE: GA-5 top ↗

→ <https://gateoverflow.in/205182>



Functions  $F(a, b)$  and  $G(a, b)$  are defined as follows:

$F(a, b) = (a - b)^2$  and  $G(a, b) = |a - b|$ , where  $|x|$  represents the absolute value of  $x$ .

What would be the value of  $G(F(1, 3), G(1, 3))$ ?

- A. 2
- B. 4
- C. 6
- D. 36

gate2018-ee general-aptitude quantitative-aptitude easy functions

Answer ↗

### Answers: Functions

### 9.22.1 Functions: GATE CSE 2015 Set 2 | Question: GA-9 top ↗

→ <https://gateoverflow.in/8040>



- ✓ It is given that  $h(p, q, r, s) = \text{remainder of } \frac{(p \times q)}{(r \times s)}$  if  $(p \times q) > (r \times s)$  or remainder of  $\frac{(r \times s)}{(p \times q)}$  if  $(r \times s) > (p \times q)$ .

$$h(2, 5, 7, 3) = \text{remainder of } \frac{(7 \times 3)}{(2 \times 5)}, \because (7 \times 3) > (2 \times 5)$$

Thus,  $h(2, 5, 7, 3) = 1$

Again, it is given that  $fg(p, q, r, s) = f(p, q, r, s) \times g(p, q, r, s)$

Also,  $f(p, q, r, s) = \max(p, q, r, s)$ , and  $g(p, q, r, s) = \min(p, q, r, s)$

So we have:

$$fg(1, 4, 6, 8) = 8 \times 1, \because \max(1, 4, 6, 8) = 8 \& \min(1, 4, 6, 8) = 1$$

Thus,  $fg(1, 4, 6, 8) = 8$

**Answer: 8**

33 votes

-- Shyam Singh (1.3k points)

### 9.22.2 Functions: GATE CSE 2015 Set 3 | Question: GA-5 top ↗

→ <https://gateoverflow.in/8303>



- ✓  $f(x)$  is linear means it is of the form  $ax + b$

given  $f(-2)$  and  $f(3)$

solve the equation and find out value for  $a$  and  $b$  then find  $f(5)$ . it will be 43

Correct Answer: C

1 votes

-- Sankaranarayanan P.N (8.6k points)

### 9.22.3 Functions: GATE CSE 2015 Set 3 | Question: GA-8 top

<https://gateoverflow.in/8385>



- ✓ When  $y$  is  $-1$ ,  $x$  is  $2$ .

When  $y$  is positive  $x$  is  $0$ .

$$\text{So, } x = -(y - |y|)$$

Correct Answer: B

1 votes

-- Arjun Suresh (328k points)

### 9.22.4 Functions: GATE Civil 2020 Set 2 | GA Question: 5 top

<https://gateoverflow.in/359838>



- ✓ Given that,  $f(x) = x^2$ .

$$\text{Now, } f(f(f(x))) = f(f(x^2)) = f(x^4) = x^8$$

$$\therefore \frac{f(f(f(x)))}{f(x)} = \frac{x^8}{x^2} = x^6 = (x^2)^3 = (f(x))^3.$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

### 9.22.5 Functions: GATE Civil 2021 Set 1 | GA Question: 9 top

<https://gateoverflow.in/359873>



- ✓ The value of the expression  $\frac{\lambda(-(-3+2), (-2+3))}{(-(-2+1))} = \frac{\lambda(-(-1), 1)}{-(-1)} = \frac{\lambda(1, 1)}{1} = \frac{(1-1)^2}{1} = \frac{0}{1} = 0$ .

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

### 9.22.6 Functions: GATE ECE 2020 | GA Question: 5 top

<https://gateoverflow.in/359771>



- ✓ Given that, a superadditive function  $f(\cdot)$ :

$$f(x_1 + x_2) \geq f(x_1) + f(x_2)$$

Since  $x > 1$ , a superadditive function can never be a decreasing function. So, options C and D can straight away be ruled out.

We can check options A and B by taking the value of  $x_1 = 2$  and  $x_2 = 3$ .

$$\begin{aligned} \text{B. } f(x) &= \sqrt{x} \\ f(2+3) &\geq f(2) + f(3) \\ \implies f(5) &\geq f(2) + f(3) \\ \implies \sqrt{5} &\geq \sqrt{2} + \sqrt{3} \\ \implies 2.236 &\geq 1.414 + 1.732 \\ \implies 2.236 &\geq 3.146 \text{ (False)} \end{aligned}$$

So, correct answer should be (A).

Reference: <https://en.wikipedia.org/wiki/Superadditivity>

#### References



1 votes

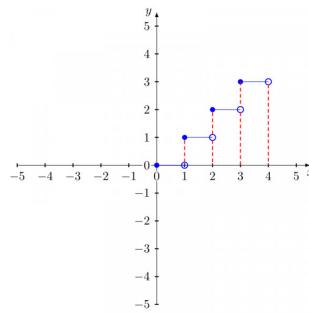
-- Lakshman Patel (63.9k points)

### 9.22.7 Functions: GATE Mechanical 2020 Set 1 | GA Question: 5 top ↗

☞ <https://gateoverflow.in/359528>



- ✓ The graph of  $y = [x]$  for  $x \in [1, 4]$ .



The required area =  $(1 \times 1) + (1 \times 2) + (1 \times 3) = 1 + 2 + 3 = 6$  unit<sup>2</sup>. [∴ Area of rectangle = Base × Height ]

So, the correct answer is (D).

↳ 2 votes

-- Lakshman Patel (63.9k points)

### 9.22.8 Functions: GATE2010 MN: GA-10 top ↗

☞ <https://gateoverflow.in/312019>



- $f_1(n) = n^{100}$
- $f_2(n) = (1.2)^n$
- $f_3(n) = (2)^{n/2} = (1.414)^n$
- $f_4(n) = (3)^{n/3} = (1.442)^n$

We know that  $(1.442)^n > (1.414)^n$  and  $(1.442)^n > (1.2)^n$

$\Rightarrow f_4(n)$  is greater than both  $f_2(n)$  and  $f_3(n)$

Now we have to check between  $f_4(n)$  and  $f_1(n)$

But  $f_1(n)$  is a polynomial function and  $f_4(n)$  is an exponential function. Any exponential function will have larger value than any polynomial function for sufficiently large value of input. So,  $f_4(n)$  has the largest value here.

Option A.  $f_4(n)$  is the correct answer.

↳ 5 votes

-- Satbir Singh (20.9k points)

### 9.22.9 Functions: GATE2012 AR: GA-7 top ↗

☞ <https://gateoverflow.in/40228>



- ✓  $f(x) = x - [x]$

$f(x)$  gives nothing but the fractional part of  $x$ .

Now, as we move up the number line between two consecutive integers say  $a$  and  $a + 1$ .

The value of  $f(a)$  starts from 0 and grows linearly till the consecutive integer and just before  $x = a + 1$  (left neighbourhood of  $a + 1$ ) it tends to the value 1.

Between  $a$  and  $a + 1$ , the graph grows linearly from 0 to 1.

But, when at  $x = a + 1$ , the value comes back to 0 and same linear graph continues between the next two consecutive integers and so on.

So, Answer C) linearly increasing function between two integers.

↳ 15 votes

-- Abhilash Panicker (7.6k points)

### 9.22.10 Functions: GATE2015 EC-3: GA-5 top ↗

☞ <https://gateoverflow.in/359518>



- ✓ Both  $\ln$  and  $e^x$  are monotonically (continuously) increasing functions. So, (i) and (ii) are TRUE.

If we take  $x = 3, y = 2; y^x = 8, x^y = 9$ . So, (iii) is false

$\cos x$  is not a monotonically increasing function. So, (iv) is false.

Correct Option: A

↳ 0 votes

-- Arjun Suresh (328k points)

**9.22.11 Functions: GATE2016 ME-2: GA-10** top ↴[www.gateoverflow.in/108309](https://gateoverflow.in/108309)

✓  $f(x) = \ln(|e^{[\sin(|x|)]}|)$

1.  $|x| \rightarrow f(x)$  is Even  $\rightarrow$  option b not possible

2.  $m = |\sin(|x|)| \geq 0 \rightarrow e^m \geq 1$

3.  $\Rightarrow f(x) = \ln(|e^m|) = \ln(e^m) \geq 0$  {from 2}  $\rightarrow$  option a not possible

4. and  $f(x)_{x=0} = 0 \rightarrow$  option d not possible

$\Rightarrow$  answer C

8 votes

-- Debashish Deka (40.7k points)

**9.22.12 Functions: GATE2018 EE: GA-5** top ↴[www.gateoverflow.in/205182](https://gateoverflow.in/205182)

✓  $F(1, 3) = (1 - 3)^2 = 4$

$G(1, 3) = |1 - 3| = 2$

$G(F(1, 3), G(1, 3)) = G(4, 2) = |4 - 2| = 2$

3 votes

-- NITISH JOSHI (24.4k points)

**9.23****Geometry (20)** top ↴**9.23.1 Geometry: GATE CSE 2014 Set 1 | Question: GA-10** top ↴[www.gateoverflow.in/778](https://gateoverflow.in/778)

When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines?

gate2014-cse-set1 quantitative-aptitude geometry combinatorics normal numerical-answers

Answer

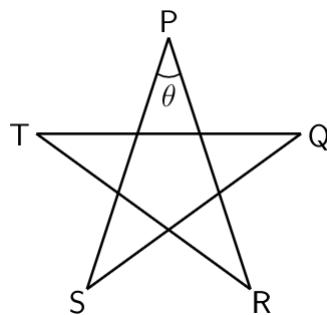
**9.23.2 Geometry: GATE CSE 2016 Set 1 | Question: GA05** top ↴[www.gateoverflow.in/39610](https://gateoverflow.in/39610)

A cube is built using 64 cubic blocks of side one unit. After it is built, one cubic block is removed from every corner of the cube. The resulting surface area of the body (in square units) after the removal is \_\_\_\_\_.

- a. 56
- b. 64
- c. 72
- d. 96

gate2016-cse-set1 quantitative-aptitude geometry normal

Answer

**9.23.3 Geometry: GATE Civil 2021 Set 1 | GA Question: 8** top ↴[www.gateoverflow.in/359875](https://gateoverflow.in/359875)

Five line segments of equal lengths, PR, PS, QS, QT and RT are used to form a star as shown in the figure above.

The value of  $\theta$ , in degrees, is \_\_\_\_\_

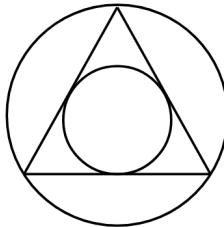
- A. 36
- B. 45
- C. 72
- D. 108

gatecivil-2021-set1 quantitative-aptitude geometry

Answer 

#### 9.23.4 Geometry: GATE Mechanical 2021 Set 2 | GA Question: 8 top ↗

<https://gateoverflow.in/359494>



The ratio of the area of the inscribed circle to the area of the circumscribed circle of an equilateral triangle is \_\_\_\_\_

- A.  $\frac{1}{8}$
- B.  $\frac{1}{6}$
- C.  $\frac{1}{4}$
- D.  $\frac{1}{2}$

gateme-2021-set2 quantitative-aptitude geometry

Answer 

#### 9.23.5 Geometry: GATE2015 EC-3: GA-8 top ↗

<https://gateoverflow.in/39521>



From a circular sheet of paper of radius 30 cm, a sector of 10% area is removed. If the remaining part is used to make a conical surface, then the ratio of the radius and height of the cone is \_\_\_\_\_

gate2015-ec-3 geometry quantitative-aptitude normal

Answer 

#### 9.23.6 Geometry: GATE2016 CE-2: GA-9 top ↗

<https://gateoverflow.in/110921>



A square pyramid has a base perimeter  $x$ , and the slant height is half of the perimeter. What is the lateral surface area of the pyramid

- A.  $x^2$
- B.  $0.75x^2$
- C.  $0.50x^2$
- D.  $0.25x^2$

gate2016-ce-2 geometry quantitative-aptitude

Answer 

#### 9.23.7 Geometry: GATE2016 EC-2: GA-10 top ↗

<https://gateoverflow.in/108729>



A wire of length 340 mm is to be cut into two parts. One of the parts is to be made into a square and the other into a rectangle where sides are in the ratio of 1 : 2. What is the length of the side of the square (in mm) such that the combined area of the square and the rectangle is a MINIMUM?

- A. 30
- B. 40
- C. 120

D. 180

gate2016-ec-2 geometry quantitative-aptitude

Answer 

### 9.23.8 Geometry: GATE2016 ME-2: GA-5

<https://gateoverflow.in/108289>



A window is made up of a square portion and an equilateral triangle portion above it. The base of the triangular portion coincides with the upper side of the square. If the perimeter of the window is 6 m, the area of the window in  $m^2$  is \_\_\_\_\_.

- A. 1.43
- B. 2.06
- C. 2.68
- D. 2.88

gate2016-me-2 quantitative-aptitude geometry

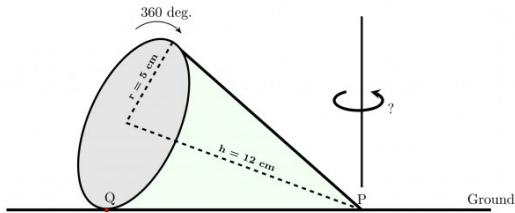
Answer 

### 9.23.9 Geometry: GATE2017 ME-1: GA-3

<https://gateoverflow.in/313658>



A right-angled cone (with base radius 5 cm and height 12 cm), as shown in the figure below, is rolled on the ground keeping the point  $P$  fixed until the point  $Q$  (at the base of the cone, as shown) touches the ground again.



By what angle (in radians) about  $P$  does the cone travel?

- A.  $\frac{5\pi}{12}$
- B.  $\frac{5\pi}{24}$
- C.  $\frac{24\pi}{5}$
- D.  $\frac{10\pi}{13}$

gate2017-me-1 general-aptitude quantitative-aptitude geometry

Answer 

### 9.23.10 Geometry: GATE2017 ME-1: GA-8

<https://gateoverflow.in/313661>



Let  $S_1$  be the plane figure consisting of the points  $(x, y)$  given by the inequalities  $|x - 1| \leq 2$  and  $|y + 2| \leq 3$ . Let  $S_2$  be the plane figure given by the inequalities  $x - y \geq -2$ ,  $y \geq 1$ , and  $x \leq 3$ . Let  $S$  be the union of  $S_1$  and  $S_2$ . The area of  $S$  is.

- A. 26
- B. 28
- C. 32
- D. 34

gate2017-me-1 general-aptitude quantitative-aptitude geometry

Answer 

### 9.23.11 Geometry: GATE2018 CE-1: GA-4

<https://gateoverflow.in/313259>



Tower  $A$  is 90 m tall and tower  $B$  is 140 m tall. They are 100 m apart. A horizontal skywalk connects the floors at 70 m in both the towers. If a taut rope connects the top of tower  $A$  to the bottom tower  $B$ , at what distance (in meters) from tower  $A$  will the rope intersect the skywalk?

gate2018-ce-1 general-aptitude quantitative-aptitude geometry numerical-answers

**Answer****9.23.12 Geometry: GATE2018 CH: GA-5** top ↗<https://gateoverflow.in/205084>

Arrange the following three-dimensional objects in the descending order of their volumes:

- A cuboid with dimensions 10 cm, 8 cm and 6 cm
  - A cube of side 8 cm
  - A cylinder with base radius 7 cm and height 7 cm
  - A sphere of radius 7 cm
- A. i), ii), iii), iv)  
 B. ii), i), iv), iii)  
 C. iii), ii), i), iv)  
 D. iv), iii), ii), i)

[gate2018-ch](#) [quantitative-aptitude](#) [normal](#) [geometry](#)
**Answer****9.23.13 Geometry: GATE2018 CH: GA-7** top ↗<https://gateoverflow.in/205092>

A set of 4 parallel lines intersect with another set of 5 parallel lines. How many parallelograms are formed?

- A. 20  
 B. 48  
 C. 60  
 D. 72

[gate2018-ch](#) [general-aptitude](#) [quantitative-aptitude](#) [easy](#) [geometry](#)
**Answer****9.23.14 Geometry: GATE2018 EC: GA-5** top ↗<https://gateoverflow.in/205209>

A  $1.5m$  tall person is standing at a distance of  $3m$  from a lamp post. The light from the lamp at the top of the post casts her shadow. The length of the shadow is twice her height. What is the height of the lamp post in meters?

- A. 1.5  
 B. 3  
 C. 4.5  
 D. 6

[gate2018-ec](#) [general-aptitude](#) [quantitative-aptitude](#) [normal](#) [geometry](#)
**Answer****9.23.15 Geometry: GATE2018 ME-1: GA-4** top ↗<https://gateoverflow.in/313645>

A rectangle becomes a square when its length and breadth are reduced by  $10\text{ m}$  and  $5\text{ m}$ , respectively. During this process, the rectangle loses  $650\text{ m}^2$  of area. What is the area of the original rectangle in square meters?

- A. 1125  
 B. 2250  
 C. 2924  
 D. 4500

[gate2018-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [geometry](#)
**Answer****9.23.16 Geometry: GATE2018 ME-2: GA-4** top ↗<https://gateoverflow.in/313636>

The perimeters of a circle, a square and an equilateral triangle are equal. Which one of the following statements is true?

- A. The circle has the largest area

- B. The square has the largest area
- C. The equilateral triangle has the largest area
- D. All the three shapes have the same area

gate2018-me-2 general-aptitude quantitative-aptitude geometry easy

Answer 

### 9.23.17 Geometry: GATE2018 ME-2: GA-7 top ↗

<https://gateoverflow.in/313613>



A wire would enclose an area of  $1936\ m^2$ , if it is bent to a square. The wire is cut into two pieces. The longer piece is thrice as long as the shorter piece. The long and the short pieces are bent into a square and a circle, respectively. Which of the following choices is closest to the sum of the areas enclosed by the two pieces in square meters?

- A. 1096
- B. 1111
- C. 1243
- D. 2486

gate2018-me-2 general-aptitude quantitative-aptitude geometry

Answer 

### 9.23.18 Geometry: GATE2019 CE-1: GA-3 top ↗

<https://gateoverflow.in/313438>



On a horizontal ground, the base of a straight ladder is 6 m away from the base of a vertical pole. The ladder makes an angle of  $45^\circ$  to the horizontal. If the ladder is resting at a point located at one-fifth of the height of the pole from the bottom, the height of the pole is \_\_\_\_\_ meters.

- A. 15
- B. 25
- C. 30
- D. 35

gate2019-ce-1 general-aptitude quantitative-aptitude geometry

Answer 

### 9.23.19 Geometry: GATE2019 CE-2: GA-3 top ↗

<https://gateoverflow.in/313370>



Suresh wanted to lay a new carpet in his new mansion with an area of  $70 \times 55$  sq.mts. However an area of 550 sq.mts. had to be left out for flower pots. If the cost carpet is Rs.50 per sq. mts. how much money (in Rs.) will be spent by Suresh for the carpet now?

- A. Rs.1,65,000
- B. Rs.1,92,500
- C. Rs.2,75,000
- D. Rs.1,27,500

gate2019-ce-2 general-aptitude quantitative-aptitude geometry

Answer 

### 9.23.20 Geometry: GATE2019 CE-2: GA-4 top ↗

<https://gateoverflow.in/313371>



A retaining wall with measurements  $30\ m \times 12\ m \times 6\ m$  was constructed with bricks of dimensions  $8\ cm \times 6\ cm \times 6\ cm$ . If 60% of the wall consists of bricks, the number of bricks used for the construction is \_\_\_\_\_ lakhs.

- A. 30
- B. 40
- C. 45
- D. 75

gate2019-ce-2 general-aptitude quantitative-aptitude geometry

Answer 

## Answers: Geometry

### 9.23.1 Geometry: GATE CSE 2014 Set 1 | Question: GA-10 [top](#)

<https://gateoverflow.in/778>



- ✓ It is 6.

Tetrahedron has 4 corner points. So, it forms 4 planes. Now, we add an internal point making a total of 5 points. Any three combination of points leads to a plane and thus we can get  ${}^5C_3 = 10$  planes. So, newly created planes =  $10 - 4 = 6$ .

163 votes

-- Palash Nandi (1.2k points)

### 9.23.2 Geometry: GATE CSE 2016 Set 1 | Question: GA05 [top](#)

<https://gateoverflow.in/39610>



- ✓ Cube is built using 64 cubic blocks of side one unit. It means it is a  $4 \times 4 \times 4$  Cube.

Surface area of each face =  $4 \times 4$  sq. units

And number of faces in a cube = 6, Thus total surface area =  $6 \times 4 \times 4 = 96$  sq. units.

A cube contains 8 corner pieces (containing 3 visible sides), and if these are removed then inner ones are visible, So, When a corner piece is removed 3 new faces of 1 sq. unit are visible and thus removal doesn't change surface area.

Hence, Option (D) is correct.

151 votes

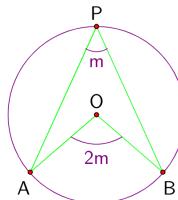
-- The\_cake (177 points)

### 9.23.3 Geometry: GATE Civil 2021 Set 1 | GA Question: 8 [top](#)

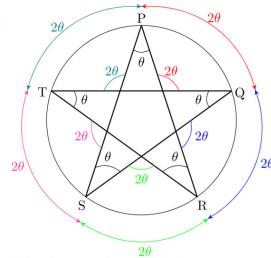
<https://gateoverflow.in/359875>



- ✓ **Central Angle Theorem:** The Central Angle Theorem states that the central angle from two chosen points  $A$  and  $B$  on the circle is always twice the inscribed angle from those two points. The inscribed angle can be defined by any point along the outer arc  $AB$  and the two points  $A$  and  $B$ .



Now, we can use the above theorem, and get the below diagram,



Now,  $10\theta = 360^\circ$

$$\implies \theta = 36^\circ.$$

So, the correct answer is (A).

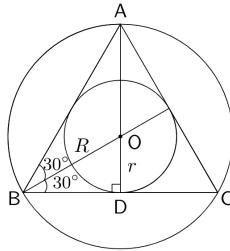
Reference: <http://jwilson.coe.uga.edu/EMAT6680Su09/Park/As8dspark/As8dspark.html>

#### References



12 votes

-- Lakshman Patel (63.9k points)

9.23.4 Geometry: GATE Mechanical 2021 Set 2 | GA Question: 8 [top ↗](#)<https://gateoverflow.in/359494>

Given that, the  $\triangle ABC$  is an equilateral triangle.

Let the radius of the inscribed circle be  $r$  cm, and radius of the circumscribed circle be  $R$  cm.

In  $\triangle OBD$ ,  $\angle OBD = 30^\circ$ ,  $\angle ODB = 90^\circ$

$$\Rightarrow \sin 30^\circ = \frac{r}{R}$$

$$\Rightarrow \frac{1}{2} = \frac{r}{R}$$

$$\Rightarrow R = 2r$$

Let the area of the inscribed circle be  $A_I$   $\text{cm}^2$  and the area of the circumscribed circle be  $A_C$   $\text{cm}^2$ .

$$\Rightarrow \frac{A_I}{A_C} = \frac{\pi r^2}{\pi R^2} = \frac{r^2}{(2r)^2} = \frac{1}{4}.$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

9.23.5 Geometry: GATE2015 EC-3: GA-8 [top ↗](#)<https://gateoverflow.in/39521>

- radius of circular sheet of paper =  $R$
- radius of the cone =  $r$
- height of cone =  $H$

Perimeter of base of cone =  $0.9 \times 2\pi R$

$$\Rightarrow 2\pi r = 0.9 * 2\pi R$$

$$\Rightarrow r = 0.9R$$

Now, height of cone  $H = \sqrt{R^2 - r^2}$

$$\Rightarrow H = r \cdot \sqrt{(R/r)^2 - 1}$$

$$\Rightarrow r/H = \frac{1}{\sqrt{(1/0.9)^2 - 1}}$$

$$= 2.06$$

10 votes

-- Dhananjay Kumar Sharma (18.8k points)

9.23.6 Geometry: GATE2016 CE-2: GA-9 [top ↗](#)<https://gateoverflow.in/110921>

Given, perimeter of a pyramid is  $x$ , so slant height is  $\frac{x}{2}$ .

Lateral Surface Area of a pyramid

$$= \frac{1}{2} \times \text{perimeter} \times \text{slant height}$$

$$= \frac{1}{2} \times x \times \frac{x}{2}$$

$$= 0.25x^2$$

**so option D is correct .**

8 votes

-- Bikram (58.3k points)

**9.23.7 Geometry: GATE2016 EC-2: GA-10** top ↗[↗ https://gateoverflow.in/108729](https://gateoverflow.in/108729)

- ✓ Let two parts be  $x$  and  $y$  and part  $x$  is used to make square and part  $y$  is used to make rectangle.

$$x + y = 340$$

If  $x$  part is used to make square, means it is the parameter of square and each side of square is  $\frac{x}{4}$

Similarly, for rectangle  $2 * (l + b) = y$  and  $l = 2b$

$$2 * 3b = y \Rightarrow b = \frac{y}{6} \text{ and } l = \frac{y}{3} \text{ (we know } y = 340 - x\text{)}$$

Question says the combined area of the square and the rectangle is a MINIMUM

$$A = \left(\frac{x}{4}\right)^2 + \frac{340-x}{6} * \frac{340-x}{3}$$

For combined area to be minimum  $\frac{dA}{dy} = 0$

$$\Rightarrow \frac{2x}{16} - \frac{2(340-x)}{18} = 0$$

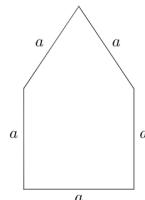
$$\Rightarrow x = 160$$

But question asks for MINIMUM length of side of square that is  $\frac{x}{4} = 40\text{mm}$

Correct Answer: *B*

13 votes

-- Manish Joshi (20.5k points)

**9.23.8 Geometry: GATE2016 ME-2: GA-5** top ↗[↗ https://gateoverflow.in/108289](https://gateoverflow.in/108289)

Perimeter(window) = 6 m

$$\Rightarrow 5a = 6 \text{ m}$$

$$\Rightarrow a = \frac{6}{5} \text{ m}$$

$$\Rightarrow a = 1.2 \text{ m}$$

Area(window) = Area(triangle) + Area(square)

$$= \frac{\sqrt{3}}{4}a^2 + a^2$$

$$= \frac{\sqrt{3}}{4}(1.2)^2 + (1.2)^2$$

$$= 2.06 \text{ m}^2$$

Correct Answer: *B*

9 votes

-- Pankaj Kumar (7.8k points)

**9.23.9 Geometry: GATE2017 ME-1: GA-3** top ↗[↗ https://gateoverflow.in/313658](https://gateoverflow.in/313658)

- ✓ Point  $Q$  will touch again, when cone will roll around  $P$  and will travel arc length of  $2\pi r$

So, arc length made by cone =  $2\pi r = 10\pi \text{ cm}$

If the cone rotates one round around point  $P$  it will cover perimeter of length  $2\pi l \text{ cm}$

where,  $l = \sqrt{h^2 + r^2} = 13$  cm

So, perimeter of one rotation =  $26\pi$  cm

Thus, the angle(in radian) which cone makes =  $\frac{10\pi}{26\pi} \times 360 \times \frac{\pi}{180} = \frac{10\pi}{13}$

Correct Answer: D

12 votes

-- Naveen Kumar (9.9k points)

### 9.23.10 Geometry: GATE2017 ME-1: GA-8 top

<https://gateoverflow.in/313661>



✓ For ' $S'_1$ ' plane

1.  $|x - 1| \leq 2$

A. when  $(x - 1) \geq 0 \Rightarrow x \geq 1$

Then  $+(x - 1) \leq 2 \Rightarrow x \leq 3 \quad \{ \text{here } (x \geq 1) \cap (x \leq 3) \Rightarrow 1 \leq x \leq 3 \}$

B. When  $(x - 1) < 0 \Rightarrow x < 1$

Then  $-(x - 1) \leq 2 \Rightarrow x \geq -1 \quad \{ \text{here } (x < 1) \cap (x \geq -1) \Rightarrow -1 \leq x < 1 \}$

Union ( $A \cup B$ )  $\Rightarrow -1 \leq x \leq 3$

2.  $|y + 2| \leq 3$

A. when  $(y + 2) \geq 0 \Rightarrow y \geq -2$

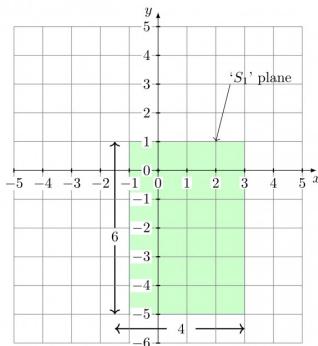
Then  $(y + 2) \leq 3 \Rightarrow y \leq 1 \quad \{ \text{here } (y \geq -2) \cap (y \leq 1) \Rightarrow -2 \leq y \leq 1 \}$

B. When  $(y + 2) < 0 \Rightarrow y < -2$

Then  $-(y + 2) \leq 3 \Rightarrow y \geq -5 \quad \{ \text{here } (y < -2) \cap (y \geq -5) \Rightarrow -5 \leq y < -2 \}$

Union ( $A \cup B$ )  $\Rightarrow -5 \leq y \leq 1$

So, ' $S'_1$ ' plane will be for intervals :  $-1 \leq x \leq 3$  and  $-5 \leq y \leq 1$

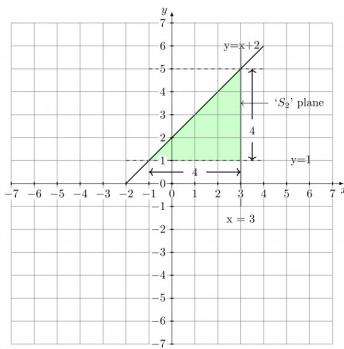


For ' $S'_2$ ' plane ,

1.  $x - y \geq -2 \Rightarrow y \leq x + 2$

2.  $y \geq 1$

3.  $x \leq 3$



Here,  $S = S_1 \cup S_2$

So, Area of  $S = \text{Area of } S_1 + \text{Area of } S_2$

$$\Rightarrow \text{Area of } S = 6 * 4 + \frac{1}{2} * 4 * 4$$

$$\Rightarrow \text{Area of } S = 24 + 8$$

$$\Rightarrow \text{Area of } S = 32$$

So, Answer is (C)

4 votes

-- ankitgupta.1729 (14.9k points)

### 9.23.11 Geometry: GATE2018 CE-1: GA-4 [top](#)

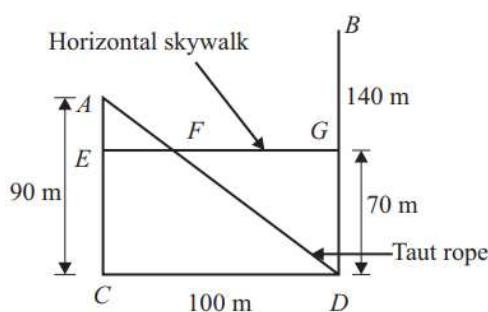


✓ Tower A is 90 m

Tower B is 140 m

A and B are 100 m apart

To find: EF distance



By proportionality theorem for  $\triangle AEF$  and  $\triangle ACD$

$$\frac{AE}{AC} = \frac{EF}{CD}$$

$$\Rightarrow \frac{20}{90} = \frac{EF}{100}$$

$$\Rightarrow EF = \frac{2}{9} \times 100 = 22.22 \text{ m}$$

So, the answer is 22.22 m

3 votes

-- Lakshman Patel (63.9k points)

### 9.23.12 Geometry: GATE2018 CH: GA-5 [top](#)



✓ Volume of each one is:

$$\text{i. } V_{\text{cuboid}} = l * b * h = 10 * 8 * 6 = 480 \text{ cm}^3$$

$$\text{ii. } V_{\text{cube}} = a^3 = 8^3 = 512 \text{ cm}^3$$

$$\text{iii. } V_{\text{cylinder}} = \pi r^2 h \approx 1077.57 \text{ cm}^3$$

$$\text{iv. } V_{\text{sphere}} = \frac{4}{3} \pi r^3 \approx 1436.76 \text{ cm}^3$$

So, the descending order is:

(D) (iv), (iii), (ii), (i)

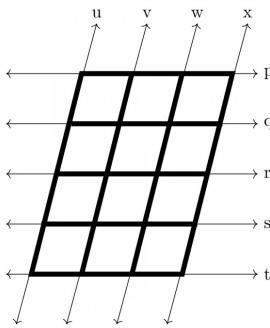
5 votes

-- Rishabh Gupta (12.4k points)

### 9.23.13 Geometry: GATE2018 CH: GA-7 [top](#)



✓ If we choose any 2 of the 4 lines and any 2 of the 5 lines we will get a parallelogram. This way we can count all the possibilities.



$$\binom{4}{2} * \binom{5}{2} = 6 * 10 = 60$$

Here, the first term is the ways of choosing 2 lines out of 4 parallel lines, and the second term is for choosing 2 lines out of 5 parallel lines.

Option (C) 60

<https://math.stackexchange.com/questions/772062/parallelograms-formed-by-parallel-lines>

<http://clay6.com/qa/40004/the-number-of-parallelogram-that-can-be-formed-from-a-set-of-four-parallel-lines>

<https://www.quora.com/How-many-parallelograms-are-formed-by-a-set-of-4-parallel-lines-intersecting-another-set-of-7-parallel-lines>

#### References



10 votes

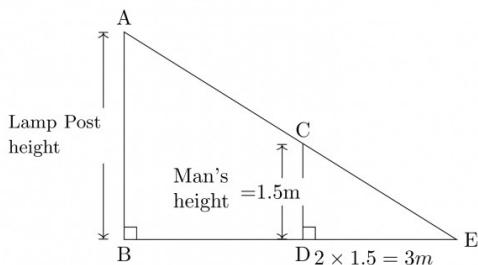
-- Rishabh Gupta (12,4k points)

#### 9.23.14 Geometry: GATE2018 EC: GA-5 top

<https://gateoverflow.in/205209>



- ✓ As we know when light is falling top of an object it casts the shadow at behind of the object



Here, we can see from  $\triangle ABE$  and  $\triangle CDE$

$$\angle B = \angle D \quad \& \quad \angle E = \angle E$$

$\therefore$  By proportionality theorem,

$$\frac{AB}{CD} = \frac{BE}{DE}$$

Given,  $CD = 1.5\text{ m}$   $BD = 3\text{ m}$   $DE = 3\text{ m}$   $\therefore AB = ?$

$$\therefore \frac{AB}{1.5} = \frac{3+3}{3}$$

$$AB = \frac{6}{3} \times 1.5$$

$$AB = 3\text{ m}$$

$\therefore$  Height of the Lamp post is  $3\text{ m}$  which is option **B**

12 votes

-- Sukanya Das (9,9k points)

#### 9.23.15 Geometry: GATE2018 ME-1: GA-4 top

<https://gateoverflow.in/313645>



- ✓ Answer: **B. 2250**

Let  $l$  and  $b$  be the length & breadth of rectangle.

$$\text{Area of rectangle, } A = l \times b \rightarrow (1)$$

Given, rectangle becomes square when  $l$  reduces by 10 and  $b$  reduces by 5

$$\Rightarrow l - 10 = b - 5 \rightarrow (2)$$

$$\text{Then, area of square} = (l - 10) \times (b - 5) = A - 650$$

$$\Rightarrow (l - 10) \times (b - 5) = (l \times b) - 650 \rightarrow (3)$$

Solving, (ii) & (iii) we get  $b = 45, l = 50$ .

$$\text{Thus, area of rectangle} = 45 \times 50 = 2250 \text{ m}^2$$



-- Naveen Kumar (9.9k points)



### 9.23.16 Geometry: GATE2018 ME-2: GA-4 top ↻

☞ <https://gateoverflow.in/313636>

- ✓ For a given perimeter circle has the largest area.

Similarly, for a given surface area, a cube has the largest volume.

So, correct answer: A



-- Arjun Suresh (328k points)

Let's take 100 units as the perimeter

Circle:

- $2\pi r = 100$
- $\Rightarrow r = 100/(2\pi) = 100/(2 \times 3.14) = 15.92$  units
- Area =  $\pi r^2$
- $= 3.14 \times 15.92 \times 15.92 = 795.82$  square units

Square:

- $4a = 100$
- $\Rightarrow a = 25$  units
- Area =  $a \times a = 25 \times 25 = 625$  square units

Equilateral Triangle:

- $3s = 100$
- $s = 100/3 = 33.33$  units
- Area =  $\frac{\sqrt{3}}{4}s^2$
- $= \frac{\sqrt{3}}{4} \times 33.33 \times 33.33$
- $= 481.029$  square units

$$795.82 > 625 > 481.029$$

Circle Area > Square Area > Equilateral Triangle Area

Hence, A is Correct.



-- Balaji Jegan (3.5k points)



### 9.23.17 Geometry: GATE2018 ME-2: GA-7 top ↻

☞ <https://gateoverflow.in/313613>

- ✓  $1936 \text{ m}^2 = a^2 \Rightarrow a = \sqrt{1936} = 44 \text{ m}$

Total length of wire = Perimeter =  $4a$

$4 \times 44 \text{ m}$  is split to two parts of lengths  $132 \text{ m}$  and  $44 \text{ m}$  respectively.

$132 \text{ m}$  is bent into a square and  $44 \text{ m}$  to a circle.

Side of the square =  $\frac{132}{4} = 33 \text{ m}$ .

$$\text{Radius of the circle} = \frac{44}{2\pi} = \frac{22}{\pi} \approx 7$$

Sum of the area enclosed by both =  $33^2 + \pi 7^2 \approx 1089 + 154 = 1243$ .

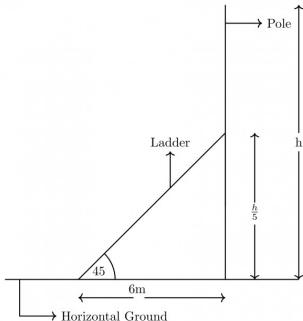
Correct Option: C

1/2 votes

-- Arjun Suresh (328k points)

### 9.23.18 Geometry: GATE2019 CE-1: GA-3 [top](#)

<https://gateoverflow.in/313438>



Let, height of the vertical pole is  $h$  meters.

Now, according to above figure,

$$\begin{aligned}\tan 45^\circ &= \frac{h/5}{6} \\ \Rightarrow 1 &= \frac{h}{30} \\ \Rightarrow h &= 30\end{aligned}$$

So, height of the pole is 30 meters.

Answer is (C)

1/2 votes

-- ankitgupta.1729 (14.9k points)

### 9.23.19 Geometry: GATE2019 CE-2: GA-3 [top](#)

<https://gateoverflow.in/313370>



✓ Ans A.

Total floor area = 3850 sq.mts

Total area to be carpeted =  $3850 - 550 = 3300$  sq.mts

Carpet cost = Rs 50/sq.mts

Total cost to carpet 3300 sq.mts =  $50 \times 3300 = \text{Rs. } 1,65,000$

1/2 votes

-- Resmi Arjun (619 points)

### 9.23.20 Geometry: GATE2019 CE-2: GA-4 [top](#)

<https://gateoverflow.in/313371>



$$\checkmark \quad \text{Number of bricks} = \frac{0.6 \times 3000 \times 1200 \times 600}{8 \times 6 \times 6} = 300 \times 150 \times 100 = 45 \text{ lakhs.}$$

1/2 votes

-- Arjun Suresh (328k points)

## 9.24

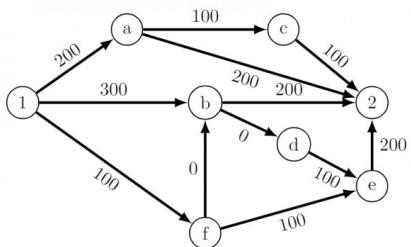
### Graph (1) [top](#)

#### 9.24.1 Graph: GATE CSE 2020 | Question: GA-5 [top](#)

<https://gateoverflow.in/333236>



There are multiple routes to reach from node 1 to node 2, as shown in the network.



The cost of travel on an edge between two nodes is given in rupees. Nodes ‘*a*’, ‘*b*’, ‘*c*’, ‘*d*’, ‘*e*’, and ‘*f*’ are toll booths. The toll price at toll booths marked ‘*a*’ and ‘*e*’ is Rs. 200, and is Rs. 100 for the other toll booths. Which is the cheapest route from node 1 to node 2?

- A. 1 – *a* – *c* – 2
- B. 1 – *f* – *b* – 2
- C. 1 – *b* – 2
- D. 1 – *f* – *e* – 2

gate2020-cse quantitative-aptitude graph

Answer

### Answers: Graph

**9.24.1 Graph: GATE CSE 2020 | Question: GA-5** top ↴

☞ <https://gateoverflow.in/333236>



✓ 1 – *a* – *c* – 2 :

- 1 – *a* = 200
- Tax at *a* = 200
- *a* – *c* = 100
- Tax at *c* = 100
- *c* – 2 : 100
- Total =  $200 + 200 + 100 + 100 + 100 = 700$

1 – *f* – *e* – 2 :

- 1 – *f* = 100
- Tax at *f* = 100
- *f* – *e* = 100
- Tax at *e* = 200
- *e* – 2 : 200
- Total =  $100 + 100 + 100 + 200 + 200 = 700$

1 – *f* – *b* – 2 :

- 1 – *f* = 100
- Tax at *f* = 100
- *f* – *b* = 0
- Tax at *b* = 100
- *b* – 2 : 200
- Total =  $100 + 100 + 0 + 100 + 200 = 500$

1 – *b* – 2 :

- 1 – *b* = 300
- Tax at *b* = 100
- *b* – 2 : 200
- Total =  $300 + 100 + 200 = 600$

#### Cheapest route

= 1 – *f* – *b* – 2

**Correct Option: B**

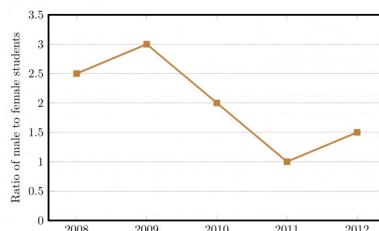
8 votes

-- Shaik Masthan (50.2k points)

9.25

Graphical Data (9) [top ↴](#)9.25.1 Graphical Data: GATE CSE 2014 Set 3 | Question: GA-9 [top ↴](#)<https://gateoverflow.in/2033>

The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students in 2011 and 2012 is equal, what is the ratio of male students in 2012 to male students in 2011?



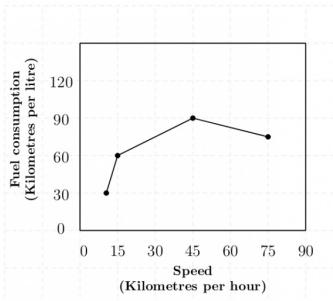
- A. 1 : 1
- B. 2 : 1
- C. 1.5 : 1
- D. 2.5 : 1

[gate2014-cse-set3](#) [quantitative-aptitude](#) [data-interpretation](#) [normal](#) [graphical-data](#)

Answer

9.25.2 Graphical Data: GATE2011 AG: GA-9 [top ↴](#)<https://gateoverflow.in/312131>

The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.



The distances covered during four laps of the journey are listed in the table below

Lap	Distance (kilometres)	Average Speed (kilometres per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap

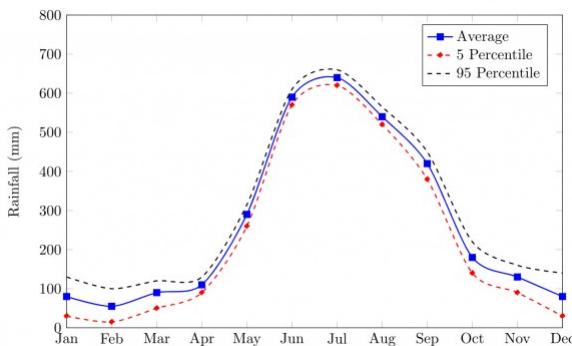
- A. P
- B. Q
- C. R
- D. S

[general-aptitude](#) [quantitative-aptitude](#) [gate2011-ag](#) [data-interpretation](#) [graphical-data](#)

Answer

9.25.3 Graphical Data: GATE2014 AE: GA-10 [top ↴](#)<https://gateoverflow.in/40310>

The monthly rainfall chart based on 50 years of rainfall in Agra is shown in the following figure.



Which of the following are true? (k percentile is the value such that k percent of the data fall below that value)

- i. On average, it rains more in July than in December
  - ii. Every year, the amount of rainfall in August is more than that in January
  - iii. July rainfall can be estimated with better confidence than February rainfall
  - iv. In August, there is at least 500 mm of rainfall
- A. (i) and (ii)  
B. (i) and (iii)  
C. (ii) and (iii)  
D. (iii) and (iv)

gate2014-ae quantitative-aptitude data-interpretation graphical-data

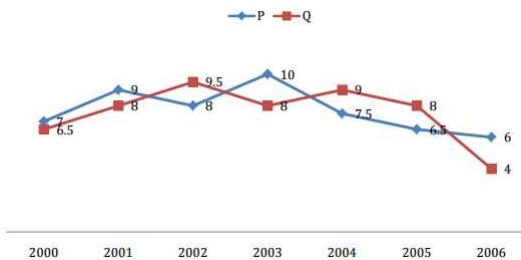
Answer ↗

#### 9.25.4 Graphical Data: GATE2016 CE-2: GA-6 top ↗

↗ <https://gateoverflow.in/110905>



Two finance companies,  $P$  and  $Q$ , declared fixed annual rates of interest on the amounts invested with them. The rates of interest offered by these companies may differ from year to year. Year-wise annual rates of interest offered by these companies are shown by the line graph provided below.



If the amounts invested in the companies,  $P$  and  $Q$ , in 2006 are in the ratio  $8 : 9$ , then the amounts received after one year as interests from companies  $P$  and  $Q$  would be in the ratio:

- A.  $2 : 3$   
B.  $3 : 4$   
C.  $6 : 7$   
D.  $4 : 3$

gate2016-ce-2 data-interpretation quantitative-aptitude graphical-data

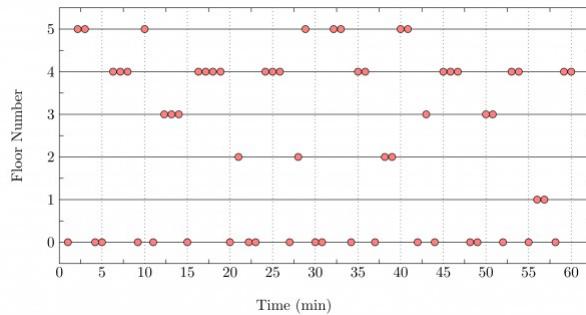
Answer ↗

#### 9.25.5 Graphical Data: GATE2017 CE-2: GA-10 top ↗

↗ <https://gateoverflow.in/313419>



The points in the graph below represent the halts of a lift for a durations of 1 minute, over a period of 1 hour.



Which of the following statements are correct?

- i. The elevator moves directly from any non-ground floor to another non-ground floor over the one hour period.
- ii. The elevator stays on the fourth floor for the longest duration over the one hour period.

- A. Only i
- B. Only ii
- C. Both i and ii
- D. Neither i nor ii

gate2017-ce-2 data-interpretation graphical-data

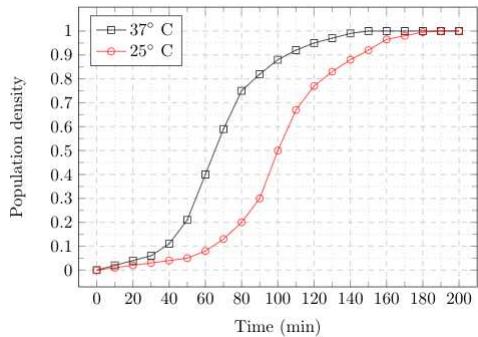
Answer

#### 9.25.6 Graphical Data: GATE2017 ME-1: GA-10

<https://gateoverflow.in/313662>



The growth of bacteria (lactobacillus) in milk leads to curd formation. A minimum bacterial population density of 0.8 (in suitable units) is needed to form curd. In the graph below, the population density of lactobacillus in 1 litre of milk is plotted as a function of time, at two different temperatures, 25°C and 37°C.



Consider the following statements based on the data shown above:

- i. The growth in bacterial population stops earlier at 37°C as compared to 25°C
- ii. The time taken for curd formation at 25°C is twice the time taken at 37°C

Which one of the following options is correct?

- A. Only i
- B. Only ii
- C. Both i and ii
- D. Neither i nor ii

gate2017-me-1 general-aptitude quantitative-aptitude data-interpretation graphical-data

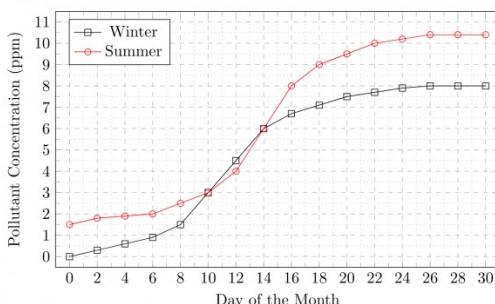
Answer

#### 9.25.7 Graphical Data: GATE2017 ME-2: GA-10

<https://gateoverflow.in/313674>



In the graph below, the concentration of a particular pollutant in a lake is plotted over (alternate) days of a month in winter (average temperature 10°C) and a month in summer (average temperature 30°C).



Consider the following statements based on the data shown above:

- Over the given months, the difference between the maximum and the minimum pollutant concentrations is the same in both winter and summer
- There are at least four days in the summer month such that the pollutant concentrations on those days are within 1 ppm of the pollutant concentrations on the corresponding days in the winter month.

Which one of the following options is correct?

- A. Only i
- B. Only ii
- C. Both i and ii
- D. Neither i nor ii

[gate2017-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [data-interpretation](#) [graphical-data](#)

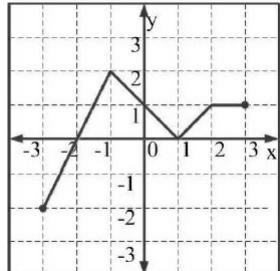
Answer

### 9.25.8 Graphical Data: GATE2018 CE-1: GA-8 top ↴

► <https://gateoverflow.in/313251>



Which of the following function(s) is an accurate description of the graph for the range(s) indicated?



- $y = 2x + 4$  for  $-3 \leq x \leq -1$
- $y = |x - 1|$  for  $-1 \leq x \leq 2$
- $y = ||x| - 1|$  for  $-1 \leq x \leq 2$
- $y = 1$  for  $2 \leq x \leq 3$

- A. i, ii and iii only
- B. i, ii and iv only
- C. i and iv only
- D. ii and iv only

[gate2018-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [graphical-data](#)

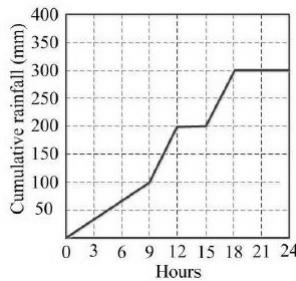
Answer

### 9.25.9 Graphical Data: GATE2018 CE-2: GA-8 top ↴

► <https://gateoverflow.in/313386>



The annual average rainfall in a tropical city is 1000 mm. On a particular rainy day (24-hour period), the cumulative rainfall experienced by the city is shown in the graph. Over the 24-hour period, 50% of the rainfall falling on a rooftop, which had an obstruction-free area of  $50 m^2$ , was harvested into a tank. What is the total volume of water collected in the tank liters?



- A. 25,000  
 B. 18,750  
 C. 7,500  
 D. 3.125

gate2018-ce-2 general-aptitude quantitative-aptitude data-interpretation graphical-data

Answer

### Answers: Graphical Data

#### 9.25.1 Graphical Data: GATE CSE 2014 Set 3 | Question: GA-9

<https://gateoverflow.in/2033>



✓ (C) 1.5 : 1

2011:

- $m_1$  = no of male students
- $f_1$  = no of female students
- $\frac{m_1}{f_1} = 1$

2012:

- $m_2$  = no of male students
- $f_2$  = no of female students
- $\frac{m_2}{f_2} = 1.5$

Given:  $f_1 = f_2 = f$   
 So,  $\frac{m_1}{f} = 1$  and  $\frac{m_2}{f} = 1.5$   
 $f = \frac{m_1}{1}$  and  $f = \frac{m_2}{1.5}$

Both the equations can be equated.

$$\frac{m_1}{1} = \frac{m_2}{1.5}$$

**Ratio of male students in 2012 to male students in 2011**  $\Rightarrow \frac{m_2}{m_1} = \frac{1.5}{1} = 1.5 : 1$

13 votes

-- Srinath Jayachandran (2.9k points)

#### 9.25.2 Graphical Data: GATE2011 AG: GA-9

<https://gateoverflow.in/312131>



✓ The first graph gives the fuel consumption in kilometers per litre for various speeds and at 45 kmph kilometers traveled per litre is 90 which is the maximum distance per kilometer and so at this speed fuel consumption per litre is the least.

Second graph shows that for lap Q the average speed is 45 kmph and so for lap Q we should have the least fuel consumption per litre.

Correct Answer: B.

2 votes

-- Arjun Suresh (328k points)

**9.25.3 Graphical Data: GATE2014 AE: GA-10** [top](#)<https://gateoverflow.in/40310>

- ✓ 1st statement true since average of July is more than that of December in the Average plot

2nd statement - not true since, we have data till 95% only -- in all data of 50 years, amount of rainfall is below the value presented by graph in 95% cases. So in the remaining 5% of years, there can be a year where it rains more in January than August

3rd statement true- since difference between 5 – percentile plot and 95 – percentile plot indicates that this was range for 90% of years. In February this range is bigger compared to July.

4th statement - not necessarily true. Here, the 5 – percentile plot is touching 500mm level. But any year in this 5% could have got a lower level of rainfall.

So, answer is *B*.

11 votes

-- Pavan Dongare (143 points)

**9.25.4 Graphical Data: GATE2016 CE-2: GA-6** [top](#)<https://gateoverflow.in/110905>

- ✓ The amounts invested in the companies, *P* and *Q*, in 2006 are in the ratio 8 : 9

The annual rate of interest in the companies *P* and *Q* are 6% and 4% respectively in the year 2006

∴ The amounts received after one year as interests from companies *P* and *Q* would be in the ratio

$$\left(8 \times \frac{6}{100}\right) : \left(9 \times \frac{4}{100}\right)$$

$$= 48 : 36$$

$$= 4 : 3$$

1 votes

-- Subarna Das (11.3k points)

**9.25.5 Graphical Data: GATE2017 CE-2: GA-10** [top](#)<https://gateoverflow.in/313419>

- ✓ From the graph we can see that movements between 1 – 2, 1 – 3, 1 – 5, 2 – 3 never happened. So, statement 1 is not TRUE.

Statement 2 is also FALSE as the elevator stays on fourth floor for 19 minutes while it stays at ground floor for 21 minutes.

So, Correct Option: D

2 votes

-- Arjun Suresh (328k points)

**9.25.6 Graphical Data: GATE2017 ME-1: GA-10** [top](#)<https://gateoverflow.in/313662>

- i. The growth in bacterial population stops earlier at 37°C as compared to 25°C - TRUE.  
From the graph it can be seen that the growth stops after 150 minutes at 37°C while it stops after 180 minutes at 25°C
- ii. The time taken for curd formation at 25°C is twice the time taken at 37°C - FALSE.  
From the graph it can be seen that curd formation happens in around 90 minutes at 37°C and in around 120 minutes at 25°C

Correct Option: A.

1 votes

-- Arjun Suresh (328k points)

**9.25.7 Graphical Data: GATE2017 ME-2: GA-10** [top](#)<https://gateoverflow.in/313674>

- Maximum pollutant concentration in the summer month = 10.5
- Maximum pollutant concentration in the winter month = 8
- Minimum pollutant concentration in the summer month = 1.5
- Minimum pollutant concentration in the winter month = 0

So, the difference between the maximum and minimum pollutant concentration in summer =  $10.5 - 1.5 = 9$ .

The difference between the maximum and minimum pollutant concentration in winter =  $8 - 0 = 8$ .

So, (i) is FALSE.

If we see days 10 – 14 the pollutant concentration between the summer and winter months are within 0.5 ppm. So, (ii) is TRUE.

Correct Option: B.

1 votes

-- Arjun Suresh (328k points)

### 9.25.8 Graphical Data: GATE2018 CE-1: GA-8 top ↗

↗ <https://gateoverflow.in/313251>



- ✓ • If we have 2 points  $(x_1, y_1)$  and  $(x_2, y_2)$  on  $X - Y$  plane,

Then equation of line will be :-  $y - y_1 = \left( \frac{y_2 - y_1}{x_2 - x_1} \right) (x - x_1)$

- Definition of  $y = |x|$  says  $y = \begin{cases} x & x \geq 0 \\ -x & x < 0 \end{cases}$

Now,

(i) Let,  $x_1 = -3, x_2 = -1, y_1 = -2, y_2 = 2$

So, Equation of Line will be :-  $y - (-2) = \left( \frac{2 - (-2)}{-1 - (-3)} \right) (x - (-3))$

$$\Rightarrow y + 2 = \frac{4}{2}(x + 3)$$

$$\Rightarrow y = 2x + 4$$

So, option (i) is correct.

$$(ii) y = \begin{cases} (x - 1), & (x - 1) \geq 0 \text{ (or)} x \geq 1 \\ -(x - 1) = -x + 1, & (x - 1) < 0 \text{ (or)} x < 1 \end{cases}$$

For,  $x \geq 1$ ,

Let,  $x_1 = 1, x_2 = 2, y_1 = 0, y_2 = 1$

So, Equation of Line will be :-  $y - 0 = \left( \frac{1 - 0}{2 - 1} \right) (x - 1)$

$$\Rightarrow y = (x - 1)$$

For,  $x < 1$ ,

Let,  $x_1 = -1, x_2 = 1, y_1 = 2, y_2 = 0$

So, Equation of Line will be :-  $y - 2 = \left( \frac{0 - 2}{1 - (-1)} \right) (x - (-1))$

$$\Rightarrow y = -x + 1$$

Both equations of lines are drawn in the given graph.

So, option (ii) is correct.

$$(iii) y = \begin{cases} x - 1, & \text{when } x \geq 0 \text{ and } (x - 1) \geq 0 \text{ i.e. } x \geq 1 \\ -(x - 1) & \text{when } x \geq 0 \text{ and } (x - 1) < 0 \text{ i.e. } x < 1 \\ x + 1 & \text{when } x < 0 \text{ and } (x + 1) \geq 0 \text{ i.e. } x \geq -1 \\ -(x + 1) & \text{when } x < 0 \text{ and } (x + 1) < 0 \text{ i.e. } x < -1 \end{cases}$$

$$\Rightarrow y = \begin{cases} x - 1, & x \geq 1 \\ -x + 1, & 0 \leq x < 1 \\ x + 1, & -1 \leq x < 0 \\ -x - 1, & x < -1 \end{cases}$$

Suppose,  $x = -1/2, y = 1/2$  but it is not showing correctly in the graph.

So, option (iii) is incorrect.

(iv) is correct as we can see in the given graph. It is constant function  $y = 1$  between  $x = 2$  and  $x = 3$  (both are inclusive)

Hence, Answer is (B)

2 votes

-- ankitgupta.1729 (14.9k points)

**9.25.9 Graphical Data: GATE2018 CE-2: GA-8** [top](#)<https://gateoverflow.in/313386>

- ✓ The graph is plotting cumulative rainfall and so in 24 hrs 300 mm of rainfall was received.

300 mm means the rainfall received in 1 square meter is 300 liters.

So, in  $50 \text{ m}^2$  the amount of rainfall received is  $300 \times 50 = 15,000 \text{ l}$

50% of this is harvested in tank. So,

$$\text{Tank capacity} = 0.5 \times 15,000 \text{ l} = 7,500 \text{ l}$$

Option C.

2 votes

-- Arjun Suresh (328k points)

**9.26****Logarithms (8)** [top](#)**9.26.1 Logarithms: GATE CSE 2011 | Question: 57** [top](#)<https://gateoverflow.in/2166>

If  $\log(P) = (1/2)\log(Q) = (1/3)\log(R)$ , then which of the following options is TRUE?

- A.  $P^2 = Q^3R^2$
- B.  $Q^2 = PR$
- C.  $Q^2 = R^3P$
- D.  $R = P^2Q^2$

[gate2011-cse](#) [quantitative-aptitude](#) [normal](#) [numerical-computation](#) [logarithms](#)

Answer

**9.26.2 Logarithms: GATE2012 AR: GA-6** [top](#)<https://gateoverflow.in/40227>

A value of  $x$  that satisfies the equation  $\log x + \log(x-7) = \log(x+11) + \log 2$  is

- A. 1
- B. 2
- C. 7
- D. 11

[gate2012-ar](#) [quantitative-aptitude](#) [numerical-computation](#) [logarithms](#)

Answer

**9.26.3 Logarithms: GATE2015 EC-1: GA-5** [top](#)<https://gateoverflow.in/39493>

If  $\log_x(\frac{5}{7}) = -\frac{1}{3}$ , then the value of  $x$  is

- A. 343/125
- B. 25/343
- C. -25/49
- D. -49/25

[gate2015-ec-1](#) [general-aptitude](#) [numerical-methods](#) [logarithms](#)

Answer

**9.26.4 Logarithms: GATE2015 EC-3: GA-9** [top](#)<https://gateoverflow.in/39522>

$\log \tan 1^\circ + \log \tan 2^\circ + \dots + \log \tan 89^\circ$  is . . .

- A. 1
- B.  $1/\sqrt{2}$
- C. 0
- D. -1

[gate2015-ec-3](#)
[summation](#)
[quantitative-aptitude](#)
[logarithms](#)
[Answer](#)


### 9.26.5 Logarithms: GATE2018 CE-2: GA-5 [top](#)

<https://gateoverflow.in/313388>


For non-negative integers,  $a, b, c$ , what would be the value of  $a + b + c$  if  $\log a + \log b + \log c = 0$ ?

- A. 3
- B. 1
- C. 0
- D. -1

[gate2018-ce-2](#)
[general-aptitude](#)
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[logarithms](#)
[Answer](#)


### 9.26.6 Logarithms: GATE2018 CE-2: GA-9 [top](#)

<https://gateoverflow.in/313383>


Given that  $\frac{\log P}{y-z} = \frac{\log Q}{z-x} = \frac{\log R}{x-y} = 10$  for  $x \neq y \neq z$ , what is the value of the product  $PQR$ ?

- A. 0
- B. 1
- C.  $xyz$
- D.  $10^{xyz}$

[gate2018-ce-2](#)
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[logarithms](#)
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### 9.26.7 Logarithms: GATE2018 ME-1: GA-6 [top](#)

<https://gateoverflow.in/313648>


For integers,  $a, b$  and  $c$ , what would be the minimum and maximum values respectively of  $a + b + c$  if  $\log |a| + \log |b| + \log |c| = 0$ ?

- A. -3 and 3
- B. -1 and 1
- C. -1 and 3
- D. 1 and 3

[gate2018-me-1](#)
[general-aptitude](#)
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### 9.26.8 Logarithms: GATE2018 ME-2: GA-5 [top](#)

<https://gateoverflow.in/313607>


The value of the expression  $\frac{1}{1 + \log_u vw} + \frac{1}{1 + \log_v wu} + \frac{1}{1 + \log_w uv}$  is \_\_\_\_\_

- A. -1
- B. 0
- C. 1
- D. 3

[gate2018-me-2](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[logarithms](#)
[Answer](#)


## Answers: Logarithms

### 9.26.1 Logarithms: GATE CSE 2011 | Question: 57 [top](#)

<https://gateoverflow.in/2166>


✓ B. is the answer.

Following logarithm formula, we get:

$$P = Q^{\frac{1}{2}} = R^{\frac{1}{3}}$$

So,  $Q^2 = P^4 = P \times P^3 = PR$ .

127 votes

-- shreya ghosh (2.8k points)

### 9.26.2 Logarithms: GATE2012 AR: GA-6 top

<https://gateoverflow.in/40227>



✓  $\log m + \log n = \log mn$

So,  $\log x + \log(x - 7) = \log(x + 11) + \log 2$

$\Rightarrow \log x(x - 7) = \log 2(x + 11)$

$\Rightarrow x(x - 7) = 2(x + 11)$

$\Rightarrow x^2 - 9x - 22 = 0$

$\Rightarrow (x - 11)(x + 2) = 0$

$\therefore x = 11$

$\because x \neq -2$ , log is undefined for negative number.

Correct Answer: D

11 votes

-- Praveen Saini (41.9k points)

### 9.26.3 Logarithms: GATE2015 EC-1: GA-5 top

<https://gateoverflow.in/39493>



✓  $\log_x \left(\frac{5}{7}\right) = -\frac{1}{3} \implies x^{-\frac{1}{3}} = \frac{5}{7}$

$\implies x^{\frac{1}{3}} = \frac{7}{5}$

$\implies x = \left[\frac{7}{5}\right]^3 = \frac{343}{125}$ .

Correct Option: A.

3 votes

-- Arjun Suresh (328k points)

### 9.26.4 Logarithms: GATE2015 EC-3: GA-9 top

<https://gateoverflow.in/39522>



$$\begin{aligned} & \checkmark (\tan 1 \cdot \tan 89) \cdot (\tan 2 \cdot \tan 88) \dots (\tan 44 \cdot \tan 46) \cdot \tan 45 \\ &= (\tan 1 \cdot \cot 1) \cdot (\tan 2 \cdot \cot 2) \dots (\tan 44 \cdot \cot 44) \cdot \tan 45 \\ &= 1 \cdot 1 \cdot 1 \dots 1 \cdot \tan 45 \\ &= 1 \end{aligned}$$

So, the given expression reduces to  $\log 1 = 0$ .

Correct Option: (C) 0

9 votes

-- deandamontvd (269 points)

### 9.26.5 Logarithms: GATE2018 CE-2: GA-5 top

<https://gateoverflow.in/313388>



✓ Given that  $a, b$  and  $c$  are non-negative integers, i.e.,  $a, b, c \geq 0$  and  $\log a + \log b + \log c = 0$

$\implies \log abc = 0$

$\implies abc = 10^0$

$\implies abc = 1$

Since  $a, b, c$  are non-negative integers,  $a = b = c = 1$

$\implies a + b + c = 1 + 1 + 1 = 3$

So, (A) is the correct answer.

2 votes

-- Lakshman Patel (63.9k points)

**9.26.6 Logarithms: GATE2018 CE-2: GA-9** top ↴[➡ https://gateoverflow.in/313383](https://gateoverflow.in/313383)

✓  $\frac{\log P}{y-z} = \frac{\log Q}{z-x} = \frac{\log R}{x-y} = 10 \quad \text{for } x \neq y \neq z$

- $\frac{\log P}{y-z} = 10 \implies \log P = 10(y-z) \quad \Rightarrow (1)$
- $\frac{\log Q}{z-x} = 10 \implies \log Q = 10(z-x) \quad \Rightarrow (2)$
- $\frac{\log R}{x-y} = 10 \implies \log R = 10(x-y) \quad \Rightarrow (3)$

Adding (1), (2) and (3) we get

$$\begin{aligned} \log P + \log Q + \log R &= 10(y-z) + 10(z-x) + 10(x-y) \\ \implies \log P + \log Q + \log R &= 10(y-z+z-x+x-y) \\ \implies \log P + \log Q + \log R &= 10 \times 0 \\ \implies \log P + \log Q + \log R &= 0 \\ \implies \log PQR &= 0 \\ \implies PQR &= 10^0 = 1. \end{aligned}$$

Hence, (B) is the correct choice.

1 votes

-- Lakshman Patel (63.9k points)

**9.26.7 Logarithms: GATE2018 ME-1: GA-6** top ↴[➡ https://gateoverflow.in/313648](https://gateoverflow.in/313648)

- ✓ Given that  $a, b$  and  $c$  are integers.

and  $\log |a| + \log |b| + \log |c| = 0$

we know that  $\log |a| + \log |b| + \log |c| = \log(|a| \cdot |b| \cdot |c|)$

$$\begin{aligned} \implies \log(|a| \cdot |b| \cdot |c|) &= 0 \\ \implies |a| \cdot |b| \cdot |c| &= 10^0 \\ \implies |a| \cdot |b| \cdot |c| &= 1 \end{aligned}$$

For minimum value of  $a+b+c$  we can put  $a=b=c=-1$  and get  
 $(a+b+c)_{\min} = -1 - 1 - 1 = -3$

For maximum value of  $a+b+c$  we can put  $a=b=c=1$  and get  
 $(a+b+c)_{\max} = 1 + 1 + 1 = 3$

So, (A) is the correct answer.

3 votes

-- Lakshman Patel (63.9k points)

**9.26.8 Logarithms: GATE2018 ME-2: GA-5** top ↴[➡ https://gateoverflow.in/313607](https://gateoverflow.in/313607)

$$\begin{aligned} \checkmark \quad & \frac{1}{1 + \log_u vw} + \frac{1}{1 + \log_v wu} + \frac{1}{1 + \log_w uv} \\ &= \frac{1}{\log_u u + \log_u vw} + \frac{1}{\log_v v + \log_v wu} + \frac{1}{\log_w w + \log_w uv} \\ &= \frac{1}{\log_u uvw} + \frac{1}{\log_v vwu} + \frac{1}{\log_w wuv} \\ &= \frac{1}{\log_u uvw} + \frac{1}{\log_v uvw} + \frac{1}{\log_w uvw} \end{aligned}$$

$$\begin{aligned}
 &= \log_{uvw} u + \log_{uvw} v + \log_{uvw} w \\
 &= \log_{uvw} uvw \\
 &= 1 \quad \because (\log_a a = 1)
 \end{aligned}$$

Hence (C) is Correct.

4 votes

-- Balaji Jegan (3.5k points)

## 9.27

### Maxima Minima (4) top ↗

#### 9.27.1 Maxima Minima: GATE CSE 2012 | Question: 62 top ↗

<https://gateoverflow.in/2210>



A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation  $y = 2x - 0.1x^2$  where  $y$  is the height of the arch in meters. The maximum possible height of the arch is

- A. 8 meters
- B. 10 meters
- C. 12 meters
- D. 14 meters

gate2012-cse quantitative-aptitude normal maxima-minima

Answer

#### 9.27.2 Maxima Minima: GATE CSE 2017 Set 2 | Question: GA-9 top ↗

<https://gateoverflow.in/118423>



The number of roots of  $e^x + 0.5x^2 - 2 = 0$  in the range  $[-5, 5]$  is

- A. 0
- B. 1
- C. 2
- D. 3

gate2017-cse-set2 quantitative-aptitude normal maxima-minima calculus

Answer

#### 9.27.3 Maxima Minima: GATE2010 TF: GA-5 top ↗

<https://gateoverflow.in/312024>



Consider the function  $f(x) = \max(7 - x, x + 3)$ . In which range does  $f$  take its minimum value?

- A.  $-6 \leq x < -2$
- B.  $-2 \leq x < 2$
- C.  $2 \leq x < 6$
- D.  $6 \leq x < 10$

general-aptitude quantitative-aptitude gate2010-tf maxima-minima functions

Answer

#### 9.27.4 Maxima Minima: GATE2013 CE: GA-6 top ↗

<https://gateoverflow.in/40274>



$X$  and  $Y$  are two positive real numbers such that  $2X + Y \leq 6$  and  $X + 2Y \leq 8$ . For which of the following values of

$(X, Y)$  the function  $f(X, Y) = 3X + 6Y$  will give maximum value?

- A.  $\left(\frac{4}{3}, \frac{10}{3}\right)$
- B.  $\left(\frac{8}{3}, \frac{20}{3}\right)$
- C.  $\left(\frac{8}{3}, \frac{10}{3}\right)$

D.  $\left(\frac{4}{3}, \frac{20}{3}\right)$

gate2013-ce quantitative-apptitude maxima-minima

Answer 

### Answers: Maxima Minima

#### 9.27.1 Maxima Minima: GATE CSE 2012 | Question: 62

<https://gateoverflow.in/2210> 

- ✓ B. 10

$$y = 2x - 0.1x^2$$

$$dy/dx = 2 - 2 \times 0.1x$$

$$dy/dx = 0 \implies x = 10$$

$$\text{So, } y = 20 - 10 = 10$$

 11 votes

-- shreya ghosh (2.8k points)

#### 9.27.2 Maxima Minima: GATE CSE 2017 Set 2 | Question: GA-9

<https://gateoverflow.in/118423> 

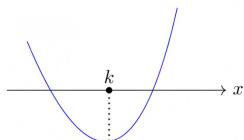
- ✓ Let  $f(x) = e^x + 0.5x^2 - 2$ , and we want to see if  $f(x) = 0$  has any solution in  $[-5, 5]$

$f'(x) = e^x + x$  and we definitely have solution of  $f'(x) = 0$  in  $[-5, 5]$  because  $f'(x)$  is continuous and  $f'(-5) < 0$ ,  $f'(5) > 0$

(Moreover  $f'(x)$  has only one solution as it is a strictly increasing function.)

Let  $k$  be one of the solution for  $f'(x) = 0$  hence  $f'(k) = 0$  where  $k \in [-5, 5]$ , for " $< k$ ",  $f'(x)$  is -ve and for " $> k$ ",  $f'(x)$  is +ve. means for  $< k$ ,  $f(x)$  is decreasing and for  $> k$ ,  $f(x)$  is increasing.

Rough plot of  $f(x)$  may go like this

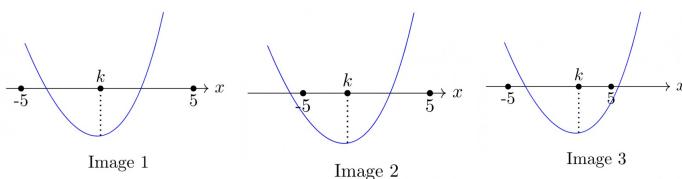


Plot of  $f(x)$

Now it is clear that  $f(x)$  has two solutions.

BUT, how can I sure that these solutions are in between  $[-5, 5]$ ?

Yes I agree that  $k \in [-5, 5]$ , but there are many possibilities of solution to be in  $[-5, 5]$



(in all three images  $k \in [-5, 5]$ )

You wanna know which image is correct? :O

Just check sign of  $f(-5)$  and  $f(5)$ , you will get to know "Image-1" is correct one.

Hence, there are 2 solutions in between of  $[-5, 5]$ .

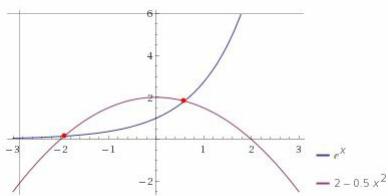
C is correct answer.

 29 votes

-- Sachin Mittal (15.8k points)

$$e^x = -0.5x^2 + 2$$

Plot  $e^x$  and Downward Parabola  $-0.5x^2 + 2$ , And find intersection.



As, these two intersect at two points. So, (C) is correct answer.

77 votes

-- Manish Joshi (20.5k points)

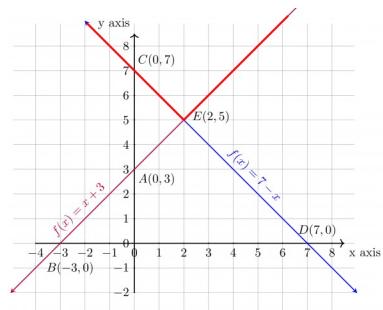
### 9.27.3 Maxima Minima: GATE2010 TF: GA-5 top

<https://gateoverflow.in/312024>



✓  $y = f(x) = \max(7 - x, x + 3) \rightarrow (1)$

We can draw the graph



To find the intersection point we can equate the two lines

$$\begin{aligned} \Rightarrow 7 - x &= x + 3 \\ \Rightarrow 2x &= 4 \Rightarrow x = 2 \end{aligned}$$

Put  $x = 2$  in equation (1) and get  $y = 5$

$$\Rightarrow \text{Intersection point } (x, y) = (2, 5)$$

Among the given options only option C range includes 2.

So, Correct answer is (C).

7 votes

-- Lakshman Patel (63.9k points)

### 9.27.4 Maxima Minima: GATE2013 CE: GA-6 top

<https://gateoverflow.in/40274>



✓  $f(x, y) = 3x + 6y = 3(x + 2y)$

maximum value of  $x + 2y$  is given by equation 2 which is  $x + 2y \leq 8$

i.e maximum value of  $f(x, y) = 3 * (8) = 24$

$f(x, y) = 24$  can be obtained by putting  $x = 4/3$  &  $y = 10/3$

So, answer is (A).

8 votes

-- Vivek Srivastava (3k points)

## 9.28

### Modular Arithmetic (2) top

#### 9.28.1 Modular Arithmetic: GATE2012 CY: GA-1 top

<https://gateoverflow.in/40232>



If  $(1.001)^{1259} = 3.52$  and  $(1.001)^{2062} = 7.85$ , then  $(1.001)^{3321} =$

- A. 2.23
- B. 4.33
- C. 11.37
- D. 27.64

[gate2012-cy](#)
[quantitative-aptitude](#)
[modular-arithmetic](#)
Answer

### 9.28.2 Modular Arithmetic: GATE2017 CE-1: GA-8 top ↗

<https://gateoverflow.in/313482>


The last digit of  $(2171)^7 + (2172)^9 + (2173)^{11} + (2174)^{13}$  is

- A. 2
- B. 4
- C. 6
- D. 8

[gate2017-ce-1](#)
[modular-arithmetic](#)
[quantitative-aptitude](#)
[numerical-computation](#)
Answer

## Answers: Modular Arithmetic

### 9.28.1 Modular Arithmetic: GATE2012 CY: GA-1 top ↗

<https://gateoverflow.in/40232>


- ✓  $1259 + 2062 = 3321$

So, Answer is  $3.52 \times 7.85 = 27.64$  (Ans)

Option (d) is correct.

12 votes

-- Himanshu Agarwal (12.4k points)

### 9.28.2 Modular Arithmetic: GATE2017 CE-1: GA-8 top ↗

<https://gateoverflow.in/313482>


- ✓ We know that

For unit digit 1,

- $1^n = 1$  where  $n$  is whole number

For unit digit 2,

- $2^1 = 2$
- $2^2 = 4$
- $2^3 = 8$
- $2^4 = 16$
- $2^5 = 32$
- Cyclicity of 2 is 4.

For unit digit 3,

- $3^1 = 3$
- $3^2 = 9$
- $3^3 = 27$
- $3^4 = 81$
- $3^5 = 243$
- Cyclicity of 3 is 4.

For unit digit 4,

- $4^1 = 4$
- $4^2 = 16$
- $4^3 = 64$
- $4^4 = 256$
- $4^5 = 1024$
- Cyclicity of 4 is 2.

For unit digit 6,

- $6^1 = 6$
- $6^2 = 36$
- We can write last digit of 6 is  $6^n = 6$  where  $n \in N$

$$(2171)^7 + (2172)^9 + (2173)^{11} + (2174)^{13}$$

We want to find last digit, so we can focus only last digit.

$$\begin{aligned} &\Rightarrow (1)^7 + (2)^9 + (3)^{11} + (4)^{13} \\ &\Rightarrow 1 + (2^4)^2 \cdot 2^1 + (3^4)^2 \cdot 3^3 + (4)^{\text{odd}} \\ &\Rightarrow 1 + (6)^2 \cdot 2^1 + (1)^2 \cdot 3^3 + 4 \\ &\Rightarrow 1 + 6 \cdot 2 + 7 + 4 \\ &\Rightarrow 1 + 2 + 7 + 4 \\ &\Rightarrow 14 \end{aligned}$$

So, last digit is 4

The answer (B) is the correct choice

6 votes

-- Lakshman Patel (63.9k points)

## 9.29

### Number Series (10)

#### 9.29.1 Number Series: GATE CSE 2013 | Question: 61

<https://gateoverflow.in/1565>



Find the sum of the expression

$$\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \dots + \frac{1}{\sqrt{80}+\sqrt{81}}$$

- A. 7
- B. 8
- C. 9
- D. 10

[gate2013-cse](#) [quantitative-aptitude](#) [normal](#) [number-series](#)

Answer

#### 9.29.2 Number Series: GATE CSE 2014 Set 2 | Question: GA-5

<https://gateoverflow.in/1942>



The value of  $\sqrt{12 + \sqrt{12 + \sqrt{12 + \dots}}}$  is

- A. 3.464
- B. 3.932
- C. 4.000
- D. 4.444

[gate2014-cse-set2](#) [quantitative-aptitude](#) [easy](#) [number-series](#)

Answer

#### 9.29.3 Number Series: GATE CSE 2014 Set 3 | Question: GA-4

<https://gateoverflow.in/2027>



Which number does not belong in the series below?

2, 5, 10, 17, 26, 37, 50, 64

- A. 17
- B. 37
- C. 64

D. 26

[gate2014-cse-set3](#) [quantitative-aptitude](#) [number-series](#) [easy](#)

Answer 

#### 9.29.4 Number Series: GATE2010 TF: GA-7

 <https://gateoverflow.in/312026>



Consider the series  $\frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{8} + \frac{1}{9} - \frac{1}{16} + \frac{1}{32} + \frac{1}{27} - \frac{1}{64} + \dots$ . The sum of the infinite series above is:

- A.  $\infty$
- B.  $\frac{5}{6}$
- C.  $\frac{1}{2}$
- D. 0

[general-aptitude](#) [quantitative-aptitude](#) [gate2010-tf](#) [number-series](#)

Answer 

#### 9.29.5 Number Series: GATE2013 EE: GA-10

 <https://gateoverflow.in/40297>



Find the sum to ' $n$ ' terms of the series  $10 + 84 + 734 + \dots$

- A.  $\frac{9(9^n+1)}{10} + 1$
- B.  $\frac{9(9^n-1)}{8} + 1$
- C.  $\frac{9(9^n-1)}{8} + n$
- D.  $\frac{9(9^n-1)}{8} + n^2$

[gate2013-ee](#) [quantitative-aptitude](#) [number-series](#)

Answer 

#### 9.29.6 Number Series: GATE2014 EC-1: GA-5

 <https://gateoverflow.in/41494>



What is the next number in the series?

12    35    81    173    357    \_\_\_\_\_.

[gate2014-ec-1](#) [number-series](#) [quantitative-aptitude](#) [numerical-answers](#)

Answer 

#### 9.29.7 Number Series: GATE2014 EC-2: GA-5

 <https://gateoverflow.in/41512>



Fill in the missing number in the series.

2    3    6    15    \_\_\_\_\_ 157.5    630

[gate2014-ec-2](#) [number-series](#) [quantitative-aptitude](#) [numerical-answers](#)

Answer 

#### 9.29.8 Number Series: GATE2014 EC-3: GA-4

 <https://gateoverflow.in/41143>



The next term in the series  $81, 54, 36, 24, \dots$  is \_\_\_\_\_.

[gate2014-ec-3](#) [number-series](#) [quantitative-aptitude](#) [numerical-answers](#)

Answer 

#### 9.29.9 Number Series: GATE2018 CE-1: GA-9

 <https://gateoverflow.in/313256>



Consider a sequence of numbers  $a_1, a_2, a_3, \dots, a_n$  where  $a_n = \frac{1}{n} - \frac{1}{n+2}$ , for each integer  $n > 0$ . What is the sum of the first 50 terms?

- A.  $(1 + \frac{1}{2}) - \frac{1}{50}$
- B.  $(1 + \frac{1}{2}) + \frac{1}{50}$

- C.  $\left(1 + \frac{1}{2}\right) - \left(\frac{1}{51} + \frac{1}{52}\right)$   
D.  $1 - \left(\frac{1}{51} + \frac{1}{52}\right)$

gate2018-ce-1 general-aptitude quantitative-aptitude number-series

Answer 

### 9.29.10 Number Series: GATE2018 EC: GA-4 top ↴

→ <https://gateoverflow.in/205208>



What is the value of  $1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \frac{1}{256} + \dots$ ?

- A.  $\frac{2}{7}$   
B.  $\frac{4}{3}$   
C.  $\frac{3}{2}$   
D.  $\frac{4}{3}$

gate2018-ec general-aptitude quantitative-aptitude number-series

Answer 

## Answers: Number Series

### 9.29.1 Number Series: GATE CSE 2013 | Question: 61 top ↴

→ <https://gateoverflow.in/1565>



- ✓ when you such overlapping expressions just rationalise it and add in most of the case you will be left with lesser number of terms ..in this case i am left with  $\sqrt{81} - \sqrt{1} = 8$ .

$$\frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}} + \dots + \frac{1}{\sqrt{80} + \sqrt{81}}$$

$$= \frac{1}{\sqrt{1} + \sqrt{2}} \times \left( \frac{\sqrt{1} - \sqrt{2}}{\sqrt{1} - \sqrt{2}} \right) + \frac{1}{\sqrt{2} + \sqrt{3}} \times \left( \frac{\sqrt{2} - \sqrt{3}}{\sqrt{2} - \sqrt{3}} \right) + \frac{1}{\sqrt{3} + \sqrt{4}} \times \left( \frac{\sqrt{3} - \sqrt{4}}{\sqrt{3} - \sqrt{4}} \right) + \dots + \frac{1}{\sqrt{80} + \sqrt{81}} \times$$

$$= \frac{\sqrt{1} - \sqrt{2}}{(\sqrt{1})^2 - (\sqrt{2})^2} + \frac{\sqrt{2} - \sqrt{3}}{(\sqrt{2})^2 - (\sqrt{3})^2} + \frac{\sqrt{3} - \sqrt{4}}{(\sqrt{3})^2 - (\sqrt{4})^2} + \dots + \frac{\sqrt{80} - \sqrt{81}}{(\sqrt{80})^2 - (\sqrt{81})^2}$$

$$= -(\sqrt{1} - \sqrt{2} + \sqrt{2} - \sqrt{3} + \sqrt{3} - \sqrt{4} + \dots + \sqrt{80} - \sqrt{81})$$

$$= \sqrt{81} - \sqrt{1}$$

$$= 8$$

Correct Answer: B

 42 votes

-- Bhagirathi Nayak (11.7k points)

### 9.29.2 Number Series: GATE CSE 2014 Set 2 | Question: GA-5 top ↴

→ <https://gateoverflow.in/1942>



✓  $x = \sqrt{12 + x}$

$$\implies x^2 = 12 + x$$

$$\implies x^2 - x - 12 = 0$$

$$\implies (x - 4)(x + 3) = 0$$

$$\implies x = 4 \text{ or } x = -3$$

Correct Answer: C

122 votes

-- Arjun Suresh (32.8k points)

### 9.29.3 Number Series: GATE CSE 2014 Set 3 | Question: GA-4 top

<https://gateoverflow.in/2027>



- If  $a_1, a_2, a_3, \dots, a_n$  is the series and  $i = 1$  to  $n$ , then the series is defined as  $a_i = i^2 + 1$ . i.e the  $i^{th}$  term is 1 plus the square of  $i$ .

Series will be as follows :  $1^2 + 1, 2^2 + 1, 3^2 + 1, 4^2 + 1, \dots, n^2 + 1$   
 $2, 5, 10, 17, 26, 37, 50, 65$

Hence 64 does not belong to the series.

Correct Answer: C

13 votes

-- Srinath Jayachandran (2.9k points)

### 9.29.4 Number Series: GATE2010 TF: GA-7 top

<https://gateoverflow.in/312026>



- We can observe that there is sum of two series.

$$\left( \frac{(1)}{2} + \frac{(-1)}{2^2} + \frac{(1)}{2^3} + \frac{(-1)}{2^4} + \frac{(1)}{2^5} + \frac{(-1)}{2^6} + \frac{(1)}{2^7} + \dots \right) + \left( \frac{1}{3^1} + \frac{1}{3^2} + \frac{1}{3^3} + \frac{1}{3^4} + \frac{1}{3^5} + \dots \right)$$

Both parts are in G.P.

First series with  $a = \frac{1}{2}$  and  $r = \frac{(-1)}{2}$   $\implies$  infinite sum  $= \frac{a}{1-r} = \frac{\frac{1}{2}}{1-\frac{(-1)}{2}} = \frac{1}{3}$

Second series with  $a = \frac{1}{3}$  and  $r = \frac{1}{3}$   $\implies$  infinite sum  $= \frac{a}{1-r} = \frac{\frac{1}{3}}{1-\frac{1}{3}} = \frac{1}{2}$

Final Sum  $= \frac{1}{3} + \frac{1}{2} = \frac{5}{6}$ .

9 votes

-- Shaik Masthan (50.2k points)

### 9.29.5 Number Series: GATE2013 EE: GA-10 top

<https://gateoverflow.in/40297>



- Ans).** This is a arithmetico -geometric series . and the break down of each number in the sequence is as follows

$$9^1 + 1, 9^2 + 3, 9^3 + 5, \dots$$

Now if we use substitution method we can find the right summation formula for the above sequence.

Take for example the first two terms of the sequence and add them we will get the sum as  $10 + 84 = 94$

Now consider the option D ,here we have  $n = 2$ , So ,we are trying to find the sum for first two numbers of the sequence.

$$\frac{9(9^2 - 1)}{8} + 2^2 = 94. \text{ Same procedure can be used to find the sum of first three numbers in the sequence}$$

The answer is option D

7 votes

-- ibia (2.2k points)

### 9.29.6 Number Series: GATE2014 EC-1: GA-5 top

<https://gateoverflow.in/41494>



- one way is this to get the answer as 725 bcz their difference is each time double

and other way is  $12 \times 2 + 11 = 35$

$$35 \times 2 + 11 = 81$$

$$81 \times 2 + 11 = 173$$

so mul by 2 and add 11 and lastly we do  $357 \times 2 + 11 = 725$

8 votes

-- rajan (4.4k points)

### 9.29.7 Number Series: GATE2014 EC-2: GA-5 [top](#)



✓  $2 \times 1.5 = 3$

$$3 \times 2 = 6$$

$$6 \times 2.5 = 15$$

$15 \times 3 = 45$  is answer

$45 \times 3.5 = 157.5$  means each time increase multiplication factor by 0.5

13 votes

-- rajan (4.4k points)

### 9.29.8 Number Series: GATE2014 EC-3: GA-4 [top](#)



✓ We get next term in sequence by  $\left(\frac{X}{3}\right) \times 2$

$$\frac{81}{3} = 27 \times 2 = 54$$

$$\frac{54}{3} = 18 \times 2 = 36$$

$$\frac{36}{3} = 12 \times 2 = 24$$

$$\frac{24}{3} = 8 \times 2 = 16$$

**Answer)16**

13 votes

-- Abhilash Panicker (7.6k points)

### 9.29.9 Number Series: GATE2018 CE-1: GA-9 [top](#)



✓ Sequence of numbers  $a_1, a_2, a_3, \dots, a_n$

where  $a_n = \frac{1}{n} - \frac{1}{n+2}$  for each integer  $n > 0$

Now we find the 1<sup>st</sup> term, 2<sup>nd</sup> term up to 50<sup>th</sup> term

$$a_1 = \frac{1}{1} - \frac{1}{1+2} = 1 - \frac{1}{3}$$

$$a_2 = \frac{1}{2} - \frac{1}{2+2} = \frac{1}{2} - \frac{1}{4}$$

$$a_3 = \frac{1}{3} - \frac{1}{3+2} = \frac{1}{3} - \frac{1}{5}$$

$$a_4 = \frac{1}{4} - \frac{1}{4+2} = \frac{1}{4} - \frac{1}{6}$$

$$a_{50} = \frac{1}{50} - \frac{1}{50+2} = \frac{1}{50} - \frac{1}{52}$$

Sum of the first 50 terms

$$S = a_1 + a_2 + a_3 + a_4 + \dots + a_{50}$$

$$S = 1 - \frac{1}{3} + \frac{1}{2} - \frac{1}{4} + \frac{1}{3} - \frac{1}{5} + \frac{1}{4} - \frac{1}{6} + \dots + \frac{1}{50} - \frac{1}{52}$$

We can write like this

$$\begin{aligned} S &= \left(1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{50}\right) - \left(\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \dots + \frac{1}{52}\right) \\ &= \left(1 + \frac{1}{2}\right) + \left\{\left(\frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{50}\right) - \left(\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \dots + \frac{1}{50}\right)\right\} - \frac{1}{51} - \frac{1}{52} \end{aligned}$$

$$= \left(1 + \frac{1}{2}\right) - \left(\frac{1}{51} + \frac{1}{52}\right)$$

So, correct options is (C).

2 votes

-- Lakshman Patel (63.9k points)

### 9.29.10 Number Series: GATE2018 EC: GA-4 top ↗

<https://gateoverflow.in/205208>

- ✓ It is an infinite G.P. with first term  $a = 1$  and common ratio  $r = \frac{1}{4}$ .

Sum of infinite G.P with  $|r| < 1$  is

$$S_{\infty} = \frac{a}{1-r}$$

$$S_{\infty} = \frac{1}{1 - \frac{1}{4}}$$

$$S_{\infty} = \frac{4}{3}$$

Hence option d) is correct

5 votes

-- Ashwani Kumar (12.8k points)

### 9.30

### Number System (1) top ↗

#### 9.30.1 Number System: GATE Civil 2020 Set 1 | GA Question: 5 top ↗

<https://gateoverflow.in/359858>

The sum of two positive numbers is 100. After subtracting 5 from each number, the product of the resulting numbers is 0. One of the original numbers is \_\_\_\_\_.

- A. 80
- B. 85
- C. 90
- D. 95

gate2020-ce-1 quantitative-apptitude number-system

Answer

### Answers: Number System

#### 9.30.1 Number System: GATE Civil 2020 Set 1 | GA Question: 5 top ↗

<https://gateoverflow.in/359858>

- ✓ Let the two positive numbers be  $x$  and  $y$ .

According to the question,  $x + y = 100 \rightarrow (1)$

And,  $(x - 5) \cdot (y - 5) = 0$

$$\Rightarrow xy - 5x - 5y + 25 = 0$$

$$\Rightarrow x(100-x) - 5(100) + 25 = 0 \quad [\because \text{From equation (1)}]$$

$$\Rightarrow 100x - x^2 - 500 + 25 = 0$$

$$\Rightarrow -x^2 + 100x - 475 = 0$$

$$\Rightarrow x^2 - 100x + 475 = 0$$

$$\Rightarrow x^2 - 95x - 5x + 475 = 0$$

$$\Rightarrow x(x - 95) - 5(x - 95) = 0$$

$$\Rightarrow (x - 95)(x - 5) = 0$$

$$\implies (x - 95) = 0 \text{ & } (x - 5) = 0$$

Now, if  $x = 95 \implies y = 5$ , and if  $x = 5 \implies y = 95$ .

$\therefore$  One of the original number is 95.

**PS:** If one number is non-zero, then another number is 5, so that when we subtract 5 from each the product will be 0.

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

9.31

### Number Theory (5) top ↗

#### 9.31.1 Number Theory: GATE CSE 2014 Set 3 | Question: GA-10 top ↗

► <https://gateoverflow.in/2034>



Consider the equation:  $(7526)_8 - (Y)_8 = (4364)_8$ , where  $(X)_N$  stands for  $X$  to the base  $N$ . Find  $Y$ .

- A. 1634
- B. 1737
- C. 3142
- D. 3162

[gate2014-cse-set3](#) [quantitative-aptitude](#) [number-theory](#) [normal](#) [digital-logic](#)

Answer

#### 9.31.2 Number Theory: GATE Electrical 2021 | GA Question: 4 top ↗

► <https://gateoverflow.in/359749>



Which one of the following numbers is exactly divisible by  $(11^{13} + 1)$ ?

- A.  $11^{26} + 1$
- B.  $11^{33} + 1$
- C.  $11^{39} - 1$
- D.  $11^{52} - 1$

[gateee-2021](#) [quantitative-aptitude](#) [number-system](#) [number-theory](#)

Answer

#### 9.31.3 Number Theory: GATE2012 AE: GA-8 top ↗

► <https://gateoverflow.in/40219>



If a prime number on division by 4 gives a remainder of 1, then that number can be expressed as

- A. sum of squares of two natural numbers
- B. sum of cubes of two natural numbers
- C. sum of square roots of two natural numbers
- D. sum of cube roots of two natural numbers

[gate2012-ae](#) [number-theory](#) [quantitative-aptitude](#)

Answer

#### 9.31.4 Number Theory: GATE2016 ME-2: GA-9 top ↗

► <https://gateoverflow.in/108304>



The binary operation  $\square$  is defined as  $a \square b = ab + (a + b)$ , where  $a$  and  $b$  are any two real numbers. The value of the identity element of this operation, defined as the number  $x$  such that  $a \square x = a$ , for any  $a$ , is

- A. 0
- B. 1
- C. 2
- D. 10

[gate2016-me-2](#) [quantitative-aptitude](#) [number-theory](#) [easy](#)

Answer

**9.31.5 Number Theory: GATE2017 ME-2: GA-3** top ↴<https://gateoverflow.in/313669>

If  $a$  and  $b$  are integers and  $a - b$  is even, which of the following must always be even?

- A.  $ab$
- B.  $a^2 + b^2 + 1$
- C.  $a^2 + b + 1$
- D.  $ab - b$

[gate2017-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [number-theory](#)

Answer

**Answers: Number Theory****9.31.1 Number Theory: GATE CSE 2014 Set 3 | Question: GA-10** top ↴<https://gateoverflow.in/2034>

✓ C.

The given numbers are in octal representation. Digits range from 0 to 7.

$$Y = 7526 - 4364$$

$$\begin{array}{r} 7526 \\ -4364 \\ \hline \end{array}$$

$$\begin{array}{r} 3142 \\ \hline \end{array}$$

steps : 1.  $(6 - 4) = 2$

2.  $(2 - 6)$ , borrow a 8. Now  $(8 + 2 - 6) = 4$

3.  $(5 - 1 - 3) = 1$  (Subtracted by 1 because ONE 8 was borrowed)

4.  $(7 - 4) = 3$

26 votes

-- Srinath Jayachandran (2.9k points)

**9.31.2 Number Theory: GATE Electrical 2021 | GA Question: 4** top ↴<https://gateoverflow.in/359749>

✓ We know that,

- $x^n - y^n$  is divisible by  $x + y$ , if  $n$  is even.
- $x^n - y^n$  is divisible by  $x - y$ , if  $n$  is odd.
- $x^n + y^n$  is divisible by  $x + y$ , if  $n$  is odd.

Now, we can check each option.

- A.  $11^{26} + 1 = (11^{13})^2 + 1^2$  is divisible by  $11^{13} + 1$ , if 2 is odd.
- B.  $11^{33} + 1 = (11^{11})^3 + 1^3$ , here  $11^{11} + 1 \neq 11^{13} + 1$ .
- C.  $11^{39} - 1 = (11^{13})^3 - 1^3$ , here  $11^{13} - 1 \neq 11^{13} + 1$ .
- D.  $11^{52} - 1 = (11^{13})^4 - 1^4$  is divisible by  $11^{13} + 1$ , if 4 is even.

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

**9.31.3 Number Theory: GATE2012 AE: GA-8** top ↴<https://gateoverflow.in/40219>

✓ Theorem: If  $p$  is a prime number which has remainder 1 when divided by 4, then  $p$  can be written as a sum of two squares.

(Reference: <http://math.arizona.edu/~wmc/Courses/323044/Lecture4.pdf>)

Example:

- $5 = 1 + 4$
- $13 = 9 + 4$
- $17 = 16 + 1$
- $29 = 25 + 4$
- $37 = 36 + 1$
- $41 = 25 + 16$

- $53 = 49 + 4$
- $61 = 36 + 25$
- $73 = 64 + 9$
- and so on.

So, option (A) is correct.

Take option (B) sum of cubes of two natural numbers.

Counter example: 5 cannot represent as cubes of two natural numbers ( $1^3 = 1, 2^3 = 8 \implies 1 + 8 = 9 \neq 5$ ).

So, option (B) is not correct.

Take option (C) sum of square roots of two natural numbers

Let  $p = 4n + 1, n \geq 0$  and  $p$  is prime.

The smallest such  $p$  is 5.

So, any  $p$  can be written as  $p = p_1 + p_2$  where  $p_1$  and  $p_2$  are natural numbers. Now, existence of  $p_1^2$  and  $p_2^2$  makes option C correct.

For option D, instead of  $p_1^2$  and  $p_2^2$  in above explanation we just need to change to  $p_1^3$  and  $p_2^3$ .

Correct options : (A), (C), (D).

It is better to pick option A here, because Options C and D seem to be given by mistake. Nowadays at least in GATE this will cause Marks to All during debate.

#### References



2 votes

-- Lakshman Patel (63.9k points)

#### 9.31.4 Number Theory: GATE2016 ME-2: GA-9 top ↗

→ <https://gateoverflow.in/108304>



✓  $a \square 0 = a \times 0 + (a + 0) = a$ .

So, 0 is the identity element.

3 votes

-- AKANKSHA DEWANGAN (3k points)

#### 9.31.5 Number Theory: GATE2017 ME-2: GA-3 top ↗

→ <https://gateoverflow.in/313669>



✓ Given that :  $a, b \in \mathbb{Z}$

$a - b = \text{even}$

- even – even = even ✓
- even – odd = odd
- odd – even = odd
- odd – odd = even ✓

Case1 :  $a = \text{even}, b = \text{even} \implies a - b = \text{even}$

- even  $\times$  even = even
- even  $\times$  odd = even
- odd  $\times$  even = even
- odd  $\times$  odd = odd
- even + even = even
- even + odd = odd
- odd + even = odd
- odd + odd = even

- A.  $ab$  ✓  
 B.  $a^2 + b^2 + 1$

- C.  $a^2 + b + 1$   
 D.  $ab - b \checkmark$

Case2 :  $a = \text{odd}$ ,  $b = \text{odd} \implies a - b = \text{even}$

- A.  $ab$   
 B.  $a^2 + b^2 + 1$   
 C.  $a^2 + b + 1$   
 D.  $ab - b \checkmark$

So, the correct answer is (D).

2 votes

-- Lakshman Patel (63.9k points)

## 9.32

### Numerical Computation (21) top ↗

#### 9.32.1 Numerical Computation: GATE CSE 2011 | Question: 65 top ↗

☞ <https://gateoverflow.in/2175>



A container originally contains 10 litres of pure spirit. From this container, 1 litre of spirit replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time. How much spirit is now left in the container?

- A. 7.58 litres  
 B. 7.84 litres  
 C. 7 litres  
 D. 7.29 litres

[gate2011-cse](#) [quantitative-aptitude](#) [normal](#) [numerical-computation](#)

Answer

#### 9.32.2 Numerical Computation: GATE CSE 2014 Set 1 | Question: GA-4 top ↗

☞ <https://gateoverflow.in/773>



If  $\left(z + \frac{1}{z}\right)^2 = 98$ , compute  $\left(z^2 + \frac{1}{z^2}\right)$ .

[gate2014-cse-set1](#) [quantitative-aptitude](#) [easy](#) [numerical-answers](#) [numerical-computation](#)

Answer

#### 9.32.3 Numerical Computation: GATE CSE 2017 Set 1 | Question: GA-4 top ↗

☞ <https://gateoverflow.in/118407>



Find the smallest number  $y$  such that  $y \times 162$  is a perfect cube.

- A. 24  
 B. 27  
 C. 32  
 D. 36

[gate2017-cse-set1](#) [general-aptitude](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer

#### 9.32.4 Numerical Computation: GATE CSE 2017 Set 2 | Question: GA-4 top ↗

☞ <https://gateoverflow.in/118418>



A test has twenty questions worth 100 marks in total. There are two types of questions. Multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?

- A. 12  
 B. 15  
 C. 18  
 D. 19

[gate2017-cse-set2](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer

**9.32.5 Numerical Computation: GATE CSE 2017 Set 2 | Question: GA-8** [top](#)<https://gateoverflow.in/118422>

$X$  is a 30 digit number starting with the digit 4 followed by the digit 7. Then the number  $X^3$  will have

- A. 90 digits
- B. 91 digits
- C. 92 digits
- D. 93 digits

[gate2017-cse-set2](#) [quantitative-aptitude](#) [numerical-computation](#) [number-representation](#)

Answer

**9.32.6 Numerical Computation: GATE Chemical 2020 | GA Question: 9** [top](#)<https://gateoverflow.in/359810>

For a matrix  $M = [m_{ij}]$ ;  $i, j = 1, 2, 3, 4$ , the diagonal elements are all zero and  $m_{ij} = -m_{ji}$ . The minimum number of elements required to fully specify the matrix is \_\_\_\_\_

- A. 0
- B. 6
- C. 12
- D. 16

[gate2020-ch](#) [quantitative-aptitude](#) [numerical-computation](#) [matrices](#)

Answer

**9.32.7 Numerical Computation: GATE2010 MN: GA-9** [top](#)<https://gateoverflow.in/312018>

A positive integer  $m$  in base 10 when represented in base 2 has the representation  $p$  and in base 3 has the representation  $q$ . We get  $p - q = 990$  where the subtraction is done in base 10. Which of the following is necessarily true:

- A.  $m \geq 14$
- B.  $9 \leq m \leq 13$
- C.  $6 \leq m \leq 8$
- D.  $m < 6$

[general-aptitude](#) [quantitative-aptitude](#) [gate2010-mn](#) [numerical-computation](#)

Answer

**9.32.8 Numerical Computation: GATE2010 TF: GA-10** [top](#)<https://gateoverflow.in/312029>

A student is answering a multiple choice examination with 65 questions with a marking scheme as follows : i) 1 marks for each correct answer , ii)  $-\frac{1}{4}$  for a wrong answer , iii)  $-\frac{1}{8}$  for a question that has not been attempted . If the student gets 37 marks in the test then the least possible number of questions the student has NOT answered is :

- A. 6
- B. 5
- C. 7
- D. 4

[general-aptitude](#) [quantitative-aptitude](#) [gate2010-tf](#) [numerical-computation](#)

Answer

**9.32.9 Numerical Computation: GATE2010 TF: GA-9** [top](#)<https://gateoverflow.in/312028>

A tank has 100 liters of water. At the end of every hour, the following two operations are performed in sequence : i) water equal to  $m\%$  of the current contents of the tank is added to the tank , ii) water equal to  $n\%$  of the current contents of the tank is removed from the tank. At the end of 5 hours, the tank contains exactly 100 liters of water . The relation between  $m$  and  $n$  is :

- A.  $m = n$
- B.  $m > n$
- C.  $m < n$

- D. None of the previous

[general-aptitude](#) [quantitative-aptitude](#) [gate2010-tf](#) [numerical-computation](#)

Answer 

### 9.32.10 Numerical Computation: GATE2012 CY: GA-1 [top](#)

<https://gateoverflow.in/40241>



Raju has 14 currency notes in his pocket consisting of only Rs. 20 notes and Rs. 10 notes. The total money value of the notes is Rs. 230. The number of Rs. 10 notes that Raju has is

- A. 5
- B. 6
- C. 9
- D. 10

[gate2012-cy](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer 

### 9.32.11 Numerical Computation: GATE2013 CE: GA-1 [top](#)

<https://gateoverflow.in/40268>



A number is as much greater than 75 as it is smaller than 117. The number is:

- A. 91
- B. 93
- C. 89
- D. 96

[gate2013-ce](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer 

### 9.32.12 Numerical Computation: GATE2014 EC-2: GA-8 [top](#)

<https://gateoverflow.in/41516>



The sum of eight consecutive odd numbers is 656. The average of four consecutive even numbers is 87. What is the sum of the smallest odd number and second largest even number?

[gate2014-ec-2](#) [quantitative-aptitude](#) [numerical-answers](#) [numerical-computation](#)

Answer 

### 9.32.13 Numerical Computation: GATE2014 EC-4: GA-4 [top](#)

<https://gateoverflow.in/41466>



Let  $f(x, y) = x^n y^m = P$ . If  $x$  is doubled and  $y$  is halved, the new value of  $f$  is

- A.  $2^{n-m}P$
- B.  $2^{m-n}P$
- C.  $2(n-m)P$
- D.  $2(m-n)P$

[gate2014-ec-4](#) [quantitative-aptitude](#) [easy](#) [numerical-computation](#)

Answer 

### 9.32.14 Numerical Computation: GATE2016 CE-2: GA-5 [top](#)

<https://gateoverflow.in/110889>



The sum of the digits of a two digit number is 12. If the new number formed by reversing the digits is greater than the original number by 54, find the original number.

- A. 39
- B. 57
- C. 66
- D. 93

[gate2016-ce-2](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer 

**9.32.15 Numerical Computation: GATE2017 ME-1: GA-7** top ↗<https://gateoverflow.in/313660>

What is the sum of the missing digits in the subtraction problem below?

$$\begin{array}{r} 5 & - & - & - & - \\ - 4 & 8 & - & 8 & 9 \\ \hline 1 & 1 & 1 & 1 \end{array}$$

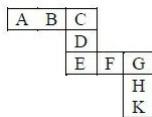
- A. 8
- B. 10
- C. 11
- D. Cannot be determined.

[gate2017-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer 

**9.32.16 Numerical Computation: GATE2018 CE-2: GA-10** top ↗<https://gateoverflow.in/313382>

Each of the letters in the figure below represents a unique integer from 1 to 9. The letters are positioned in the figure such that each of  $(A + B + C)$ ,  $(C + D + E)$ ,  $(E + F + G)$  and  $(G + H + K)$  is equal to 13. Which integer does  $E$  represent?



- A. 1
- B. 4
- C. 6
- D. 7

[gate2018-ce-2](#) [general-aptitude](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer 

**9.32.17 Numerical Computation: GATE2018 ME-1: GA-5** top ↗<https://gateoverflow.in/313646>

A number consists of two digits. The sum of the digits is 9. If 45 is subtracted from the number, its digits are interchanged. What is the number?

- A. 63
- B. 72
- C. 81
- D. 90

[gate2018-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [numerical-computation](#)

Answer 

**9.32.18 Numerical Computation: GATE2018 ME-2: GA-9** top ↗<https://gateoverflow.in/313630>

A house has a number which need to be identified. The following three statements are given that can help in identifying the house number?

- i. If the house number is a multiple of 3, then it is a number from 50 to 59.
- ii. If the house number is NOT a multiple of 4, then it is a number from 60 to 69.
- iii. If the house number is NOT a multiple of 6, then it is a number from 70 to 79.

What is the house number?

- A. 54
- B. 65
- C. 66
- D. 76

[gate2018-me-2](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[numerical-computation](#)
[Answer](#)
**9.32.19 Numerical Computation: GATE2019 EE: GA-9**
top ↗
<https://gateoverflow.in/313566>


Given two sets  $X = \{1, 2, 3\}$  and  $Y = \{2, 3, 4\}$ , we construct a set  $Z$  of all possible fractions where the numerators belong to set  $X$  and the denominators belong to set  $Y$ . The product of elements having minimum and maximum values in the set  $Z$  is \_\_\_\_\_.

- A.  $1/12$
- B.  $1/8$
- C.  $1/6$
- D.  $3/8$

[gate2019-ee](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[numerical-computation](#)
[Answer](#)
**9.32.20 Numerical Computation: GATE2019 ME-1: GA-4**
top ↗
<https://gateoverflow.in/313598>


The sum and product of two integers are 26 and 165 respectively. The difference between these two integers is \_\_\_\_\_.

- A. 2
- B. 3
- C. 4
- D. 6

[gate2019-me-1](#)
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[Answer](#)
**9.32.21 Numerical Computation: GATE2019 ME-2: GA-4**
top ↗
<https://gateoverflow.in/313573>


The product of three integers  $X$ ,  $Y$  and  $Z$  is 192.  $Z$  is equal to 4 and  $P$  is equal to the average of  $X$  and  $Y$ . What is the minimum possible value of  $P$ ?

- A. 6
- B. 7
- C. 8
- D. 9.5

[gate2019-me-2](#)
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**Answers: Numerical Computation**
**9.32.1 Numerical Computation: GATE CSE 2011 | Question: 65**
top ↗
<https://gateoverflow.in/2175>


✓ Quantity left after  $n$  operations  $= x \left(1 - \frac{y}{x}\right)^n$

where,  $x$  = initial quantity

$y$  = amount of mixture withdrawn each time (this should be same every time)

$n$  = no. of times operation performed

$$\begin{aligned}
 &= 10 \left(1 - \frac{1}{10}\right)^3 \\
 &= 10 \left(\frac{9}{10}\right)^3 \\
 &= 10 \times 0.9 \times 0.9 \times 0.9 \\
 &= 10 \times 0.729 = 7.29 \text{ litres}
 \end{aligned}$$

Hence, option D is correct.

29 votes

-- Manu Thakur (34k points)

**9.32.2 Numerical Computation: GATE CSE 2014 Set 1 | Question: GA-4**

✓ 
$$\left( Z + \frac{1}{Z} \right)^2 = \left( z^2 + 2(z) \left( \frac{1}{z} \right) + \left( \frac{1}{z} \right)^2 \right) = \left( z^2 + \frac{1}{z^2} \right) + 2 = 98$$

$\Rightarrow 98 - 2 = 96$  is answer..

21 votes

-- Jay (831 points)

**9.32.3 Numerical Computation: GATE CSE 2017 Set 1 | Question: GA-4**

✓  $y \times 162 = y \times 3^4 \times 2$

So, for perfect cube we need to add two 3s and two 2s.

Answer is:  $3^2 \times 2^2 = 36$ .

Correct Answer: D

24 votes

-- KAUSHAL DUBEY (259 points)

**9.32.4 Numerical Computation: GATE CSE 2017 Set 2 | Question: GA-4**

✓ Ans: B.15

Let the number of MCQs be  $x$  and number of essay questions be  $y$ .

Given MCQs are worth 3 marks each and essay questions are worth 11 marks each.

Also, total number of questions is 20 worth 100 marks in total.

$$\Rightarrow x + y = 20 \text{ and } 3x + 11y = 100.$$

$$\Rightarrow 3x + 11(20 - x) = 100$$

$$\Rightarrow 8x = 120$$

$$\Rightarrow x = \frac{120}{8} = 15$$

13 votes

-- Orochimaru (483 points)

**9.32.5 Numerical Computation: GATE CSE 2017 Set 2 | Question: GA-8**

✓  $X = 4777\ldots (7 \text{ 29 times})$

It can be written as  $X = 4.7777\ldots * 10^{29}$

$$X^3 = (4.777\ldots * 10^{29})^3 = (4.777\ldots)^3 * 10^{87}$$

Now, even if we round up  $4.777\ldots$  to 5, we could represent  $5^3 = 125$  in 3 digits. So, We can say  $(4.77\ldots)^3$  also has 3 digits before decimal point.

So,  $X^3$  requires  $3 + 87 = 90$  digits.

Correct Answer: A

82 votes

-- Manish Joshi (20.5k points)

**9.32.6 Numerical Computation: GATE Chemical 2020 | GA Question: 9**

- ✓ For a matrix  $M = [m_{ij}]$ ;  $i, j = 1, 2, 3, 4$ , the diagonal elements are all zero and  $m_{ij} = -m_{ji}$  (This is the property of skew-symmetric matrix).

$$\text{Now, } M = \begin{bmatrix} 0 & -m_{21} & -m_{31} & -m_{41} \\ m_{21} & 0 & -m_{32} & -m_{42} \\ m_{31} & m_{32} & 0 & -m_{43} \\ m_{41} & m_{42} & m_{43} & 0 \end{bmatrix}$$

Out of 16 elements, 4 are 0s and 6 are the negative of the other 6. So, we need at least 6 elements to fully specify the matrix.

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

### 9.32.7 Numerical Computation: GATE2010 MN: GA-9 top ↴

<https://gateoverflow.in/312018>



$$p - q = 990 \implies p = 1100, q = 110$$

In base 10 subtraction we are getting result 990. Since  $p$  is in base 2 it can have digits 0 or 1 only. And since  $q$  is in base 3 it can have digits 0, 1, 2 only.

We can get result digit 0 by

- 0 – 0
- 1 – 1

We can get result digit 9 by

- 10 – 1
- 11 – 2

So, possible values of  $p$  and  $q$  can be (their decimal values must be same too)

- 1100 and 110 – 12
- 1101 and 111 – 13

So, only matching option is Option B.

2 votes

-- Arjun Suresh (328k points)

### 9.32.8 Numerical Computation: GATE2010 TF: GA-10 top ↴

<https://gateoverflow.in/312029>



- ✓ Let  $n_c$  denote the number of correct answers and  $n_w$  denote the number of wrong answers.

$$\text{Total marks} = 1 \times n_c - \frac{1}{4} \times n_w - \frac{1}{8} \times (65 - (n_c + n_w))$$

$$\text{It is given } 37 = n_c - \frac{1}{4} \times n_w - \frac{1}{8} \times (65 - (n_c + n_w))$$

$$\implies 37 = n_c - \frac{1}{4} \times n_w - \frac{65}{8} + \frac{n_c}{8} + \frac{n_w}{8}$$

$$\implies 45 + \frac{1}{8} = n_c + \frac{n_c}{8} - \frac{n_w}{8}$$

$$\implies 361 = 9n_c - n_w$$

To minimize the number of unanswered questions we have to maximize  $n_c + n_w$ .

Possible values of  $(n_c, n_w)$  are

- (41, 8)
- (42, 17)
- (43, 26) – not possible as  $43 + 26 > 65$ .

So, maximum value of  $n_c + n_w = 42 + 17 = 59$ .

So, minimum number of unanswered questions  $= 65 - 59 = 6$ .

Correct Option: A.

1 votes

-- Arjun Suresh (328k points)

### 9.32.9 Numerical Computation: GATE2010 TF: GA-9 top ↴

<https://gateoverflow.in/312028>



- ✓ Initially the tank is having 100 liters of water.

Every hour, the capacity changes as  $C' = C \left(1 + \frac{m}{100}\right) \left(1 - \frac{n}{100}\right)$

So, after 5 hours we get  $C' = 100 = 100 \left(1 + \frac{m}{100}\right)^5 \left(1 - \frac{n}{100}\right)^5$

$$\Rightarrow \left(1 + \frac{m}{100}\right)^5 \left(1 - \frac{n}{100}\right)^5 = 1$$

$$\Rightarrow \left(1 + \frac{m}{100}\right) \left(1 - \frac{n}{100}\right) = 1$$

$$\Rightarrow 1 + \frac{m}{100} - \frac{n}{100} - \frac{mn}{10000} = 1$$

$$\Rightarrow 100(m - n) = mn$$

Since,  $m, n > 0, m - n > 0 \Rightarrow m > n$ .

4 votes

-- Arjun Suresh (328k points)

#### 9.32.10 Numerical Computation: GATE2012 CY: GA-10 [top](#)



✓ No. of Rs 20 notes  $-x$

No. of Rs 10 notes  $-y$

Given,

$$x + y = 14$$

$$20x + 10y = 230$$

Solving the two equations, we get.

$$x = 9, y = 5$$

So, the number of Rs. 10 notes is 5.

**Answer A.**

8 votes

-- Abhilash Panicker (7.6k points)

#### 9.32.11 Numerical Computation: GATE2013 CE: GA-1 [top](#)



✓ D. 96

Let the number be  $x$ . Writing equation,

$$x - 75 = 117 - x$$

$$2 \times x = 192$$

$$x = \frac{192}{2} = 96$$

11 votes

-- Gaurav Sharma (1.8k points)

#### 9.32.12 Numerical Computation: GATE2014 EC-2: GA-8 [top](#)

<https://gateoverflow.in/41516>



✓ Let the eight consecutive odd numbers be  $n, n + 2, n + 4, n + 6, n + 8, n + 10, n + 12$  and  $n + 14$

Sum of these numbers is 656,  $\Rightarrow 8n + 56 = 656$ , so,  $n = 75$ .

Let the four consecutive even numbers be  $m, m + 2, m + 4$ , and  $m + 6$

Average of these numbers is 87,  $\Rightarrow \frac{(4m + 12)}{4} = 87$ , so,  $m = 84$

Sum of smallest odd number and second largest even number is  $n + (m + 4) = 75 + 88 = 163$

14 votes

-- Praveen Saini (41.9k points)

#### 9.32.13 Numerical Computation: GATE2014 EC-4: GA-4 [top](#)

<https://gateoverflow.in/41466>



✓  $f(x, y) = x^n y^m = P$

Now,  $x$  is doubled so we substitute  $2x$  for  $x$  AND  $y$  is halved so we substitute  $y/2$  for  $y$

$$f(x, y) = (2x)^n \left(\frac{y}{2}\right)^m$$

We get,

$$f(x, y) = (2)^n (x)^n (y)^m (2)^{-m}$$

$$f(x, y) = 2^{n-m} x^n y^m = 2^{n-m} P$$

Answer A)  $2^{n-m} P$

12 votes

-- Abhilash Panicker (7.6k points)



#### 9.32.14 Numerical Computation: GATE2016 CE-2: GA-5 top ↴

<https://gateoverflow.in/110889>

- ✓ Let the two digits be  $x$  and  $y$ .

Original number =  $xy = 10x + y$

$$x + y = 12 \rightarrow (1)$$

Given that new number formed by reversing the digits is greater than the original number by 54,

$$y * 10 + x = 10 * x + y + 54$$

$$10y + x = 10x + y + 54$$

$$9y - 9x = 54$$

$$x - y = -6 \rightarrow (2)$$

From (1) and (2)

$$2x = 6$$

$$x = 3 \text{ and } y = 9$$

Hence, Original number =  $xy = 10x + y = 39$

Correct Answer: A

4 votes

-- Muktinath Vishwakarma (23.9k points)



#### 9.32.15 Numerical Computation: GATE2017 ME-1: GA-7 top ↴

<https://gateoverflow.in/313660>

- ✓ Answer D

$$50100 - 48989 = 1111$$

and

$$50000 - 48889 = 1111$$

Since, there are two possibilities the missing digits can not be determined.

4 votes

-- Ajay kumar soni (10.6k points)



#### 9.32.16 Numerical Computation: GATE2018 CE-2: GA-10 top ↴

<https://gateoverflow.in/313382>



- ✓ We have to get sum 13 in 4 ways.

- $A + B + C = 13$

- $C + D + E = 13$

- $E + F + G = 13$

- $G + H + I = 13$

Adding all 4 we get

$$A + B + D + F + H + I + 2(C + E + G) = 52$$

Since  $A \rightarrow G$  sum to 45 we get

$$C + E + G = 52 - 45 = 7$$

Only option we can add to 7 with 3 distinct positive integers is  $1 + 2 + 4$ . So,  $C, E, G \in \{1, 2, 4\}$

We also have  $C + D + E = 13$ . If  $C$  and  $E$  are 1, 2 this is not possible as this requires  $D$  to be 10 which is not allowed. So, at least one of  $E$  or  $C$  must be 4 also making  $G$  to be either 1 or 2.

Since,  $E + F + G = 13$ ,  $E + G$  must also be  $\geq 4$  meaning  $E$  and  $G$  cannot be 1, 2. Since,  $G \leq 2$ , it means  $E > 2$ .

So, only option is  $E = 4$ .

Correct Option: B.

6 votes

-- Arjun Suresh (328k points)

### 9.32.17 Numerical Computation: GATE2018 ME-1: GA-5 [top](#)

<https://gateoverflow.in/313646>



- ✓ Let the two digit number be  $xy$ . Its value in decimal is  $10x + y$ .

Then sum of two digits  $= x + y = 9 \rightarrow (1)$

$$\text{and } (10x + y) - 45 = 10y + x \quad \{\because xy = 10y + x\}$$

$$10x + y - 10y - x = 45$$

$$x - y = 5 \rightarrow (2)$$

From the equations (1) and (2), we get  $x = 7, y = 2$

So, the number is 72

Correct answer: (B).

1 votes

-- Lakshman Patel (63.9k points)

### 9.32.18 Numerical Computation: GATE2018 ME-2: GA-9 [top](#)

<https://gateoverflow.in/313630>



- ✓ Consider 54:

- $54 \bmod 3 = 0$  and 54 lies between 50 and 59
- $54 \bmod 4 \neq 0$  but 54 does not lie between 60 and 69, hence 54 is not the answer

Consider 65:

- $65 \bmod 3 \neq 0$
- $65 \bmod 4 \neq 0$  and 65 lies between 60 and 69
- $65 \bmod 6 \neq 0$  but 65 does not lie between 70 and 79, hence 65 is not the answer

Consider 66:

- $66 \bmod 3 = 0$  but 66 does not lie between 50 and 59, hence 66 is not the answer

Consider 76:

- $76 \bmod 3 \neq 0$
- $76 \bmod 4 = 0$
- $76 \bmod 6 \neq 0$  and 76 lies between 70 and 79, hence 76 is the answer

**D is Correct 😊**

1 votes

-- Balaji Jegan (3.5k points)

### 9.32.19 Numerical Computation: GATE2019 EE: GA-9 [top](#)

<https://gateoverflow.in/313566>



- ✓ Answer D.

For minimum value pick the smallest value from  $X$  as numerator and largest value from  $Y$  as denominator  
 $\Rightarrow$  Minimum value =  $\frac{1}{4}$

For maximum value pick the largest value from  $X$  as numerator and smallest value from  $Y$  as denominator  
 $\Rightarrow$  Maximum value =  $\frac{3}{2}$

$$\text{Their product} = \frac{1}{4} \times \frac{3}{2} = \frac{3}{8}$$

2 votes

-- Shalini26 (449 points)

**9.32.20 Numerical Computation: GATE2019 ME-1: GA-4** top ↗ <https://gateoverflow.in/313598>

- ✓ Let the two integers be  $x$  and  $y$ .

Given that:

- $x + y = 26 \rightarrow (1)$
- $xy = 165 \rightarrow (2)$

To be find:  $x - y = ?$ We know that  $(x - y)^2 = x^2 + y^2 - 2xy$ 

$$\Rightarrow (x - y)^2 = x^2 + y^2 + 2xy - 4xy$$

$$\Rightarrow (x - y)^2 = (x + y)^2 - 4xy$$

Put the values from equation (1) and (2) and we get

$$\Rightarrow (x - y)^2 = (26)^2 - 4 \times 165$$

$$\Rightarrow (x - y)^2 = 676 - 660$$

$$\Rightarrow (x - y)^2 = 16$$

$$\Rightarrow (x - y) = \sqrt{16}$$

$$\Rightarrow x - y = \pm 4$$

$$\Rightarrow x - y = 4 \text{ (or)} x - y = -4$$

-4 is ruled out as both the sum and product of the numbers are positive meaning both the numbers must be positive.

So, (C) is the correct choice.

4 votes

-- Lakshman Patel (63.9k points)

**9.32.21 Numerical Computation: GATE2019 ME-2: GA-4** top ↗ <https://gateoverflow.in/313573>**Given**

$$X * Y * Z = 192,$$

$$Z = 4,$$

$$P = \left( \frac{X+Y}{2} \right)$$

**Solution**

$$X * Y * Z = 192$$

$$\Rightarrow X * Y * 4 = 192$$

$$\Rightarrow X * Y = 48$$

Now 48 should be broken into product of 2 numbers such that they are close to each other because if numbers are close to each other then their average will be minimum..

For eg:- 48 can be  $4 * 12$ ,  $1 * 48$ ,  $6 * 8$ ,  $16 * 3$  but here we will select  $6 * 8$  because 6 and 8 are closest to each other with a difference of 2.

$$\Rightarrow X * Y = 6 * 8$$

$$X = 6, Y = 8$$

$$P = \left( \frac{X+Y}{2} \right) = \left( \frac{8+6}{2} \right) = 7$$

 $\therefore$  Option B. 7 is the correct answer.

3 votes

-- Satbir Singh (20.9k points)

**9.33****Percentage (19)** top ↗

**9.33.1 Percentage: GATE CSE 2014 Set 1 | Question: GA-8** [top](#)<https://gateoverflow.in/776>

Round-trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is *Rs* 100, a group of 5 tourists purchasing round-trip tickets will be charged *Rs* \_\_\_\_\_

[gate2014-cse-set1](#) [quantitative-aptitude](#) [easy](#) [numerical-answers](#) [percentage](#)

Answer

**9.33.2 Percentage: GATE CSE 2014 Set 3 | Question: GA-8** [top](#)<https://gateoverflow.in/2032>

The Gross Domestic Product (*GDP*) in Rupees grew at 7% during 2012 – 2013. For international comparison, the *GDP* is compared in US Dollars (*USD*) after conversion based on the market exchange rate. During the period 2012 – 2013 the exchange rate for the *USD* increased from *Rs.* 50/*USD* to *Rs.* 60/*USD*. India's GDP in USD during the period 2012 – 2013

- A. increased by 5%
- B. decreased by 13%
- C. decreased by 20%
- D. decreased by 11%

[gate2014-cse-set3](#) [quantitative-aptitude](#) [normal](#) [percentage](#)

Answer

**9.33.3 Percentage: GATE Mechanical 2020 Set 2 | GA Question: 5** [top](#)<https://gateoverflow.in/359548>

There are five levels  $\{P, Q, R, S, T\}$  in a linear supply chain before a product reaches customers, as shown in the figure.



At each of the five levels, the price of the product is increased by 25%. If the product is produced at level *P* at the cost of *Rs.* 120 per unit, what is the price paid (in rupees) by the customers?

- A. 187.50
- B. 234.38
- C. 292.96
- D. 366.21

[gateme-2020-set2](#) [quantitative-aptitude](#) [percentage](#)

Answer

**9.33.4 Percentage: GATE2011 AG: GA-4** [top](#)<https://gateoverflow.in/312121>

There are two candidates *P* and *Q* in an election. During the campaign, 40% of the voters promised to vote for *P*, and rest for *Q*. However, on the day of election 15% of the voters went back on their promise to vote for *P* and instead voted for *Q*. 25% of the voters went back on their promise to vote for *Q* and instead voted for *P*. Suppose, *P* lost by 2 votes, then what was the total number of voters?

- A. 100
- B. 110
- C. 90
- D. 95

[general-aptitude](#) [quantitative-aptitude](#) [gate2011-ag](#) [percentage](#)

Answer

**9.33.5 Percentage: GATE2012 AE: GA-7** [top](#)<https://gateoverflow.in/40218>

The total runs scored by four cricketers *P*, *Q*, *R* and *S* in years 2009 and 2010 are given in the following table;

Player	2009	2010
P	802	1008
Q	765	912
R	429	619
S	501	701

The player with the lowest percentage increase in total runs is

- A. P
- B. Q
- C. R
- D. S

gate2012-ae quantitative-aptitude percentage

Answer ↗

### 9.33.6 Percentage: GATE2012 CY: GA-8 top ↗

→ <https://gateoverflow.in/40239>



The data given in the following table summarizes the monthly budget of an average household.

Category	Amount(Rs.)
Food	4000
Rent	2000
Savings	1500
Other expenses	1800
Clothing	1200

The approximate percentage of the monthly budget NOT spent on savings is

- A. 10%
- B. 14%
- C. 81%
- D. 86%

gate2012-cy quantitative-aptitude percentage

Answer ↗

### 9.33.7 Percentage: GATE2013 EE: GA-2 top ↗

→ <https://gateoverflow.in/40289>



In the summer of 2012, in New Delhi, the mean temperature of Monday to Wednesday was  $41^{\circ}\text{C}$  and of Tuesday to Thursday was  $43^{\circ}\text{C}$ . If the temperature on Thursday was 15% higher than that of Monday, then the temperature in  $^{\circ}\text{C}$  on Thursday was

- A. 40
- B. 43
- C. 46
- D. 49

gate2013-ee quantitative-aptitude percentage

Answer ↗

### 9.33.8 Percentage: GATE2014 AE: GA-9 top ↗

→ <https://gateoverflow.in/40309>



One percent of the people of country  $X$  are taller than 6 ft. Two percent of the people of country  $Y$  are taller than 6 ft. There are thrice as many people in country  $X$  as in country  $Y$ . Taking both countries together, what is the percentage of people taller than 6 ft?

- A. 3.0
- B. 2.5
- C. 1.5
- D. 1.25

gate2014-ae percentage quantitative-aptitude

Answer 

### 9.33.9 Percentage: GATE2014 EC-4: GA-8

<https://gateoverflow.in/41470>



Industrial consumption of power doubled from 2000 – 2001 to 2010 – 2011. Find the annual rate of increase in percent assuming it to be uniform over the years.

- A. 5.6
- B. 7.2
- C. 10.0
- D. 12.2

gate2014-ec-4 percentage normal quantitative-aptitude

Answer 

### 9.33.10 Percentage: GATE2015 CE-2: GA-7

<https://gateoverflow.in/40182>



The given question is followed by two statements; select the most appropriate option that solves the question.

Capacity of a solution tank  $A$  is 70% of the capacity of tank  $B$ . How many gallons of solution are in tank  $A$  and tank  $B$ ?

Statements:

- I. Tank  $A$  is 80% full and tank  $B$  is 40% full.
- II. Tank  $A$  if full contains 14,000 gallons of solution.

- A. Statement I alone is sufficient.
- B. Statement II alone is sufficient.
- C. Either statement I or II alone is sufficient.
- D. Both the statements I and II together are sufficient.

gate2015-ce-2 quantitative-aptitude general-aptitude percentage

Answer 

### 9.33.11 Percentage: GATE2016 CE-2: GA-4

<https://gateoverflow.in/110885>



$(x\% \text{ of } y) + (y\% \text{ of } x)$  is equivalent to \_\_\_\_\_.

- A. 2% of  $xy$
- B. 2% of  $(xy/100)$
- C.  $xy\%$  of 100
- D. 100% of  $xy$

gate2016-ce-2 quantitative-aptitude percentage

Answer 

### 9.33.12 Percentage: GATE2016 EC-1: GA-4

<https://gateoverflow.in/108074>



In a huge pile of apples and oranges, both ripe and unripe mixed together, 15% are unripe fruits. Of the unripe fruits, 45% are apples. Of the ripe ones, 66% are oranges. If the pile contains a total of 5692000 fruits, how many of them are apples?

- A. 2029198
- B. 2467482
- C. 2789080
- D. 3577422

gate2016-ec-1 percentage quantitative-aptitude

**Answer****9.33.13 Percentage: GATE2017 CE-1: GA-4** top ↗<https://gateoverflow.in/313484>

If the radius of a right circular cone is increased by 50% its volume increases by

- A. 75%
- B. 100%
- C. 125%
- D. 237.5%

[gate2017-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [percentage](#) [geometry](#)
**Answer****9.33.14 Percentage: GATE2017 EC-1: GA-3** top ↗<https://gateoverflow.in/313519>

In the summer, water consumption is known to decrease overall by 25%. A Water Board official states that in the summer household consumption decreases by 20%, while other consumption increases by 70%. Which of the following statement is correct?

- A. The ratio of household to other consumption is 8/17
- B. The ratio of household to other consumption is 1/17
- C. The ratio of household to other consumption is 17/8
- D. There are errors in the official's statement.

[gate2017-ec-1](#) [general-aptitude](#) [quantitative-aptitude](#) [percentage](#)
**Answer****9.33.15 Percentage: GATE2018 EE: GA-9** top ↗<https://gateoverflow.in/205189>

A designer uses marbles of four different colours for his designs. The cost of each marble is the same, irrespective of the colour. The table below shows the percentage of marbles of each colour used in the current design. The cost of each marble increased by 25%. Therefore, the designer decided to reduce equal numbers of marbles of each colour to keep the total cost unchanged. What is the percentage of blue marbles in the new design?

Blue	Black	Red	Yellow
40%	25%	20%	15%

- A. 35.75
- B. 40.25
- C. 43.75
- D. 46.25

[gate2018-ee](#) [general-aptitude](#) [quantitative-aptitude](#) [normal](#) [percentage](#)
**Answer****9.33.16 Percentage: GATE2019 CE-2: GA-7** top ↗<https://gateoverflow.in/313372>

Population of state  $X$  increased by  $x\%$  and the population of state  $Y$  increased by  $y\%$  from 2001 to 2011. Assume that  $x$  is greater than  $y$ . Let  $P$  be the ratio of the population of state  $X$  to state  $Y$  in a given year. The percentage increase in  $P$  from 2001 to 2011 is \_\_\_\_\_

- A.  $\frac{x}{y}$
- B.  $x - y$
- C.  $\frac{100(x-y)}{100+x}$
- D.  $\frac{100(x-y)}{100+y}$

[gate2019-ce-2](#) [general-aptitude](#) [quantitative-aptitude](#) [percentage](#)
**Answer**

**9.33.17 Percentage: GATE2019 IN: GA-3** [top](#)<https://gateoverflow.in/313546>

The radius as well as the height of a circular cone increases by 10%. The percentage increase in its volume is \_\_\_\_\_.

- A. 17.1
- B. 21.0
- C. 33.1
- D. 72.8

[gate2019-in](#) [general-aptitude](#) [quantitative-aptitude](#) [geometry](#) [percentage](#)

Answer

**9.33.18 Percentage: GATE2019 IN: GA-7** [top](#)<https://gateoverflow.in/313548>

In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners, only 294 million access the Internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country?

- A. 10.50
- B. 14.70
- C. 15.00
- D. 50.00

[gate2019-in](#) [general-aptitude](#) [quantitative-aptitude](#) [percentage](#)

Answer

**9.33.19 Percentage: GATE2019 ME-2: GA-6** [top](#)<https://gateoverflow.in/313578>

Fiscal deficit was 4% of the GDP in 2015 and that increased to 5% in 2016. If the GDP increased by 10% from 2015 to 2016, the percentage increase in the actual fiscal deficit is \_\_\_\_\_

- A. 37.50
- B. 35.70
- C. 25.00
- D. 10.00

[gate2019-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [percentage](#)

Answer

**Answers: Percentage****9.33.1 Percentage: GATE CSE 2014 Set 1 | Question: GA-8** [top](#)<https://gateoverflow.in/776>

- ✓ For individual, round-trip discount 10% on TOTAL fare.

So, for each person, discount for Total fare of Rs.  $200 = 200 \times 1.1 = 20$ .

So, for 5 members discount = 100 rupees

For 5 member group they is extra 5% discount on TOTAL fare i.e.,  $5 \times 200 \times 5\% = 50$  rupees.

Total discount is  $100 + 50 = 150$ .

They have to pay  $5 \times 200 - 150 = 850$  rupees

16 votes

-- Palash Nandi (1.2k points)

**9.33.2 Percentage: GATE CSE 2014 Set 3 | Question: GA-8** [top](#)<https://gateoverflow.in/2032>

- ✓ Let India's  $GDP = Rs. x$

$Rs. 50 = 1 USD$

$$Rs. x = \frac{1}{50} \times x \text{ USD}$$

$$\text{New } GDP = GDP + 0.07 \times GDP$$

$$= Rs 1.07x$$

$$Rs 60 = 1 \text{ USD}$$

$$Rs 1.07x = \frac{1}{60} \times 1.07x$$

$$\text{Change in GDP} = \frac{\text{new} - \text{old}}{\text{old}} \times 100$$

$$= \frac{\left(\frac{1.07x}{60}\right) - \left(\frac{x}{50}\right)}{\frac{x}{50}} \times 100$$

$$= \frac{\left(\frac{-13x}{6000}\right)}{\left(\frac{x}{50}\right)} \times 100$$

$$= \left(\frac{-13}{120}\right) \times 100$$

$$= -0.10833 \times 100$$

$$= -10.833$$

$$\approx -11$$

So, there is an 11% decrease

Answer = **option D**

26 votes

-- Amar Vashishth (25.2k points)



### 9.33.3 Percentage: GATE Mechanical 2020 Set 2 | GA Question: 5 top

<https://gateoverflow.in/359548>

- Given that, at each of the five levels, the price of the product is increased by 25%.

Then, the price paid (in rupees) by the customers =  $120 \times \frac{125}{100} \times \frac{125}{100} \times \frac{125}{100} \times \frac{125}{100} \times \frac{125}{100} = \frac{46875}{128} = 366.21$ .

(Or)

The price paid (in rupees) by the customers =  $(1.25)^5 \times 120 = 366.21$ .

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)



### 9.33.4 Percentage: GATE2011 AG: GA-4 top

<https://gateoverflow.in/312121>

- Let  $x$  be the number of votes

- Number of votes  $P$  was supposed to get =  $0.4x$
- Number of votes  $Q$  was supposed to get =  $0.6x$

Now according to the given conditions,

- Number of votes  $P$  got =  $\frac{85}{100}(0.4x) + \frac{25}{100}(0.6x)$
- Number of votes  $Q$  has got =  $\frac{75}{100}(0.6x) + \frac{15}{100}(0.4x)$

$$P - Q = 2$$

$$\implies \frac{75}{100}(0.6x) + \frac{15}{100}(0.4x) - \frac{85}{100}(0.4x) - \frac{25}{100}(0.6x) = 2$$

$$\implies 45x + 6x - 34x - 15x = 200$$

$$\implies x = 100$$

Correct Option: A.

13 votes

-- Pooja Palod (24k points)

### 9.33.5 Percentage: GATE2012 AE: GA-7 top ↗

<https://gateoverflow.in/40218>



- ✓ % increase is defined as:  $\left( \frac{\text{final value} - \text{initial value}}{\text{initial value}} \right) \times 100$

$$p = \frac{206}{802} \times 100 = 25.68\%$$

$$q = \frac{147}{765} \times 100 = 19.21$$

$$r = \frac{190}{429} \times 100 = 44.28$$

$$s = \frac{200}{501} \times 100 = 39.42$$

So, the lowest increase is for Q.

B is the answer

6 votes

-- Joker (1.6k points)

### 9.33.6 Percentage: GATE2012 CY: GA-8 top ↗

<https://gateoverflow.in/40239>



- ✓  $\frac{9000}{10500} \times 100 = 85.7\%$

Correct Answer: D

8 votes

-- srestha (85k points)

### 9.33.7 Percentage: GATE2013 EE: GA-2 top ↗

<https://gateoverflow.in/40289>



- ✓ Let the temperatures on Monday, Tuesday, Wednesday and Thursday be  $x^\circ, y^\circ, z^\circ$  and  $w^\circ C$  respectively.

Given that,

- $x + y + z = 3 \times 41$
- $y + z + w = 3 \times 43$

Thursday temperature is 15% higher than Monday temperature. So,

- $w = 1.15x$

After solving above equations, we get  $w = 46$

Therefore, correct answer is (C).

7 votes

-- suraj (4.8k points)

### 9.33.8 Percentage: GATE2014 AE: GA-9 top ↗

<https://gateoverflow.in/40309>



- ✓ Let the no. people in  $Y = a$ .

No. of people in  $Y$  greater than 6 feet =  $\frac{2a}{100}$

No. of people in  $X = 3a$

No. of people in  $X$  greater than 6 feet =  $\frac{3a}{100}$

Total number of people greater than 6 feet =  $\frac{2a}{100} + \frac{3a}{100} = \frac{5a}{100}$

Total number of people =  $a + 3a = 4a$ .

$$\text{Percentage of people in } X + Y \text{ greater than 6 feet} = \left( \frac{5a}{100} \div 4a \right) \times 100 = 1.25\%$$

Correct Answer: D

6 votes

-- Sandip Shaw (803 points)



### 9.33.9 Percentage: GATE2014 EC-4: GA-8 [top](#)

<https://gateoverflow.in/41470>

- ✓ Here we need to consider compound interest consumption is doubled in 10 years

$$2P = P \left[ 1 + \frac{R}{100} \right]^{10}$$

$$2 = \left[ 1 + \frac{R}{100} \right]^{10}$$

$$\sqrt[10]{2} \times 100 = 100 + R$$

$$1.07177 \times 100 = 100 + R$$

$$R = 7.177 \approx 7.2$$

So, ans is option B

12 votes

-- Lokesh Dafale (8.2k points)



### 9.33.10 Percentage: GATE2015 CE-2: GA-7 [top](#)

<https://gateoverflow.in/40182>

- ✓ Statement 1 gives the relative filling of the 2 tanks.

Statement 2 gives the capacity of Tank A.

And since we have the relative capacities of the two tanks with both statements we can get the current amount of solution in them. And both the statements are necessary.

Correct Option: D

2 votes

-- Arjun Suresh (328k points)



### 9.33.11 Percentage: GATE2016 CE-2: GA-4 [top](#)

<https://gateoverflow.in/110885>

$$\checkmark X\% \text{ of } Y = \frac{X}{100} \times Y = X \times \frac{Y}{100} \rightarrow (1)$$

and

$$Y\% \text{ of } X = \frac{Y}{100} \times X = Y \times \frac{X}{100} \rightarrow (2)$$

From equations (1) and (2) it is clear that  $X\% \text{ of } Y + Y\% \text{ of } X$

$$= 2 \times \frac{XY}{100} \text{ which is equivalent to } 2\% \text{ of } XY$$

Hence, Answer is option A

7 votes

-- Arnabi Bej (5.8k points)



### 9.33.12 Percentage: GATE2016 EC-1: GA-4 [top](#)

<https://gateoverflow.in/108074>

- ✓ Total fruits = 5692000

$$= \left\{ \begin{array}{l} \text{Unripe}(15\%) \rightarrow 853800 \\ \text{Ripe}(85\%) \rightarrow 4838200 \end{array} \right\}$$

$$= \left\{ \begin{array}{l} \text{Unripe}(15\%) \left\{ \begin{array}{l} \text{Apples}(45\%) \rightarrow 384210 \\ \text{Orange} \rightarrow \text{Don't care} \end{array} \right\} \\ \text{Ripe}(85\%) \left\{ \begin{array}{l} \text{Apples}(34\%) \rightarrow 1644988 \\ \text{Orange} \rightarrow \text{Don't care} \end{array} \right\} \end{array} \right\}$$

$$\text{So, Total Apples} = 384210 + 1644988 = 2029198$$

Correct Answer: A

6 votes

-- Lokesh Dafale (8.2k points)

**9.33.13 Percentage: GATE2017 CE-1: GA-4** top ↴[➡ https://gateoverflow.in/313484](https://gateoverflow.in/313484)

- ✓ Volume of the cone  $V = \frac{1}{3}\pi r^2 h$

Here only radius change so we can write  $V \propto r^2$

$$r \rightarrow r + \frac{50}{100}r \implies r \rightarrow 1.5r$$

$$\text{New volume } V' \propto (1.5r)^2 \propto 2.25r^2$$

$$\text{Percentage changes in volume} = \frac{2.25r^2 - r^2}{r^2} \times 100 = 1.25 \times 100 = 125\%$$

So, correct option is (C)

2 votes

-- Lakshman Patel (63.9k points)

**9.33.14 Percentage: GATE2017 EC-1: GA-3** top ↴[➡ https://gateoverflow.in/313519](https://gateoverflow.in/313519)

- ✓ Let the original water consumption be  $X = Y + Z \rightarrow (1)$ , where  $Y$  is the household consumption and  $Z$  is the other consumption.

$$\text{New water consumption} = 0.75X = 0.8Y + 1.7Z \rightarrow (2)$$

$$(2) - 0.75(1) \implies 0.05Y + 0.95Z = 0$$

which means either  $Y$  or  $Z$  must be negative which is not possible as both of them are consumption amount of water.

So, correct option is D. There are errors in the official's statement.

3 votes

-- Arjun Suresh (328k points)

**9.33.15 Percentage: GATE2018 EE: GA-9** top ↴[➡ https://gateoverflow.in/205189](https://gateoverflow.in/205189)

- ✓ Assuming total marbles = 100

& Cost of each marble = 1 Re.

$\therefore$  To buy 100 marbles designer need to spend  $100 \times 1 = 100$  Rs.

After increasing price cost of 100 marbles = 125 Rs.

Now, at 100 Rs. the designer can buy  $\frac{100}{125} \times 100 = 80$  marbles

the designer decided to reduce equal numbers of marbles of each colour to keep the total cost unchanged.

$$\text{Therefore } (40 - x) + (25 - x) + (20 - x) + (15 - x) = 80$$

$$4x = 100 - 80$$

$$x = 5$$

$$\text{Percentage of blue marbles in the new design} = \frac{40 - 5}{80} \times 100$$

$$= \frac{35}{80} \times 100 \\ = 43.75$$

Hence, the answer is **option C**

9 votes

-- Sukanya Das (9.9k points)

**9.33.16 Percentage: GATE2019 CE-2: GA-7** top ↴[➡ https://gateoverflow.in/313372](https://gateoverflow.in/313372)

- ✓  $P$  in 2001  $P_{2001} = \frac{a}{b}$  where  $a$  is the population of  $X$  and  $b$  that of  $Y$ .

$$P \text{ in 2011 } P_{2011} = \frac{\frac{a}{100}a}{\frac{y}{100}b} = \frac{(1+0.01x)a}{(1+0.01y)b}$$

$$\text{Percentage Increase in } P = \frac{P_{2011} - P_{2001}}{P_{2001}} \times 100$$

$$= \frac{\frac{(1+0.01x)a}{(1+0.01y)b} - \frac{a}{b}}{\frac{a}{b}} \times 100 = \left[ \frac{1+0.01x}{1+0.01y} - 1 \right] \times 100 = \frac{x-y}{100+y} \times 100 = \frac{100(x-y)}{100+y}$$

Correct Answer: D

3 votes

-- Arjun Suresh (328k points)



### 9.33.17 Percentage: GATE2019 IN: GA-3 [top](#)

<https://gateoverflow.in/313546>

✓ Volume of a cone,  $V = \frac{\pi}{3}r^2h$

$$r \rightarrow 1.1r, h \rightarrow 1.1h \implies V \rightarrow 1.1^2 \times 1.1V = 1.331V$$

So, percentage increase in volume = 33.1%

Correct Option: C

5 votes

-- Arjun Suresh (328k points)



### 9.33.18 Percentage: GATE2019 IN: GA-7 [top](#)

<https://gateoverflow.in/313548>

✓ Percentage of e-commerce buyers =  $\frac{294}{1400} \times 0.5 \times 100 = \frac{42}{4}\% = 10.5\%$

Correct Option: A

1 votes

-- Arjun Suresh (328k points)



### 9.33.19 Percentage: GATE2019 ME-2: GA-6 [top](#)

<https://gateoverflow.in/313578>

✓ Fiscal deficit in 2015 = 4% of GDP in 2015

Fiscal deficit in 2016 = 5% of GDP in 2016

GDP in 2016 =  $1.1 \times$  GDP in 2015

So, Fiscal deficit in 2016 = 5% of  $1.1 \times$  GDP in 2015 = 5.5% of GDP in 2015.

So, Fiscal deficit increased from 4% to 5.5% of the GDP in 2015.

$$\text{Percentage increase} = \frac{5.5 - 4}{4} \times 100\% = \frac{300}{8}\% = 37.5\%$$

3 votes

-- Arjun Suresh (328k points)

## 9.34

### Permutation And Combination (4) [top](#)



#### 9.34.1 Permutation And Combination: GATE Civil 2021 Set 1 | GA Question: 5 [top](#)

<https://gateoverflow.in/359881>

Four persons P, Q, R and S are to be seated in a row, all facing the same direction, but not necessarily in the same order. P and R cannot sit adjacent to each other. S should be seated to the right of Q. The number of distinct seating arrangements possible is:

- A. 2
- B. 4
- C. 6
- D. 8

[gatecivil-2021-set1](#) [quantitative-aptitude](#) [permutation-and-combination](#) [seating-arrangements](#)

Answer

#### 9.34.2 Permutation And Combination: GATE Civil 2021 Set 2 | GA Question: 5 [top](#)

<https://gateoverflow.in/359901>



Four persons P, Q, R and S are to be seated in a row. R should not be seated at the second position from the left end of the row. The number of distinct seating arrangements possible is:

- A. 6  
B. 9  
C. 18  
D. 24

gatcivil-2021-set2 quantitative-aptitude permutation-and-combination seating-arrangements

Answer 

### 9.34.3 Permutation And Combination: GATE Mechanical 2021 Set 1 | GA Question: 10



Five persons P, Q, R, S and T are sitting in a row not necessarily in the same order. Q and R are separated by one person, and S should not be seated adjacent to Q.

The number of distinct seating arrangements possible is:

- A. 4  
B. 8  
C. 10  
D. 16

gateme-2021-set1 quantitative-aptitude permutation-and-combination seating-arrangements

Answer 

### 9.34.4 Permutation And Combination: GATE Mechanical 2021 Set 2 | GA Question: 1



Five persons P, Q, R, S and T are to be seated in a row, all facing the same direction, but not necessarily in the same order. P and T cannot be seated at either end of the row. P should not be seated adjacent to S. R is to be seated at the second position from the left end of the row. The number of distinct seating arrangements possible is:

- A. 2  
B. 3  
C. 4  
D. 5

gateme-2021-set2 quantitative-aptitude permutation-and-combination seating-arrangements

Answer 

## Answers: Permutation And Combination

### 9.34.1 Permutation And Combination: GATE Civil 2021 Set 1 | GA Question: 5



- ✓ Given that, four persons P, Q, R and S are to be seated in a row.
  - P and R cannot sit adjacent to each other.
  - S should be seated to the right of Q.

Now, the four persons can be seated in the below arrangements:

- |   |   |   |   |
|---|---|---|---|
| Q | P | S | R |
|---|---|---|---|
- |   |   |   |   |
|---|---|---|---|
| Q | R | S | P |
|---|---|---|---|
- |   |   |   |   |
|---|---|---|---|
| P | Q | S | R |
|---|---|---|---|
- |   |   |   |   |
|---|---|---|---|
| R | Q | S | P |
|---|---|---|---|
- |   |   |   |   |
|---|---|---|---|
| P | Q | R | S |
|---|---|---|---|
- |   |   |   |   |
|---|---|---|---|
| R | Q | P | S |
|---|---|---|---|

∴ The number of distinct seating arrangements possible = 6.

So, the correct answer is (C).

 1 votes

-- Lakshman Patel (63.9k points)

**9.34.2 Permutation And Combination: GATE Civil 2021 Set 2 | GA Question: 5** top ↗ ↗ https://gateoverflow.in/359901

- ✓ It is given that, four persons  $P, Q, R$ , and  $S$  are to be seated in a row.  $R$  should not be seated at the second position from the left end of the row.

Now, we can make the possible arrangements.

- From the left end, the second position can be filled in 3 ways.
- From the left end, the first position can be filled in 3 ways.
- From the right end, the second position can be filled in 2 ways.
- From the right end, the first position can be filled in 1 way.

3	3	2	1
1	2	3	4

$\therefore$  The number of distinct seating arrangements possible  $= 3 \times 3 \times 2 \times 1 = 18$ .

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63,9k points)

**9.34.3 Permutation And Combination: GATE Mechanical 2021 Set 1 | GA Question: 10** top ↗

- ✓ Given that, five persons  $P, Q, R, S$ , and  $T$  are sitting in a row.

1.  $Q$  and  $R$  are separated by one person.
2.  $S$  should not be seated adjacent to  $Q$ .

We can follow the above two conditions, we get the following sitting orders:

- First fix the position of  $Q$ , and  $R$ , we get,
  - $Q P R S T$
  - $Q P R T S$
  - $Q T R S P$
  - $Q T R P S$
- Again fix the position of  $Q$ , and  $R$ , we get,
  - $P Q T R S$
  - $T Q P R S$
- Again fix the position of  $Q$ , and  $R$ , we get,
  - $S P Q T R$
  - $S T Q P R$

Now, we can fix the positions interchangeably, and get the following sitting orders:

- First fix the position of  $R$ , and  $Q$ , we get,
  - $R P Q T S$
  - $R T Q P S$
- Again fix the position of  $R$ , and  $Q$ , we get,
  - $S R P Q T$
  - $S R T Q P$
- Again fix the position of  $R$ , and  $Q$ , we get,
  - $S P R T Q$
  - $S T R P Q$
  - $P S R T Q$
  - $T S R P Q$

$\therefore$  The number of distinct seating arrangements possible  $= 16$ .

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63,9k points)

**9.34.4 Permutation And Combination: GATE Mechanical 2021 Set 2 | GA Question: 1** top ↗

- ✓ Given that, five persons  $P, Q, R, S$  and  $T$  are to be seated in a row.

- $P$  and  $T$  cannot be seated at either end of the row.
- $P$  should not be seated adjacent to  $S$ .

- $R$  is to be seated at the second position from the left end of the row.

Now, the five persons can be seated in the below arrangements:

- First we fix the position of  $R$ , and now we have two choices for  $P$  and  $T$ , then place the  $S$  and  $Q$  in the remaining positions.

- |     |     |     |     |     |
|-----|-----|-----|-----|-----|
| $S$ | $R$ | $P$ | $T$ | $Q$ |
|-----|-----|-----|-----|-----|
- |     |     |     |     |     |
|-----|-----|-----|-----|-----|
| $Q$ | $R$ | $P$ | $T$ | $S$ |
|-----|-----|-----|-----|-----|
- |     |     |     |     |     |
|-----|-----|-----|-----|-----|
| $S$ | $R$ | $T$ | $P$ | $Q$ |
|-----|-----|-----|-----|-----|

The number of distinct seating arrangements possible is = 3.

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

### 9.35

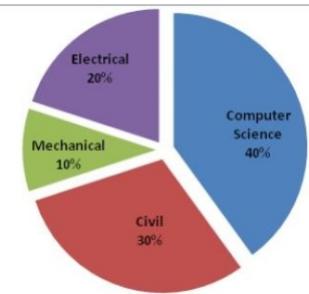
#### Pie Chart (11) [top](#)

##### 9.35.1 Pie Chart: GATE CSE 2015 Set 1 | Question: GA-9 [top](#)

<https://gateoverflow.in/8013>



The pie chart below has the breakup of the number of students from different departments in an engineering college for the year 2012. The proportion of male to female students in each department is 5 : 4. There are 40 males in Electrical Engineering. What is the difference between the numbers of female students in the civil department and the female students in the Mechanical department?



[gate2015-cse-set1](#) [quantitative-apitude](#) [data-interpretation](#) [numerical-answers](#) [pie-chart](#)

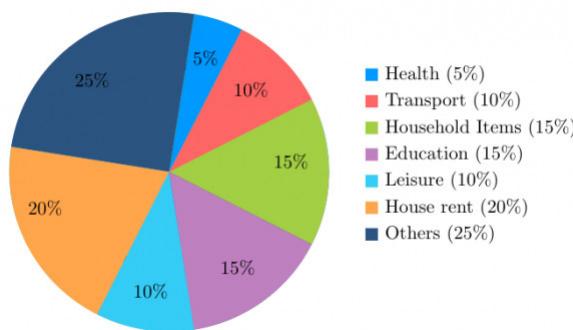
Answer [\\$](#)

##### 9.35.2 Pie Chart: GATE Civil 2020 Set 1 | GA Question: 10 [top](#)

<https://gateoverflow.in/359848>



The total expenditure of a family, on different activities in a month, is shown in the pie-chart. The extra money spent on education as compared to transport (in percent) is \_\_\_\_\_.



- A. 5  
B. 33.3  
C. 50  
D. 100

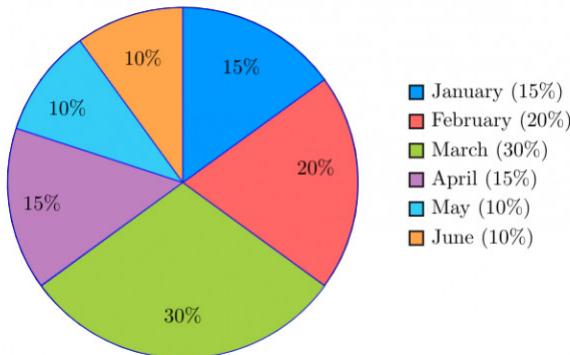
[gate2020-ce-1](#) [quantitative-apitude](#) [data-interpretation](#) [pie-chart](#)

Answer [\\$](#)

9.35.3 Pie Chart: GATE Civil 2020 Set 2 | GA Question: 10 [top ↴](#)<https://gateoverflow.in/359828>

The monthly distribution of 9 Watt LED bulbs sold by two firms  $X$  and  $Y$  from January to June 2018 is shown in the pie-chart and the corresponding table. If the total number of LED bulbs sold by the two firms during April-June 2018 is 50000, then the number of LED bulbs sold by the firm  $Y$  during April-June 2018 is \_\_\_\_\_.

Percentage of 9 Watt LED bulbs sold by the firms  $X$  and  $Y$  from January 2018 to June, 2018



Month	Ratio of LED bulbs sold by two firms ( $X : Y$ )
January	7 : 8
February	2 : 3
March	2 : 1
April	3 : 2
May	1 : 4
June	9 : 11

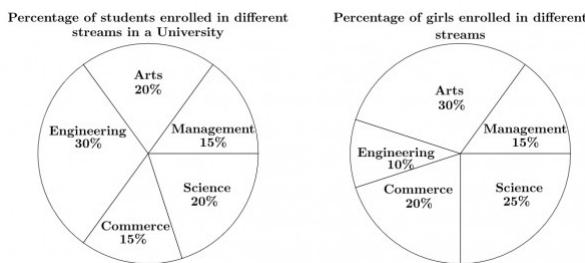
- A. 11250
- B. 9750
- C. 8750
- D. 8250

gate2020-ce-2 quantitative-aptitude data-interpretation pie-chart

Answer

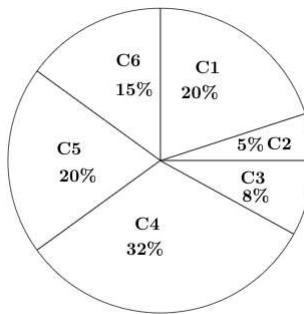
9.35.4 Pie Chart: GATE Mechanical 2020 Set 2 | GA Question: 10 [top ↴](#)<https://gateoverflow.in/359538>

The two pie-charts given below show the data of total students and only girls registered in different streams in a university. If the total number of students registered in the university is 5000, and the total number of the registered girls is 1500; then, the ratio of boys enrolled in Arts to the girls enrolled in Management is \_\_\_\_\_.



- A. 2 : 1
- B. 9 : 22
- C. 11 : 9
- D. 22 : 9

gateme-2020-set2 quantitative-aptitude data-interpretation pie-chart

Answer 9.35.5 Pie Chart: GATE Mechanical 2021 Set 1 | GA Question: 9 top ↗<https://gateoverflow.in/359469>

Company	Ratio
C1	3 : 2
C2	1 : 4
C3	5 : 3
C4	2 : 3
C5	9 : 1
C6	3 : 4

The distribution of employees at the rank of executives, across different companies  $C_1, C_2, \dots, C_6$  is presented in the chart given above. The ratio of executives with a management degree to those without a management degree in each of these companies is provided in the table above. The total number of executives across all companies is 10,000.

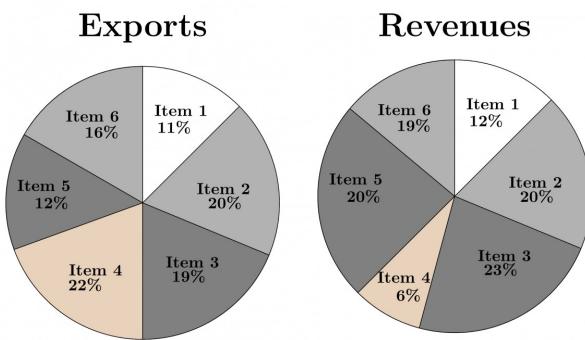
The total number of management degree holders among the executives in companies  $C_2$  and  $C_5$  together is \_\_\_\_\_.

- A. 225
- B. 600
- C. 1900
- D. 2500

[gateme-2021-set1](#) [quantitative-apptitude](#) [data-interpretation](#) [pie-chart](#)

Answer 9.35.6 Pie Chart: GATE2014 AG: GA-8 top ↗<https://gateoverflow.in/41672>

The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?



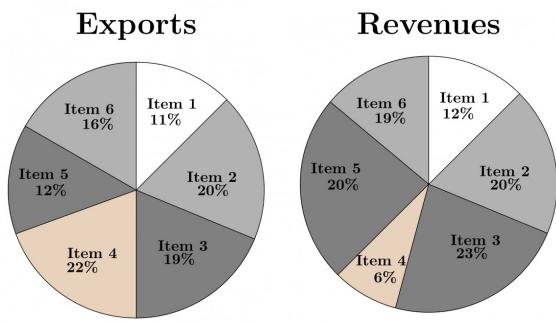
- A. 1 : 2
- B. 2 : 1
- C. 1 : 4
- D. 4 : 1

[gate2014-ag](#) [quantitative-aptitude](#) [data-interpretation](#) [pie-chart](#) [ratio-proportion](#) [normal](#)
**Answer**

### 9.35.7 Pie Chart: GATE2014 EC-2: GA-9 [top](#)

<https://gateoverflow.in/41517>


The total exports and revenues from the exports of a country are given in the two charts shown below. The pie chart for exports shows the quantity of each item exported as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 500 thousand tonnes and the total revenues are 250 crore rupees. Which item among the following has generated the maximum revenue per kg?



- A. Item 2
- B. Item 3
- C. Item 6
- D. Item 5

[gate2014-ec-2](#) [quantitative-aptitude](#) [data-interpretation](#) [pie-chart](#) [normal](#)
**Answer**

### 9.35.8 Pie Chart: GATE2014 EC-3: GA-7 [top](#)

<https://gateoverflow.in/41459>


The multi-level hierarchical pie chart shows the population of animals in a reserve forest. The correct conclusions from this information are:



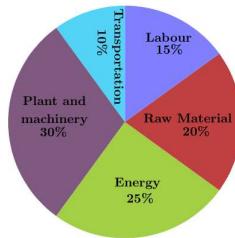
- (i) Butterflies are birds
- (ii) There are more tigers in this forest than red ants
- (iii) All reptiles in this forest are either snakes or crocodiles
- (iv) Elephants are the largest mammals in this forest

- A. (i) and (ii) only
- B. (i), (ii), (iii) and (iv)
- C. (i), (iii) and (iv) only
- D. (i), (ii) and (iii) only

[gate2014-ec-3](#) [quantitative-aptitude](#) [data-interpretation](#) [pie-chart](#) [normal](#)
**Answer**

**9.35.9 Pie Chart: GATE2014 EC-3: GA-9** [top](#)<https://gateoverflow.in/41461>

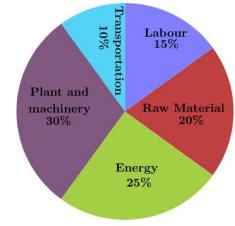
A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs.4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. If the company registered a profit of Rs. 10 lakhs in 2012, at what price (in Rs) was each air purifier sold?


[gate2014-ec-3](#) [quantitative-aptitude](#) [data-interpretation](#) [pie-chart](#) [numerical-answers](#)

Answer

**9.35.10 Pie Chart: GATE2014 EC-4: GA-9** [top](#)<https://gateoverflow.in/41471>

A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. What is the percentage increase in total cost for the company in 2013?


[gate2014-ec-4](#) [quantitative-aptitude](#) [data-interpretation](#) [pie-chart](#) [numerical-answers](#)

Answer

**9.35.11 Pie Chart: GATE2017 EC-1: GA-4** [top](#)<https://gateoverflow.in/313520>

40% of deaths on city roads may be attributed to drunken driving. The number of degrees needed to represent this as a slice of a pie chart is

- A. 120
- B. 144
- C. 160
- D. 212

[gate2017-ec-1](#) [general-aptitude](#) [quantitative-aptitude](#) [percentage](#) [pie-chart](#)

Answer

**Answers: Pie Chart****9.35.1 Pie Chart: GATE CSE 2015 Set 1 | Question: GA-9** [top](#)<https://gateoverflow.in/8013>

✓ Number of female students in Electrical =  $40 \times \frac{4}{5} = 32$

Number of female students in Civil =  $32 \times \frac{30}{20} = 48$  (Since proportion of male students to female students is same, the breakup chart is the same for number of female students)

$$\text{Number of female students in Mechanical} = 32 \times \frac{10}{20} = 16$$

So, answer =  $48 - 16 = 32$

20 votes

-- Arjun Suresh (328k points)

### 9.35.2 Pie Chart: GATE Civil 2020 Set 1 | GA Question: 10 [top](#)

<https://gateoverflow.in/359848>

- ✓ The expenditure of a family, on education = 15%, on transport = 10%.

$$\text{The extra money spent on education as compared to transport} = \left( \frac{15 - 10}{10} \right) \times 100\% = 50\%.$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

### 9.35.3 Pie Chart: GATE Civil 2020 Set 2 | GA Question: 10 [top](#)

<https://gateoverflow.in/359828>

- ✓ We can find the number of LED bulbs sold by Y during April – June 2018 by adding up the monthly units sold.

- LED bulbs sold in April by Y =  $\frac{2}{5} \times 15\% = 6\%$
- LED bulbs sold in May by Y =  $\frac{4}{5} \times 10\% = 8\%$
- LED bulbs sold in June by Y =  $\frac{11}{20} \times 10\% = 5.5\%$

Total LED bulbs sold by Y during April-June =  $(6 + 8 + 5.5)\% = 19.5\%$ .

The total number of LED bulbs sold by the two firms during April-June =  $50000(15\% + 10\% + 10\%) = 35\%$ .

- 35% → 50000
- 19.5% →  $\left( \frac{50000}{35} \right) \times 19.5 = 27857.1428$ .

1 votes

-- Lakshman Patel (63.9k points)

### 9.35.4 Pie Chart: GATE Mechanical 2020 Set 2 | GA Question: 10 [top](#)

<https://gateoverflow.in/359538>

- ✓ Given that, the total number of students registered in the university is 5000, and the total number of the registered girls is 1500.

- Number of boys enrolled in Arts =  $(5000 \times 20\%) - (1500 \times 30\%) = 1000 - 450 = 550$ .
- Number of girls enrolled in Management =  $1500 \times 15\% = 225$ .

Now, the required ratio =  $550 : 225 = 110 : 45 = 22 : 9$ .

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

### 9.35.5 Pie Chart: GATE Mechanical 2021 Set 1 | GA Question: 9 [top](#)

<https://gateoverflow.in/359469>

Given that the total number of employees at the rank of executives across all companies is 10,000.

- The number of employees in the company C2 =  $\frac{5}{100} \times 10000 = 500$
- The number of employees in company C2, who has management degree =  $\frac{1}{5} \times 500 = 100$
- The number of employees in the company C5 =  $\frac{20}{100} \times 10000 = 2000$
- The number of employees in company C2, who has management degree =  $\frac{9}{10} \times 2000 = 1800$

∴ The total number of management degree holders among the executives in companies C2 and C5 together

$$= 100 + 1800 = 1900.$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

### 9.35.6 Pie Chart: GATE2014 AG: GA-8 [top](#)

<https://gateoverflow.in/41672>

- ✓ Item 1:  $11 \times x = 12$

$$\text{Item 4: } 22 \times y = 6$$

$$\frac{x}{y} = \frac{12 \times 22}{11 \times 6} = 4 : 1$$

Correct Answer: D

9 votes

-- Arjun Suresh (328k points)

### 9.35.7 Pie Chart: GATE2014 EC-2: GA-9 [top](#)

<https://gateoverflow.in/41517>

- ✓ Suppose some item A has Revenue  $x\%$  and Exports  $y\%$ .

$$\text{So, for this item } A \text{ Revenue per } kg = \frac{x}{y} \times \frac{250 \text{ crore}}{500 \text{ thousand} \times 1000}$$

In that way Revenue per kg is directly proportional to  $\frac{\text{Revenue}}{\text{Export}}$

- Item 1: Revenue per  $kg \propto \frac{12}{11}$
- Item 2: Revenue per  $kg \propto \frac{20}{20}$
- Item 3: Revenue per  $kg \propto \frac{23}{19}$
- Item 4: Revenue per  $kg \propto \frac{6}{22}$
- Item 5: Revenue per  $kg \propto \frac{20}{12}$
- Item 6: Revenue per  $kg \propto \frac{19}{16}$

We can see that for Item 5 Revenue per  $kg$  value is highest.

Correct Option: D.

5 votes

-- Rupendra Choudhary (11.3k points)

### 9.35.8 Pie Chart: GATE2014 EC-3: GA-7 [top](#)

<https://gateoverflow.in/41459>

- ✓ Ans will be (D)

The given pie chart is about population of animals, not about size of animals

So, (iv) is not true

- (i) is true as butterfly comes under the pie birds.
- (ii) is true as the pie chart portion of tigers is more than that of red ants.
- (iii) is true as the pie portion corresponding to reptiles consists of only snakes and crocodiles.

12 votes

-- srestha (85k points)

### 9.35.9 Pie Chart: GATE2014 EC-3: GA-9 [top](#)

<https://gateoverflow.in/41461>

- ✓ Expenditure on labour =  $Rs. 4,50,000$

$$\text{So, } 15\% \text{ of total expenditure} = Rs. 4,50,000$$

$$\text{Then, total (100\%) of expenditure} = Rs. 4,50,000 \times \frac{100\%}{15\%} = Rs. 30,00,000$$

$$\text{Now, Profit} = Rs. 10,00,000$$

$$\text{Total selling cost} = Rs. 30,00,000 + 10,00,000 = Rs. 40,00,000.$$

$$\text{So, 200 air purifier selling cost} = \frac{Rs. 40,00,000}{200} = Rs. 20,000$$

10 votes

-- srestha (85k points)

**9.35.10 Pie Chart: GATE2014 EC-4: GA-9** <https://gateoverflow.in/41471>

- ✓ % increase = 30% of raw material costs + 20% of (labor costs + transportation costs + plant and machine costs + energy costs)

$$= 30\% \text{ of } 20\% \text{ of total costs} + 20\% \text{ of } (15\% + 10\% + 30\% + 25\%) \text{ of total cost}$$

$$= 30\% \text{ of } 20\% \text{ of total costs} + 20\% \text{ of } 80\% \text{ of total costs}$$

$$= 110\% \text{ of } 20\% \text{ of total costs}$$

$$= 1.1 \times 20\% \text{ of total cost}$$

$$= 22\% \text{ of total cost}$$

7 votes

-- Aksh Singh (343 points)

**9.35.11 Pie Chart: GATE2017 EC-1: GA-4** <https://gateoverflow.in/313520>

- ✓ Answer is B.

$$40\% \text{ of } 360^\circ = \frac{40}{100} \times 360^\circ = 144^\circ$$

So, the number of degrees needed to represent 40% in a pie chart is 144

1 votes

-- Jotheeswari (92, 9k points)

**9.36****Polynomials (3)** **9.36.1 Polynomials: GATE CSE 2016 Set 1 | Question: GA09** <https://gateoverflow.in/39611>

If  $f(x) = 2x^7 + 3x - 5$ , which of the following is a factor of  $f(x)$ ?

- A.  $(x^3 + 8)$
- B.  $(x - 1)$
- C.  $(2x - 5)$
- D.  $(x + 1)$

[gate2016-cse-set1](#) [quantitative-aptitude](#) [polynomials](#) [normal](#)

Answer

**9.36.2 Polynomials: GATE2018 CH: GA-9** <https://gateoverflow.in/205082>

If  $x^2 + x - 1 = 0$  what is the value of  $x^4 + \frac{1}{x^4}$ ?

- A. 1
- B. 5
- C. 7
- D. 9

[gate2018-ch](#) [quantitative-aptitude](#) [easy](#) [polynomials](#)

Answer

**9.36.3 Polynomials: GATE2018 EE: GA-3** <https://gateoverflow.in/205099>

The three roots of the equation  $f(x) = 0$  are  $x = \{-2, 0, 3\}$ . What are the three values of  $x$  for which  $f(x - 3) = 0$ ?

- A.  $-5, -3, 0$
- B.  $-2, 0, 3$
- C.  $0, 6, 8$
- D.  $1, 3, 6$

gate2018-ee general-aptitude quantitative-aptitude easy polynomials

Answer 

### Answers: Polynomials

#### 9.36.1 Polynomials: GATE CSE 2016 Set 1 | Question: GA09

<https://gateoverflow.in/39611>



- ✓ for  $x = 1$ ,

$$f(1) = 2(1)^7 + 3(1) - 5 = 0 ,$$

so  $x = 1$  is a root for  $f(x)$

so  $(x - 1)$  is factor

Correct Answer: **B**

 43 votes

-- Pooja Palod (24k points)

#### 9.36.2 Polynomials: GATE2018 CH: GA-9

<https://gateoverflow.in/205082>



- ✓  $(x^2 + x - 1) = 0$

$$\implies (x^2 - 1) = -x$$

$$\implies (x^2 - 1)^2 = (-x)^2$$

$$\implies x^4 - 2x^2 + 1 = x^2$$

$$\implies x^4 + 1 = 3x^2$$

$$\implies (x^4 + 1)^2 = (3x^2)^2$$

$$\implies x^8 + 2x^4 + 1 = 9x^4$$

$$\implies x^8 + 1 = 7x^4$$

Now, we can divide both sides by  $x^4$  and get

$$x^4 + \frac{1}{x^4} = 7$$

 11 votes

-- srestha (85k points)

#### 9.36.3 Polynomials: GATE2018 EE: GA-3

<https://gateoverflow.in/205099>



- ✓ answer D)

given roots are  $0, -2, 3$

so, the equation is  $f(x) = x(x + 2)(x - 3)$

now  $f(x - 3) = (x - 3)(x - 1)(x - 6)$

roots of  $f(x - 3)$  are  $3, 1, 6$

 7 votes

-- reena kandari (7.1k points)

### 9.37

### Probability (21)

#### 9.37.1 Probability: GATE CSE 2015 Set 1 | Question: GA-10

<https://gateoverflow.in/8014>



The probabilities that a student passes in mathematics, physics and chemistry are  $m, p$  and  $c$  respectively. Of these subjects, the student has 75% chance of passing in at least one, a 50% chance of passing in at least two and a 40% chance of passing in exactly two. Following relations are drawn in  $m, p, c$ :

- I.  $p + m + c = 27/20$   
 II.  $p + m + c = 13/20$   
 III.  $(p) \times (m) \times (c) = 1/10$

- A. Only relation I is true.  
 B. Only relation II is true.  
 C. Relations II and III are true.  
 D. Relations I and III are true.

gate2015-cse-set1 quantitative-aptitude probability

Answer 

### 9.37.2 Probability: GATE CSE 2015 Set 1 | Question: GA-3

<https://gateoverflow.in/8004>



Given Set  $A = \{2, 3, 4, 5\}$  and Set  $B = \{11, 12, 13, 14, 15\}$ , two numbers are randomly selected, one from each set. What is the probability that the sum of the two numbers equals 16?

- A. 0.20  
 B. 0.25  
 C. 0.30  
 D. 0.33

gate2015-cse-set1 quantitative-aptitude probability normal

Answer 

### 9.37.3 Probability: GATE CSE 2017 Set 1 | Question: GA-5

<https://gateoverflow.in/118408>



The probability that a  $k$ -digit number does NOT contain the digits 0, 5, or 9 is

- A.  $0.3^k$   
 B.  $0.6^k$   
 C.  $0.7^k$   
 D.  $0.9^k$

gate2017-cse-set1 general-aptitude quantitative-aptitude probability easy

Answer 

### 9.37.4 Probability: GATE CSE 2017 Set 2 | Question: GA-5

<https://gateoverflow.in/118419>



There are 3 red socks, 4 green socks and 3 blue socks. You choose 2 socks. The probability that they are of the same colour is

- A.  $\frac{1}{5}$   
 B.  $\frac{7}{30}$   
 C.  $\frac{1}{4}$   
 D.  $\frac{4}{15}$

gate2017-cse-set2 quantitative-aptitude probability

Answer 

### 9.37.5 Probability: GATE CSE 2018 | Question: GA-10

<https://gateoverflow.in/204071>



A six sided unbiased die with four green faces and two red faces is rolled seven times. Which of the following combinations is the most likely outcome of the experiment?

- A. Three green faces and four red faces.  
 B. Four green faces and three red faces.

- C. Five green faces and two red faces.  
D. Six green faces and one red face

[gate2018-cse](#) [quantitative-aptitude](#) [probability](#) [normal](#)

Answer 

### 9.37.6 Probability: GATE CSE 2021 Set 1 | GA Question: 8

 <https://gateoverflow.in/357469>



There are five bags each containing identical sets of ten distinct chocolates. One chocolate is picked from each bag. The probability that at least two chocolates are identical is \_\_\_\_\_

- A. 0.3024  
B. 0.4235  
C. 0.6976  
D. 0.8125

[gate2021-cse-set1](#) [quantitative-aptitude](#) [probability](#)

Answer 

### 9.37.7 Probability: GATE Civil 2021 Set 2 | GA Question: 3

 <https://gateoverflow.in/359905>



Two identical cube shaped dice each with faces numbered 1 to 6 are rolled simultaneously. The probability that an even number is rolled out on each dice is:

- A.  $\frac{1}{36}$   
B.  $\frac{1}{12}$   
C.  $\frac{1}{8}$   
D.  $\frac{1}{4}$

[gatcivil-2021-set2](#) [quantitative-aptitude](#) [probability](#)

Answer 

### 9.37.8 Probability: GATE2012 AE: GA-6

 <https://gateoverflow.in/40217>



Two policemen, A and B, fire once each at the same time at an escaping convict. The probability that A hits the convict is three times the probability that B hits the convict. If the probability of the convict not getting injured is 0.5, the probability that B hits the convict is

- A. 0.14  
B. 0.22  
C. 0.33  
D. 0.40

[gate2012-ae](#) [quantitative-aptitude](#) [probability](#)

Answer 

### 9.37.9 Probability: GATE2012 AR: GA-9

 <https://gateoverflow.in/40230>



A smuggler has 10 capsules in which five are filled with narcotic drugs and the rest contain the original medicine. All the 10 capsules are mixed in a single box, from which the customs officials picked two capsules at random and tested for the presence of narcotic drugs. The probability that the smuggler will be caught is

- A. 0.50  
B. 0.67  
C. 0.78  
D. 0.82

[gate2012-ar](#) [quantitative-aptitude](#) [probability](#)

Answer 

**9.37.10 Probability: GATE2012 CY: GA-7** top ↗<https://gateoverflow.in/4173>

*A* and *B* are friends. They decide to meet between 1:00 pm and 2:00 pm on a given day. There is a condition that whoever arrives first will not wait for the other for more than 15 minutes. The probability that they will meet on that day is

- A.  $1/4$
- B.  $1/16$
- C.  $7/16$
- D.  $9/16$

[gate2012-cy](#) [quantitative-aptitude](#) [probability](#)

Answer

**9.37.11 Probability: GATE2013 EE: GA-6** top ↗<https://gateoverflow.in/40293>

What is the chance that a leap year, selected at random, will contain 53 Saturdays?

- A.  $2/7$
- B.  $3/7$
- C.  $1/7$
- D.  $5/7$

[gate2013-ee](#) [quantitative-aptitude](#) [probability](#)

Answer

**9.37.12 Probability: GATE2014 AG: GA-4** top ↗<https://gateoverflow.in/41668>

In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is \_\_\_\_\_ years.

[gate2014-ag](#) [quantitative-aptitude](#) [probability](#) [numerical-answers](#) [normal](#)

Answer

**9.37.13 Probability: GATE2014 EC-2: GA-4** top ↗<https://gateoverflow.in/41511>

A regular die has six sides with numbers 1 to 6 marked on its sides. If a very large number of throws show the following frequencies of occurrence:  $1 \rightarrow 0.167$ ;  $2 \rightarrow 0.167$ ;  $3 \rightarrow 0.152$ ;  $4 \rightarrow 0.166$ ;  $5 \rightarrow 0.168$ ;  $6 \rightarrow 0.180$ . We call this die:

- A. Irregular
- B. Biased
- C. Gaussian
- D. Insufficient

[gate2014-ec-2](#) [quantitative-aptitude](#) [probability](#) [normal](#)

Answer

**9.37.14 Probability: GATE2014 EC-3: GA-10** top ↗<https://gateoverflow.in/41462>

A batch of one hundred bulbs is inspected by testing four randomly chosen bulbs. The batch is rejected if even one of the bulbs is defective. A batch typically has five defective bulbs. The probability that the current batch is accepted is \_\_\_\_\_.

[gate2014-ec-3](#) [quantitative-aptitude](#) [probability](#) [numerical-answers](#) [normal](#)

Answer

**9.37.15 Probability: GATE2015 CE-2: GA-5** top ↗<https://gateoverflow.in/40180>

Four cards are randomly selected from a pack of 52 cards. If the first two cards are kings, what is the probability that the third card is a king?

- A.  $4/52$

- B.  $2/50$   
 C.  $(1/52) \times (1/52)$   
 D.  $(1/52) \times (1/51) \times (1/50)$

gate2015-ce-2 quantitative-aptitude probability easy

Answer 

### 9.37.16 Probability: GATE2015 EC-2: GA- 5

<https://gateoverflow.in/39506>



Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram's selection is  $1/6$  and that of Ramesh is  $1/8$ . What is the probability that only one of them will be selected?

- A.  $47/48$   
 B.  $1/4$   
 C.  $13/48$   
 D.  $35/48$

gate2015-ec-2 quantitative-aptitude probability

Answer 

### 9.37.17 Probability: GATE2016 EC-1: GA-6

<https://gateoverflow.in/108086>



A person moving through a tuberculosis prone zone has a  $50\%$  probability of becoming infected. However, only  $30\%$  of infected people develop the disease. What percentage of people moving through a tuberculosis prone zone remains infected but does not show symptoms of disease?

- A. 15  
 B. 33  
 C. 35  
 D. 37

gate2016-ec-1 quantitative-aptitude probability

Answer 

### 9.37.18 Probability: GATE2017 CE-2: GA-5

<https://gateoverflow.in/313416>



Two dice are thrown simultaneously. The probability that the product of the numbers appearing on the top faces of the dice is a perfect square is

- A.  $\frac{1}{9}$   
 B.  $\frac{2}{9}$   
 C.  $\frac{1}{3}$   
 D.  $\frac{4}{9}$

gate2017-ce-2 quantitative-aptitude probability

Answer 

### 9.37.19 Probability: GATE2017 ME-2: GA-4

<https://gateoverflow.in/313671>



A couple has 2 children. The probability that both children are boys if the older one is a boy is

- A.  $1/4$   
 B.  $1/3$   
 C.  $1/2$   
 D. 1

gate2017-me-2 quantitative-aptitude probability

Answer 

**9.37.20 Probability: GATE2018 EE: GA-8** top ↗<https://gateoverflow.in/205188>

A class of twelve children has two more boys than girls. A group of three children are randomly picked from this class to accompany the teacher on a field trip. What is the probability that the group accompanying the teacher contains more girls than boys?

- A. 0
- B.  $\frac{325}{864}$
- C.  $\frac{525}{864}$
- D.  $\frac{5}{12}$

[gate2018-ee](#) [quantitative-aptitude](#) [probability](#)
Answer **9.37.21 Probability: GATE2018 ME-2: GA-10** top ↗<https://gateoverflow.in/313632>

An unbiased coin is tossed six times in a row and four different such trials are conducted. One trial implies six tosses of the coin. If H stands for head and T stands for tail, the following are the observations from the four trials.

1. HTHTHT
2. TTHHHT
3. HTTHHT
4. HHHT\_\_

Which statement describing the last two coin tosses of the fourth trial has the highest probability of being correct?

- A. Two T will occur.
- B. One H and one T will occur.
- C. Two H will occur.
- D. One H will be followed by one T.

[gate2018-me-2](#) [quantitative-aptitude](#) [probability](#)
Answer **Answers: Probability****9.37.1 Probability: GATE CSE 2015 Set 1 | Question: GA-10** top ↗<https://gateoverflow.in/8014>

✓ Probability of non pass =  $1 - \text{Probability of at least one pass} = 1 - 0.75 = 0.25$

$$(1 - m)(1 - p)(1 - c) = 0.25$$

$$(1 + mp - m - p)(1 - c) = 0.25$$

$$1 + mp - m - p - c - mpc + mc + pc = 0.25$$

$$\mathbf{m + p + c - mp - pc - mc + mpc = 0.75} \rightarrow (1)$$

Probability of exactly 2 pass = 0.4

$$mp(1 - c) + pc(1 - m) + mc(1 - p) = 0.4$$

$$mp + pc + mc - 3mpc = 0.4$$

$$\mathbf{mp + pc + mc - 2mpc = 0.5} \rightarrow (2)$$

(Adding the probability of all pass to probability of exactly 2 pass gives probability of at least 2 pass)

$$\text{So, } \mathbf{mpc = 0.1} \rightarrow (3)$$

From (2) and (3),

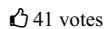
$$\mathbf{mp + pc + mc - mpc = 0.6} \rightarrow (4)$$

From (1) and (4)

$$m + p + c = 0.75 + 0.6$$

$$m + p + c = 1.35 = 135/100 = 27/20$$

So, D option



-- Arjun Suresh (328k points)

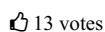
### 9.37.2 Probability: GATE CSE 2015 Set 1 | Question: GA-3 top ↗

<https://gateoverflow.in/8004>



- ✓ option A because total combinations are  $5 \times 4 = 20$  and out of 20 we have only 4 combinations which have sum 16

1. 2, 14
2. 3, 13
3. 4, 12
4. 5, 11



-- Anoop Sonkar (4.1k points)

### 9.37.3 Probability: GATE CSE 2017 Set 1 | Question: GA-5 top ↗

<https://gateoverflow.in/118408>

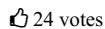


- ✓ Total possibilities  $=(10)^k$ , because every digit has 10 options from 0 to 9.

Possibility of not containing any digit 0, 5, 9  $=(7)^k$ , now every digit has 7 options.

$$\text{Asked probability} = \frac{(7)^k}{(10)^k} = (0.7)^k$$

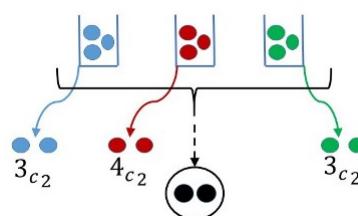
So C is the answer.



-- KAUSHAL DUBEY (259 points)

### 9.37.4 Probability: GATE CSE 2017 Set 2 | Question: GA-5 top ↗

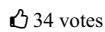
<https://gateoverflow.in/118419>



$$\frac{^3C_2 + ^4C_2 + ^3C_2}{^{10}C_2} = \frac{4}{15}.$$

assuming ball are not identical

Correct Answer: D



-- 2018 (5.5k points)

### 9.37.5 Probability: GATE CSE 2018 | Question: GA-10 top ↗

<https://gateoverflow.in/204071>



- ✓ We can calculate the probability of each of the options but by logic we can easily eliminate the ones with more number of red faces - option A can be avoided without any calculation.

$$A = P(3G, 4R) = {}^7C_3 \cdot \left(\frac{4}{6}\right)^3 \left(\frac{2}{6}\right)^4$$

$$B = P(4G, 3R) = {}^7C_4 \cdot \left(\frac{4}{6}\right)^4 \left(\frac{2}{6}\right)^3$$

$$C = P(5G, 2R) = {}^7C_5 \cdot \left(\frac{4}{6}\right)^5 \left(\frac{2}{6}\right)^2$$

$$D = P(6G, 1R) = {}^7C_6 \cdot \left(\frac{4}{6}\right)^6 \left(\frac{2}{6}\right)^1$$

Option A is clearly smaller and hence eliminated.

$$\frac{C}{B} = \frac{{}^7C_5}{{}^7C_4} \cdot \frac{4}{6} \cdot \frac{6}{2} = \frac{3}{5} \cdot 2 > 1.$$

So,  $C > B$ .

$$\frac{C}{D} = \frac{{}^7C_5}{{}^7C_6} \cdot \frac{6}{4} \cdot \frac{2}{6} = \frac{21}{7} \cdot 0.5 > 1.$$

So,  $C > D$ .

Hence, C is the most favourable outcome.

37 votes

-- Arjun Suresh (328k points)



### 9.37.6 Probability: GATE CSE 2021 Set 1 | GA Question: 8 top

<https://gateoverflow.in/357469>

#### ✓ Option C

$$P(\text{No two chocolates are identical}) = \frac{10 \times 9 \times 8 \times 7 \times 6}{10^5} = \frac{30240}{10^5} = 0.3024$$

$$\begin{aligned} P(\text{At least two chocolates are identical}) &= 1 - P(\text{No two chocolates are identical}) \\ &= 1 - 0.3024 = 0.6976 \end{aligned}$$

Alternatively,

Number of ways of selecting 5 **distinct** chocolates, one each from the 5 bags is same as selecting 5 chocolates from 10 distinct ones =  ${}^{10}C_5$ .

If “distinct” requirement is not there, each of the 5 chocolate has 10 options  $\implies 10^5$ .

$$\text{So, probability that no two chocolates are identical} = \frac{{}^{10}C_5}{10^5} = 0.3024$$

Probability that **at least** 2 chocolates are identical =  $1 - 0.3024 = 0.6976$

7 votes

-- zxy123 (2.5k points)



### 9.37.7 Probability: GATE Civil 2021 Set 2 | GA Question: 3 top

<https://gateoverflow.in/359905>

✓ Two identical cube-shaped dice each with faces numbered 1 to 6 are rolled simultaneously. Then all possible outcomes.

- (1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6)
- (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6)
- (3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6)
- (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6)
- (5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6)
- (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)

The probability that an even number is rolled out on each dice is  $= \frac{9}{36} = \frac{1}{4}$ .

**Short Method:** Two identical cube-shaped dice each with faces numbered 1 to 6 are rolled simultaneously.

Dice 1 : 1, 2, 3, 4, 5, 6

Dice 2 : 1, 2, 3, 4, 5, 6

- $P(\text{Even number on first dice}) = P(E_1) = \frac{3}{6} = \frac{1}{2}$
- $P(\text{Even number on second dice}) = P(E_2) = \frac{3}{6} = \frac{1}{2}$

Now,  $P(\text{Even number on both dice}) = P(E_1 \cap E_2) = P(E_1) \cdot P(E_2) = \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$ .

**PS:** These two events are independent events.

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63,9k points)

### 9.37.8 Probability: GATE2012 AE: GA-6 top

<https://gateoverflow.in/40217>



✓  $X - A$  hits the convict

$Y - B$  hits the convict

Given,  $P(X) = 3 \times P(Y)$

$Z - \text{Convict is injured}$

$Z' - \text{Convict is not injured}$

Given,  $P(Z') = 0.5$

$$\Rightarrow P(Z) = 1 - P(Z') = 1 - 0.5 = 0.5$$

Now,

$$P(Z) = P(X) \times P(Y') + P(X') \times P(Y) + P(X) \times P(Y)$$

Let  $P(Y) = t$

$$P(X) = 3t$$

$$P(Y') = 1 - t$$

$$P(X') = 1 - 3t$$

Substituting in above equation,

$$0.5 = (3t \times (1 - t)) + ((1 - 3t) \times t) + (t \times 3t)$$

$$\Rightarrow 3t - 3t^2 + t - 3t^2 + 3t^2 = 0.5$$

$$\Rightarrow 3t^2 - 4t + 0.5 = 0$$

$$\Rightarrow 6t^2 - 8t + 1 = 0$$

Solving, we get  $t = 1.193$  (eliminated as probability cannot be greater than 1) OR  $t = 0.1396$

Therefore,  $P(Y) = t = 0.1396$

**Answer (A) 0.14**

#### Alternative Method: by Joker

$$P(Z') = 0.5$$

Now,

$$P(Z') = (P(X') \times P(Y'))$$

$$\Rightarrow 0.5 = (1 - t) \times (1 - 3t)$$

Solving this gives the same equation as above.

$$6t^2 - 8t + 1 = 0$$

and the same answer.

8 votes

-- Abhilash Panicker (7,6k points)

### 9.37.9 Probability: GATE2012 AR: GA-9 top

<https://gateoverflow.in/40230>



✓ The smuggler would be caught if any one or both the randomly picked capsule contains drugs.

$M$  represents Medicine,  $D$  represents Drugs

- $A -$  The smuggler will be caught
- $B -$  The randomly picked capsules contains  $M, D$
- $C -$  The randomly picked capsules contains  $D, M$
- $D -$  The randomly picked capsules contains  $D, D$

$$P(A) = P(B) + P(C) + P(D)$$

$$\begin{aligned} P(A) &= (5/10) \times (5/9) + (5/10) \times (5/9) + (5/10) \times (4/9) \\ &= 0.278 + 0.278 + 0.222 \\ &= 0.778 \end{aligned}$$

Hence, Answer is Option (C) 0.78

11 votes

-- Abhilash Panicker (7,6k points)

**9.37.10 Probability: GATE2012 CY: GA-7** [top](#)<https://gateoverflow.in/4173>

- ✓ Meeting occurs if the first person arrives between 1 : 00 and 1 : 45 and the second person arrives in the next 15 minutes or if both the persons arrive between 1 : 45 and 2 : 00.

Case 1:

- 45/60 are favourable cases and hence probability of first person arriving between 1 : 00 and 1 : 45 is 3/4.
- Probability of second person arriving in the next 15 minutes = 15/60 = 1/4
- So, probability of one person arriving between 1 : 00 and 1 : 45 and meeting the other =  $3/4 \times 1/4 \times 2 = 3/8$  (2 for choosing the first arriving friend)

Case 2:

- Both friends must arrive between 1 : 45 and 2 : 00. Probability =  $1/4 \times 1/4 = 1/16$ .

So, probability of a meet =  $3/8 + 1/16 = 7/16$ 

Correct Answer: C

37 votes

-- Arjun Suresh (328k points)

**9.37.11 Probability: GATE2013 EE: GA-6** [top](#)<https://gateoverflow.in/40293>

- ✓ Sample space is

 $S : \{\text{Monday-Tuesday, Tuesday-Wednesday, Wednesday-Thursday} \dots \text{Sunday-Monday}\}$ 
Number of elements in  $S = n(S) = 7$ What we want is a set  $A$  (say) that comprises of the elements Saturday-Sunday and Friday-SaturdayNumber of elements in set  $A = n(A) = 2$ 

By definition, probability of occurrence of  $A = \frac{n(A)}{n(S)} = 27$

Therefore, probability that a leap year has 53 Saturdays is  $\frac{2}{7}$ .

Correct Answer: A

10 votes

-- Pooja Palod (24k points)

**9.37.12 Probability: GATE2014 AG: GA-4** [top](#)<https://gateoverflow.in/41668>

- ✓ Probability of an earthquake greater than magnitude 6 is 0.04.

This means 4 out of 100 years will face an earthquake greater than magnitude 6. So average time between successive earthquakes will be  $100/4 = 25$  years.

15 votes

-- Aditya Sharma (499 points)

**9.37.13 Probability: GATE2014 EC-2: GA-4** [top](#)<https://gateoverflow.in/41511>

- ✓ For a very large number of throws, the frequency should be same for an unbiased die.

But given frequencies are not same, hence the die is biased.Hence, option B.

6 votes

-- Ashish Gupta (759 points)

**9.37.14 Probability: GATE2014 EC-3: GA-10** [top](#)<https://gateoverflow.in/41462>

- ✓ In a batch there are total 100 bulbs of which  
95 are working  
5 are defective.

$$P(\text{Selecting 4 working bulbs}) = \frac{95}{100} \times \frac{94}{99} \times \frac{93}{98} \times \frac{92}{97} = 0.81$$

8 votes

-- Abhilash Panicker (7.6k points)

**9.37.15 Probability: GATE2015 CE-2: GA-5** top ↴[w https://gateoverflow.in/40180](https://gateoverflow.in/40180)

- ✓ There are 4 kings in a pack of 52 cards.  
If 2 cards are selected and both are kings, remaining cards will be 50 out of which 2 will be kings.

So, answer is B.

7 votes

-- Pooja Palod (24k points)

**9.37.16 Probability: GATE2015 EC-2: GA- 5** top ↴[w https://gateoverflow.in/39506](https://gateoverflow.in/39506)

- ✓ Selection of RAM and not Ramesh is  $1/6 \times 7/8$  and selection of Ramesh and not Ram is  $1/8 \times 5/6$ . So, net probability is  $12/48 = 1/4$ .

Correct Option (B)

3 votes

-- Ritaban Basu (519 points)

**9.37.17 Probability: GATE2016 EC-1: GA-6** top ↴[w https://gateoverflow.in/108086](https://gateoverflow.in/108086)

- ✓ Probability of being infected = 0.5

Probability of developing disease = 0.3

Only when a person develops disease he will show symptoms of it and whenever a disease is developed we can expect symptoms to be shown.

So, Probability of not showing symptoms =  $1 - 0.3 = 0.7$

Probability of being infected and not showing any symptoms =  $0.5 \times 0.7 = 0.35$

Correct Answer: C 35%

2 votes

-- Arjun Suresh (328k points)

**9.37.18 Probability: GATE2017 CE-2: GA-5** top ↴[w https://gateoverflow.in/313416](https://gateoverflow.in/313416)

- ✓ When two dices are thrown simultaneously, the total number of combinations of the number that will be shown on faces of both the dices is given by,

(1,1), (1,2), (1,3), (1,4), (1,5), (1,6)  
 (2,1), (2,2), (2,3), (2,4), (2,5), (2,6)  
 (3,1), (3,2), (3,3), (3,4), (3,5), (3,6)  
 (4,1), (4,2), (4,3), (4,4), (4,5), (4,6)  
 (5,1), (5,2), (5,3), (5,4), (5,5), (5,6)  
 (6,1), (6,2), (6,3), (6,4), (6,5), (6,6)

⇒ Squares of all integers are known as perfect squares.

$$P(E) = \frac{n(E)}{n(S)}$$

$$\Rightarrow P(E) = \frac{8}{36} = \frac{2}{9}$$

So, (B) is the correct answer.

3 votes

-- Lakshman Patel (63.9k points)

**9.37.19 Probability: GATE2017 ME-2: GA-4** top ↴[w https://gateoverflow.in/313671](https://gateoverflow.in/313671)

- ✓ The couple has 2 children.

If the older one is a boy then the younger kid can be either boy or girl with equal probability because these are **independent** events.

So, if one kid is a boy, the probability that other kid will be boy =  $\frac{1}{2}$

So, (C) is the correct choice.

1 votes

-- Lakshman Patel (63.9k points)

### 9.37.20 Probability: GATE2018 EE: GA-8 top ↴



✓ In the class,  $Boys = Girls + 2$

&  $Boys + Girls = 12$

$\therefore Boys = 7 \text{ & Girls} = 5$

Now, We have to choose 3 students from 12 students which can be done in  ${}^{12}C_3$

But among these 3 students, girls should be more than the boys

It can be done in 2 ways

either in the field trip, there are 2 girls and 1 boys OR there are 3 girls

$\therefore$  Choosing 2 girls from 5 girls AND choosing 1 boys from 7 boys =  ${}^5C_2 \times {}^7C_1$

Choosing 3 girls from 5 girls =  ${}^5C_3$

$\therefore$  Probability that the group accompanying the teacher contains more girls than boys

$$= \frac{\text{number of favorable ways}}{\text{total number of ways}}$$

$$= \frac{{}^5C_2 \times {}^7C_1 + {}^5C_3}{{}^{12}C_3}$$

$$= \frac{(10) \times (7) + (10)}{220}$$

$$= \frac{80}{220} = \frac{4}{11}$$

Hence, the answer is None of these

This was marks to all in GATE

8 votes

-- Sukanya Das (9.9k points)

### 9.37.21 Probability: GATE2018 ME-2: GA-10 top ↴



✓ The outcome of a coin toss is independent of the previous outcomes - so no need to look into history.

Possible Outcomes:

1.  $HH$
2.  $HT$
3.  $TH$
4.  $TT$

A.  $P(2T) = P(TT) = 1/4 = 0.25$

B.  $P(1H \text{ AND } 1T) = P(HT) + P(TH) = 1/4 + 1/4 = 0.25 + 0.25 = 0.5$

C.  $P(2H) = P(HH) = 1/4 = 0.25$

D.  $P(HT) = 1/4 = 0.25$

$0.5 > 0.25$ , So B is Correct 😊

6 votes

-- Balaji Jegan (3.5k points)

## 9.38

### Probability Density Function (1) top ↴

#### 9.38.1 Probability Density Function: GATE Electrical 2021 | GA Question: 8 top ↴



Let  $X$  be a continuous random variable denoting the temperature measured. The range of temperature is  $[0, 100]$  degree Celsius and let the probability density function of  $X$  be  $f(x) = 0.01$  for  $0 \leq X \leq 100$ .

The mean of  $X$  is \_\_\_\_\_

- A. 2.5
- B. 5.0
- C. 25.0
- D. 50.0

gateee-2021 quantitative-apitude probability probability-density-function expectation

Answer 

### Answers: Probability Density Function

#### 9.38.1 Probability Density Function: GATE Electrical 2021 | GA Question: 8 top ↗

<https://gateoverflow.in/359741>



- Given that the probability density function of  $X$  is  $f(x) = 0.01$ ;  $0 \leq X \leq 100$ .

$$\text{The mean or expectation } E(X) = \int_a^b x f(x) dx$$

$$\implies E(X) = \int_0^{100} 0.01x dx$$

$$\implies E(X) = 0.01 \int_0^{100} x dx$$

$$\implies E(X) = 0.01 \left[ \frac{x^2}{2} \right]_0^{100}$$

$$\implies E(X) = 0.01 \left[ \frac{100^2}{2} - \frac{0^2}{2} \right]$$

$$\implies E(X) = 0.01 \left[ \frac{100^2}{2} \right] = \frac{1}{100} \times \frac{100^2}{2} = \frac{100}{2} = 50.$$

We can also find the mean using the continuous uniform distribution.

A continuous random variable  $X$  is said to have a uniform distribution on the interval  $[a, b]$  if the probability density function (pdf) of  $X$  is:

$$f(x; a, b) = \begin{cases} \frac{1}{b-a} ; & a \leq x \leq b \\ 0 ; & \text{otherwise} \end{cases}$$

$$\implies f(x; 0, 100) = \begin{cases} \frac{1}{100-0} ; & 0 \leq x \leq 100 \\ 0 ; & \text{otherwise} \end{cases}$$

$$\implies f(x; 0, 100) = \begin{cases} \frac{1}{100} ; & 0 \leq x \leq 100 \\ 0 ; & \text{otherwise} \end{cases}$$

$$\implies f(x; 0, 100) = \begin{cases} 0.01 ; & 0 \leq x \leq 100 \\ 0 ; & \text{otherwise} \end{cases}$$

For continuous uniform distribution, the mean or expectation  $\mu_X = E(X) = \frac{a+b}{2} = \frac{0+100}{2} = \frac{100}{2} = 50$ .

So, the correct answer is (D).

References:

- <https://www.colorado.edu/amath/sites/default/files/attached-files/ch4.pdf>
- [https://www.probabilitycourse.com/chapter4/4\\_2\\_1\\_uniform.php](https://www.probabilitycourse.com/chapter4/4_2_1_uniform.php)

#### References



 1 votes

-- Lakshman Patel (63.9k points)

9.39

Profit Loss (4) [top](#)9.39.1 Profit Loss: GATE CSE 2021 Set 1 | GA Question: 7 [top](#)<https://gateoverflow.in/357470>

Items	Cost (₹)	Profit %	Marked Price (₹)
P	5,400	---	5,860
Q	---	25	10,000

Details of prices of two items P and Q are presented in the above table. The ratio of cost of item P to cost of item Q is 3:4. Discount is calculated as the difference between the marked price and the selling price. The profit percentage is calculated as the ratio of the difference between selling price and cost, to the cost

$$(\text{Profit \%} = \frac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100).$$

The discount on item Q, as a percentage of its marked price, is \_\_\_\_\_

- A. 25
- B. 12.5
- C. 10
- D. 5

Items	Cost (₹)	Profit %	Marked Price (₹)
P	5,400	---	5,860
Q	---	25	10,000

Details of prices of two items P and Q are presented in the above table. The ratio of cost of item P to cost of item Q is 3 : 4. Discount is calculated as the difference between the marked price and the selling price. The profit percentage is calculated as the ratio of the difference between selling price and cost, to the cost

$$(\text{Profit \%} = \frac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100)$$

The discount on item Q, as a percentage of its marked price, is \_\_\_\_\_

- A. 25
- B. 12.5
- C. 10
- D. 5

[gate2021-cse-set1](#) [quantitative-aptitude](#) [profit-loss](#)

Answer

9.39.2 Profit Loss: GATE2013 CE: GA-9 [top](#)<https://gateoverflow.in/40278>

A firm is selling its product at Rs. 60 per unit. The total cost of production is Rs. 100 and firm is earning total profit of Rs. 500. Later, the total cost increased by 30%. By what percentage the price should be increased to maintained the same profit level.

- A. 5
- B. 10
- C. 15
- D. 30

[quantitative-aptitude](#) [gate2013-ce](#) [profit-loss](#)

Answer

**9.39.3 Profit Loss: GATE2018 CE-1: GA-6** top ↗[↗ https://gateoverflow.in/313249](https://gateoverflow.in/313249)

A fruit seller sold a basket of fruits at 12.5% loss. Had he sold it for Rs. 108 more, he would have made a 10% gain. What is the loss in Rupees incurred by the fruit seller?

- A. 48
- B. 52
- C. 60
- D. 108

[gate2018-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [profit-loss](#)

Answer

**9.39.4 Profit Loss: GATE2019 ME-1: GA-7** top ↗[↗ https://gateoverflow.in/313599](https://gateoverflow.in/313599)

A person divided an amount of Rs. 100,000 into two parts and invested in two different schemes. In one he got 10% profit and in the other he got 12%. If the profit percentages are interchanged with these investments he would have got Rs. 120 less. Find the ratio between his investments in the two schemes.

- A. 9 : 16
- B. 11 : 14
- C. 37 : 63
- D. 47 : 53

[gate2019-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [ratio-proportion](#) [profit-loss](#)

Answer

**Answers: Profit Loss****9.39.1 Profit Loss: GATE CSE 2021 Set 1 | GA Question: 7** top ↗[↗ https://gateoverflow.in/357470](https://gateoverflow.in/357470)

✓ Option C

$$\frac{\text{Cost of P}}{\text{Cost of Q}} = \frac{3}{4} \frac{5400}{\text{Cost of Q}} = \frac{3}{4} \text{Cost of Q} = 7200$$

$$\text{Profit \%} = \frac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100$$

$$\implies 25 = \frac{SP - 7200}{7200} \times 100 \implies SP = 9000$$

$$\text{Discount \%} = \frac{10000 - 9000}{10000} \times 100 = 10\%$$

4 votes

-- zxy123 (2.5k points)

**9.39.2 Profit Loss: GATE2013 CE: GA-9** top ↗[↗ https://gateoverflow.in/40278](https://gateoverflow.in/40278)

✓ Let  $N$  units be made.

Selling price per item = *Rs.* 60

Let  $X$  be the cost per unit

We are given

$$500(\text{as profit}) = \underbrace{60 - X + 60 - X + 60 - X + 60 - X + \dots 60 - X}_{N \text{ times}}$$

$$N(60 - X) = 500 \implies 60N - NX = 500$$

$$\text{Total cost is } \text{Rs. } 100 \implies (60N - 100) = 500 \implies N = 10$$

Now the cost has increased by 30%

New cost is *Rs.* 130 and the extra 30 has to be equally divided among 10 units to maintain same profit level.

So, selling price should increase by 3 from 60  $\implies \frac{3}{60} \times 100 = 5\%$  increase.

Correct Answer: A

6 votes

-- Deepesh Kataria (1.6k points)

### 9.39.3 Profit Loss: GATE2018 CE-1: GA-6 top

<https://gateoverflow.in/313249>



- Let  $x$  be the Cost Price.

$$12.5\% x + 10\% x = 108$$

$$22.5\% x = 108$$

$$\Rightarrow x = \frac{108}{22.5}$$

$$\text{Loss} = \frac{108}{22.5} \times 12.5 = \text{Rs. } 60$$

So, correct answer is (C).

4 votes

-- Lakshman Patel (63.9k points)

### 9.39.4 Profit Loss: GATE2019 ME-1: GA-7 top

<https://gateoverflow.in/313599>



- Let  $X$  be his investment in the first scheme and  $Y$  be in the second scheme.

We have,

$$1.1X + 1.12Y = 1.12X + 1.1Y + 120$$

$$\Rightarrow 0.02Y = 0.02X + 120$$

$$\Rightarrow 2Y = 2X + 12000$$

$$\Rightarrow Y = X + 6000$$

Since  $X + Y = 100,000$ ,  $2X = 94,000 \Rightarrow X = 47,000$

$$\Rightarrow Y = 47,000 + 6000 = 53,000$$

So,  $X : Y = 47 : 53$ .

Correct Option: D.

4 votes

-- Arjun Suresh (328k points)

## 9.40

### Quadratic Equations (10) top

#### 9.40.1 Quadratic Equations: GATE CSE 2014 Set 1 | Question: GA-5 top

<https://gateoverflow.in/770>



The roots of  $ax^2 + bx + c = 0$  are real and positive.  $a, b$  and  $c$  are real. Then  $ax^2 + b|x| + c = 0$  has

- no roots
- 2 real roots
- 3 real roots
- 4 real roots

[gate2014-cse-set1](#) [quantitative-aptitude](#) [quadratic-equations](#) [normal](#)

Answer

#### 9.40.2 Quadratic Equations: GATE CSE 2016 Set 2 | Question: GA-05 top

<https://gateoverflow.in/39532>



In a quadratic function, the value of the product of the roots  $(\alpha, \beta)$  is 4. Find the value of

$$\frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}}$$

- A.  $n^4$
- B.  $4^n$
- C.  $2^{2n-1}$
- D.  $4^{n-1}$

gate2016-cse-set2 quantitative-aptitude quadratic-equations normal

Answer 

#### 9.40.3 Quadratic Equations: GATE CSE 2021 Set 2 | GA Question: 4

<https://gateoverflow.in/357546>



If  $\left(x - \frac{1}{2}\right)^2 - \left(x - \frac{3}{2}\right)^2 = x + 2$ , then the value of  $x$  is:

- A. 2
- B. 4
- C. 6
- D. 8

gate2021-cse-set2 quantitative-aptitude quadratic-equations

Answer 

#### 9.40.4 Quadratic Equations: GATE ECE 2020 | GA Question: 9

<https://gateoverflow.in/359762>



$a, b, c$  are real numbers. The quadratic equation  $ax^2 - bx + c = 0$  has equal roots, which is  $\beta$ , then

- A.  $\beta = b/a$
- B.  $\beta^2 = ac$
- C.  $\beta^3 = bc/(2a^2)$
- D.  $\beta^2 \neq 4ac$

gate2020-ece quantitative-aptitude quadratic-equations

Answer 

#### 9.40.5 Quadratic Equations: GATE2011 MN: GA-62

<https://gateoverflow.in/31540>



A student attempted to solve a quadratic equation in  $x$  twice. However, in the first attempt, he incorrectly wrote the constant term and ended up with the roots as (4, 3). In the second attempt, he incorrectly wrote down the coefficient of  $x$  and got the roots as (3, 2). Based on the above information, the roots of the correct quadratic equation are

- A. (-3, 4)
- B. (3, -4)
- C. (6, 1)
- D. (4, 2)

gate2011-mn quadratic-equations quantitative-aptitude

Answer 

#### 9.40.6 Quadratic Equations: GATE2013 EE: GA-8

<https://gateoverflow.in/40295>



The set of values of  $p$  for which the roots of the equation  $3x^2 + 2x + p(p-1) = 0$  are of opposite sign is

- A.  $(-\infty, 0)$
- B.  $(0, 1)$
- C.  $(1, \infty)$
- D.  $(0, \infty)$

gate2013-ee quantitative-aptitude quadratic-equations

Answer 

**9.40.7 Quadratic Equations: GATE2015 EC-2: GA-9** [top](#)<https://gateoverflow.in/39510>

if  $a^2 + b^2 + c^2 = 1$  then  $ab + bc + ac$  lies in the interval

- A.  $[1, 2/3]$
- B.  $[-1/2, 1]$
- C.  $[-1, 1/2]$
- D.  $[2, -4]$

[gate2015-ec-2](#) [numerical-answers](#) [quantitative-aptitude](#) [quadratic-equations](#)

Answer

**9.40.8 Quadratic Equations: GATE2016 EC-2: GA-4** [top](#)<https://gateoverflow.in/108482>

Given  $(9 \text{ inches})^{1/2} = (0.25 \text{ yards})^{1/2}$ , which one of the following statements is TRUE?

- A. 3 inches = 0.5 yards
- B. 9 inches = 1.5 yards
- C. 9 inches = 0.25 yards
- D. 81 inches = 0.0625 yards

[gate2016-ec-2](#) [quantitative-aptitude](#) [quadratic-equations](#)

Answer

**9.40.9 Quadratic Equations: GATE2018 EE: GA-4** [top](#)<https://gateoverflow.in/205181>

For what values of  $k$  given below is  $\frac{(k+2)^2}{(k-3)}$  an integer?

- A. 4, 8, 18
- B. 4, 10, 16
- C. 4, 8, 28
- D. 8, 26, 28

[gate2018-ee](#) [general-aptitude](#) [quantitative-aptitude](#) [easy](#) [quadratic-equations](#)

Answer

**9.40.10 Quadratic Equations: GATE2018 ME-1: GA-7** [top](#)<https://gateoverflow.in/313650>

Given that  $a$  and  $b$  are integers and  $a + a^2b^3$  is odd, which of the following statements is correct?

- A.  $a$  and  $b$  are both odd
- B.  $a$  and  $b$  are both even
- C.  $a$  is even and  $b$  is odd
- D.  $a$  is odd and  $b$  is even

[gate2018-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [quadratic-equations](#) [system-of-equations](#)

Answer

**Answers: Quadratic Equations****9.40.1 Quadratic Equations: GATE CSE 2014 Set 1 | Question: GA-5** [top](#)<https://gateoverflow.in/770>

- ✓ Let the positive roots be  $m$  and  $n$ . Now,  $-m$  and  $-n$  will also satisfy the equation  $ax^2 + b|x| + c = 0$  and hence we have 4 real roots.

Correct Answer: D

36 votes

-- Arjun Suresh (328k points)

**9.40.2 Quadratic Equations: GATE CSE 2016 Set 2 | Question: GA-05** [top ↴](#)<https://gateoverflow.in/39532>

$$\begin{aligned} & \checkmark \quad \frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}} \\ &= \frac{\alpha^n + \beta^n}{\left(\frac{1}{\alpha^n} + \frac{1}{\beta^n}\right)} \\ &= \frac{\alpha^n + \beta^n}{\left(\frac{\alpha^n + \beta^n}{\alpha^n \beta^n}\right)} \\ &= (\alpha \beta)^n \\ &= 4^n \end{aligned}$$

as product of roots,

$$\alpha \beta = 4$$

Correct Answer: **B**

30 votes

-- Praveen Saini (41.9k points)

**9.40.3 Quadratic Equations: GATE CSE 2021 Set 2 | GA Question: 4** [top ↴](#)<https://gateoverflow.in/357546>

$$\begin{aligned} & \checkmark \quad \text{Given that, } \left(x - \frac{1}{2}\right)^2 - \left(x - \frac{3}{2}\right)^2 = x + 2 \\ & \implies \left(x - \frac{1}{2} - x + \frac{3}{2}\right) \left(x - \frac{1}{2} + x - \frac{3}{2}\right) = x + 2 \quad [\because a^2 - b^2 = (a-b)(a+b)] \\ & \implies 2x - 2 = x + 2 \\ & \implies x = 4 \end{aligned}$$

So, the correct answer is (B).

8 votes

-- Lakshman Patel (63.9k points)

**9.40.4 Quadratic Equations: GATE ECE 2020 | GA Question: 9** [top ↴](#)<https://gateoverflow.in/359762>

$\checkmark$  In general, for a quadratic equation  $ax^2 + bx + c = 0$ , sum of roots is given by :  $-\frac{b}{a}$  and product of roots by :  $\frac{-c}{a}$

 $\therefore$  Here both the roots are  $\beta$ .

So, according to the given quadratic equation, we have

- $2\beta = \frac{b}{a} \rightarrow (1)$  and
- $\beta^2 = \frac{c}{a} \rightarrow (2)$

Multiplying equations (1) and (2) and simplifying, we get  $\beta^3 = \frac{bc}{2a^2}$ 

Option C is correct

2 votes

-- haralk10 (1.8k points)

**9.40.5 Quadratic Equations: GATE2011 MN: GA-62** [top ↴](#)<https://gateoverflow.in/31540>

$\checkmark$  If equation is  $ax^2 + bx + c = 0$  and roots of the equation are  $x_1$  and  $x_2$

then  $x_1 + x_2 = -b/a$   
and  $x_1 \cdot x_2 = c/a$ in 1st attempt  $c$  is incorrect, So, we can say  $x_1 + x_2 = 4 + 3 = 7 \rightarrow (i)$  [as here  $-b/a$  is correct]

in 2nd attempt  $b$  is incorrect. So, we can say  $x_1 \cdot x_2 = 3.2 = 6 \rightarrow (ii)$  [as here  $c/a$  is correct]

Now solving  $(ii)$  we get,

$$x_2 = 6/x_1 \rightarrow (iii)$$

Putting it in eqn.  $(i)$

$$x_1 + \frac{6}{x_1} = 7$$

$$\Rightarrow x_1^2 - 7x_1 + 6 = 0$$

$$\Rightarrow x_1 = 1 \text{ or } x_1 = 6$$

Answer is (C)

13 votes

-- srestha (85k points)

#### 9.40.6 Quadratic Equations: GATE2013 EE: GA-8 [top](#)

<https://gateoverflow.in/40295>



- ✓ Roots of equation are of opposite sign then for the equation,  $ax^2 + bx + c = 0$ , product of roots,  $\frac{c}{a}$ , should be (negative number) less than 0

$$\frac{p(p-1)}{3} < 0$$

$$p(p-1) < 0$$

so  $p$  must be less than 1 and greater than 0

#### Option B

22 votes

-- Praveen Saini (41.9k points)

#### 9.40.7 Quadratic Equations: GATE2015 EC-2: GA-9 [top](#)

<https://gateoverflow.in/39510>



- ✓ Ans (B)

$(a + b + c)^2$  should be  $\geq 0$ .

$$\therefore a^2 + b^2 + c^2 + 2ab + 2bc + 2ca \geq 0$$

Given  $a^2 + b^2 + c^2 = 1$  therefore  $1 + 2(ab + bc + ca) \geq 0$

$$\Rightarrow ab + bc + ca \geq -\frac{1}{2}$$

Now to find the upper limit,

$$(a - b)^2 + (b - c)^2 + (c - a)^2 \geq 0$$

Expanding we get,  $2(a^2 + b^2 + c^2) - 2(ab + bc + ca) \geq 0$

$$\Rightarrow 2 - 2(ab + bc + ca) \geq 0$$

$$\Rightarrow ab + bc + ca \leq 1$$

Answer B. [-1/2,1]

22 votes

-- Ganesh K (329 points)

#### 9.40.8 Quadratic Equations: GATE2016 EC-2: GA-4 [top](#)

<https://gateoverflow.in/108482>



- ✓ It is so simple ☺, squaring LHS and RHS we get

$$9 \text{ inches} = 0.25 \text{ yards}$$

Option D is wrong, because when we square once more we get

$$81 \text{ inches}^2 = 0.0625 \text{ yards}^2$$

Correct Option: C.

2 votes

-- AKANKSHA DEWANGAN (3k points)

**9.40.9 Quadratic Equations: GATE2018 EE: GA-4** top ↴[☛ https://gateoverflow.in/205181](https://gateoverflow.in/205181)

- ✓ We'll try to eliminate the wrong options

- when  $k = 4$ ,  $\frac{(4+2)^2}{4-3} = \frac{36}{1} = 36$  (integer)
- when  $k = 8$ ,  $\frac{(8+2)^2}{8-3} = \frac{100}{5} = 20$  (integer)
- when  $k = 10$ ,  $\frac{(10+2)^2}{10-3} = \frac{144}{7} = 20.57$  (not an integer)
- when  $k = 16$ ,  $\frac{(16+2)^2}{16-3} = \frac{324}{13} = 24.92$  (not an integer)
- when  $k = 18$ ,  $\frac{(18+2)^2}{18-3} = \frac{400}{15} = 26.66$  (not an integer)
- when  $k = 26$ ,  $\frac{(26+2)^2}{26-3} = \frac{784}{23} = 34.08$  (not an integer)
- when  $k = 28$ ,  $\frac{(28+2)^2}{28-3} = \frac{900}{25} = 36$  (integer)

Correct option **(C) 4, 8, 28**

5 votes

-- Sukanya Das (9.9k points)

**9.40.10 Quadratic Equations: GATE2018 ME-1: GA-7** top ↴[☛ https://gateoverflow.in/313650](https://gateoverflow.in/313650)

- ✓ Given that  $a$  and  $b$  are integers.

And  $a + a^2b^3$  is odd

So,  $a(1 + ab^3)$  is also odd.

We now that only odd  $\times$  odd is odd. (even  $\times$  even = even, odd  $\times$  even = even)  
Therefore  $a$  is odd and  $(1 + ab^3)$  is odd

So,  $ab^3 = \text{even}$      $\{\because 1 + x \text{ is odd} \implies x \text{ is odd} - 1 \implies x \text{ is even}\}$

Since  $a$  is odd and  $ab^3$  is even,  $b$  must be even.

Therefore,  $a$  is odd and  $b$  is even.

Hence, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

**9.41****Ratio Proportion (22)** top ↴**9.41.1 Ratio Proportion: GATE CSE 2016 Set 1 | Question: GA10** top ↴[☛ https://gateoverflow.in/39612](https://gateoverflow.in/39612)

In a process, the number of cycles to failure decreases exponentially with an increase in load. At a load of 80 units, it takes

100 cycles for failure. When the load is halved, it takes

10000 cycles for failure. The load for which the failure will happen in

5000 cycles is \_\_\_\_\_.

- 40.00
- 46.02
- 60.01
- 92.02

[gate2016-cse-set1](#) [quantitative-aptitude](#) [ratio-proportion](#) [normal](#)

Answer

**9.41.2 Ratio Proportion: GATE CSE 2018 | Question: GA-7** top ↗<https://gateoverflow.in/204068>

If  $pqr \neq 0$  and  $p^{-x} = \frac{1}{q}$ ,  $q^{-y} = \frac{1}{r}$ ,  $r^{-z} = \frac{1}{p}$ , what is the value of the product  $xyz$ ?

- A.  $-1$
- B.  $\frac{1}{pqr}$
- C.  $1$
- D.  $pqr$

[gate2018-cse](#) [quantitative-aptitude](#) [ratio-proportion](#)

Answer

**9.41.3 Ratio Proportion: GATE CSE 2018 | Question: GA-8** top ↗<https://gateoverflow.in/204069>

In a party, 60% of the invited guests are male and 40% are female. If 80% of the invited guests attended the party and if all the invited female guests attended, what would be the ratio of males to females among the attendees in the party?

- A. 2:3
- B. 1:1
- C. 3:2
- D. 2:1

[gate2018-cse](#) [quantitative-aptitude](#) [ratio-proportion](#)

Answer

**9.41.4 Ratio Proportion: GATE CSE 2021 Set 1 | GA Question: 1** top ↗<https://gateoverflow.in/357476>

The ratio of boys to girls in a class is 7 to 3.

Among the options below, an acceptable value for the total number of students in the class is:

- A. 21
- B. 37
- C. 50
- D. 73

[gate2021-cse-set1](#) [quantitative-aptitude](#) [ratio-proportion](#)

Answer

**9.41.5 Ratio Proportion: GATE CSE 2021 Set 2 | GA Question: 8** top ↗<https://gateoverflow.in/357542>

The number of students in three classes is in the ratio 3 : 13 : 6. If 18 students are added to each class, the ratio changes to 15 : 35 : 21.

The total number of students in all the three classes in the beginning was:

- A. 22
- B. 66
- C. 88
- D. 110

[gate2021-cse-set2](#) [ratio-proportion](#) [quantitative-aptitude](#)

Answer

**9.41.6 Ratio Proportion: GATE Civil 2020 Set 2 | GA Question: 8** top ↗<https://gateoverflow.in/359832>

The ratio of ‘the sum of the odd positive integers from 1 to 100’ to ‘the sum of the even positive integers from 150 to 200’ is \_\_\_\_\_.

- A. 45 : 95
- B. 1 : 2
- C. 50 : 91

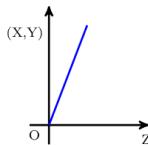
D. 1 : 1

gate2020-ce-2 quantitative-aptitude ratio-proportion

Answer 

#### 9.41.7 Ratio Proportion: GATE Mechanical 2020 Set 2 | GA Question: 9 <https://gateoverflow.in/359540>

An engineer measures THREE quantities,  $X$ ,  $Y$  and  $Z$  in an experiment. She finds that they follow a relationship that is represented in the figure below: (the product of  $X$  and  $Y$  linearly varies with  $Z$ )



Then, which of the following statements is FALSE?

- A. For fixed  $Z$ ;  $X$  is proportional to  $Y$
- B. For fixed  $Y$ ;  $X$  is proportional to  $Z$
- C. For fixed  $X$ ;  $Z$  is proportional to  $Y$
- D.  $XY/Z$  is constant

gateme-2020-set2 quantitative-aptitude ratio-proportion

Answer 

#### 9.41.8 Ratio Proportion: GATE Mechanical 2021 Set 1 | GA Question: 8 <https://gateoverflow.in/359474>

The number of hens, ducks and goats in farm  $P$  are 65, 91 and 169, respectively. The total number of hens, ducks and goats in a nearby farm  $Q$  is 416. The ratio of hens : ducks : goats in farm  $Q$  is 5 : 14 : 13. All the hens, ducks and goats are sent from farm  $Q$  to farm  $P$ .

The new ratio of hens : ducks : goats in farm  $P$  is \_\_\_\_\_

- A. 5 : 7 : 13
- B. 5 : 14 : 13
- C. 10 : 21 : 26
- D. 21 : 10 : 26

gateme-2021-set1 quantitative-aptitude ratio-proportion

Answer 

#### 9.41.9 Ratio Proportion: GATE2011 AG: GA-8 <https://gateoverflow.in/312128>

Three friends,  $R$ ,  $S$  and  $T$  shared toffee from a bowl.  $R$  took  $\frac{1}{3}$ <sup>rd</sup> of the toffees, but returned four to the bowl.  $S$  took  $\frac{1}{4}$ <sup>th</sup> of what was left but returned three toffees to the bowl.  $T$  took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

- A. 38
- B. 31
- C. 48
- D. 41

general-aptitude quantitative-aptitude gate2011-ag ratio-proportion

Answer 

#### 9.41.10 Ratio Proportion: GATE2011 GG: GA-4 <https://gateoverflow.in/40205>

If  $m$  students require a total of  $m$  pages of stationery in  $m$  days, then 100 students will require 100 pages of stationery in

- A. 100 days
- B.  $m/100$  days

- C.  $100/m$  days  
D.  $m$  days

gate2011-gg quantitative-aptitude ratio-proportion

Answer 

#### 9.41.11 Ratio Proportion: GATE2013 AE: GA-1

<https://gateoverflow.in/40242>



If  $3 \leq X \leq 5$  and  $8 \leq Y \leq 11$  then which of the following options is TRUE?

- A.  $\left(\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{5}\right)$   
 B.  $\left(\frac{3}{11} \leq \frac{X}{Y} \leq \frac{5}{8}\right)$   
 C.  $\left(\frac{3}{11} \leq \frac{X}{Y} \leq \frac{8}{5}\right)$   
 D.  $\left(\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{11}\right)$

gate2013-ae quantitative-aptitude ratio-proportion normal

Answer 

#### 9.41.12 Ratio Proportion: GATE2014 AE: GA-8

<https://gateoverflow.in/40308>



The smallest angle of a triangle is equal to two thirds of the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is  $3 : 4 : 5 : 6$ . The largest angle of the triangle is twice its smallest angle. What is the sum, in degrees, of the second largest angle of the triangle and the largest angle of the quadrilateral?

gate2014-ae quantitative-aptitude ratio-proportion numerical-answers

Answer 

#### 9.41.13 Ratio Proportion: GATE2015 EC-1: GA-9

<https://gateoverflow.in/39496>



A cube of side 3 units is formed using a set of smaller cubes of side 1 unit. Find the proportion of the number of faces of the smaller cubes visible to those which are NOT visible.

- A.  $1 : 4$   
 B.  $1 : 3$   
 C.  $1 : 2$   
 D.  $2 : 3$

gate2015-ec-1 general-aptitude quantitative-aptitude geometry ratio-proportion

Answer 

#### 9.41.14 Ratio Proportion: GATE2017 CE-2: GA-4

<https://gateoverflow.in/313415>



What is the value of  $x$  when  $81 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$ ?

- A. 1  
 B. -1  
 C. -2  
 D. Can not be determined

gate2017-ce-2 ratio-proportion quantitative-aptitude

Answer 

#### 9.41.15 Ratio Proportion: GATE2018 CE-1: GA-7

<https://gateoverflow.in/313254>



The price of a wire made of a super alloy material is proportional to the square of its length. The price of  $10m$  length of the wire is Rs. 1600. What would be the total price (in Rs.) of two wires of length  $4m$  and  $6m$ ?

- A. 768

- B. 832
- C. 1440
- D. 1600

[gate2018-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [ratio-proportion](#)

Answer 

#### 9.41.16 Ratio Proportion: GATE2018 CE-2: GA-6 top ↗

☞ <https://gateoverflow.in/313385>



In manufacturing industries, loss is usually taken to be proportional to the square of the deviation from a target. If the loss is Rs. 4900 for a deviation of 7 units, what would be the loss in Rupees for a deviation of 4 units from the target?

- A. 400
- B. 1200
- C. 1600
- D. 2800

[gate2018-ce-2](#) [general-aptitude](#) [quantitative-aptitude](#) [ratio-proportion](#)

Answer 

#### 9.41.17 Ratio Proportion: GATE2018 EC: GA-7 top ↗

☞ <https://gateoverflow.in/205211>



Two alloys  $A$  and  $B$  contain gold and copper in the ratios of  $2 : 3$  and  $3 : 7$  by mass, respectively. Equal masses of alloys  $A$  and  $B$  are melted to make an alloy  $C$ . The ratio of gold to copper in alloy  $C$  is \_\_\_\_\_.

- A. 5 : 10
- B. 7 : 13
- C. 6 : 11
- D. 9 : 13

[gate2018-ec](#) [general-aptitude](#) [quantitative-aptitude](#) [normal](#) [ratio-proportion](#)

Answer 

#### 9.41.18 Ratio Proportion: GATE2019 EE: GA-7 top ↗

☞ <https://gateoverflow.in/313564>



The ratio of the number of boys and girls who participated in an examination is  $4 : 3$ . The total percentage of candidates who passed the examination is 80 and the percentage of girls who passed the exam is 90. The percentage of boys who passed is \_\_\_\_\_.

- A. 55.50
- B. 72.50
- C. 80.50
- D. 90.00

[gate2019-ee](#) [general-aptitude](#) [quantitative-aptitude](#) [ratio-proportion](#) [percentage](#)

Answer 

#### 9.41.19 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-1 top ↗

☞ <https://gateoverflow.in/314545>



Two liquids  $A$  and  $B$  are in the ratio  $4 : 1$  in container 1 and in container 2, they are in the ratio  $1 : 3$ . In what ratio should the contents of the two containers be mixed so as to obtain a mixture of  $A$  and  $B$  in the ratio  $1 : 1$ ?

- A. 5 : 6
- B. 4 : 3
- C. 3 : 4
- D. 6 : 5

[gate2020-practise-2](#) [quantitative-aptitude](#) [ratio-proportion](#)

Answer 

**9.41.20 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-3** top ↗<https://gateoverflow.in/314540>

Anupama and Swathy bought 1 acre of land for Rs. 2 lakhs in year 2010. Anupama planted coconut and lemon trees in the ratio 4 : 1 on equal area of land. There were a total of 100 lemon trees. The cost of one coconut was Rs.5. The crop took 7 years to mature and when the crop was reaped in 2017, the total revenue generated was 25% of the total amount put in by Anupama and Swathy together. The revenue generated from the coconut and lemon trees were in the ratio 3 : 2 and it was shared equally by Anupama and Swathy as the initial amount spent by them were equal.

What was the ratio of yields per acre of land for coconuts & lemons?

- A. 3 : 2
- B. 2 : 3
- C. 1 : 1
- D. cannot be determined.

gate2020-practise-2 ratio-proportion**Answer** **9.41.21 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-5** top ↗<https://gateoverflow.in/314537>

It takes a pendulum of a clock 5 seconds to strike 2 o'clock. How much time (in seconds) will it take to strike 10 o'clock?

gate2020-practise-2 numerical-answers ratio-proportion**Answer** **9.41.22 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-6** top ↗<https://gateoverflow.in/314535>

If 9 apples cost Rs. 100 and 10 mangoes cost Rs. 100 then the maximum number of fruits one can buy with Rs. 150 is

gate2020-practise-2 numerical-answers ratio-proportion**Answer** **Answers: Ratio Proportion****9.41.1 Ratio Proportion: GATE CSE 2016 Set 1 | Question: GA10** top ↗<https://gateoverflow.in/39612>

- ✓ The number of cycles to failure decrease exponentially with an increase in load.

So, we have general equation

$$y = ae^{-bx}$$

where  $y$  is number of cycles to failure, and  $x$  is load.

At load of 80 units , it takes 100 cycles for failure.

$$100 = ae^{-80b} \quad \rightarrow (1)$$

when load is halved it takes 10000 cycles for failure.

$$10000 = ae^{-40b} \quad \rightarrow (2)$$

Divide (2) by (1)

$$\Rightarrow e^{40b} = 100$$

$$\Rightarrow b = \frac{\log_e 100}{40} \quad \rightarrow (3)$$

At 5000 cycles to failure

$$5000 = ae^{-xb} \rightarrow (4)$$

divide (2) by (4)

$$\implies e^{b(x-40)} = 2$$

$$\implies b(x - 40) = \log_e 2$$

$$\implies \frac{\log_e 100}{40} \times (x - 40) = \log_e 2 \quad (\text{using (3)})$$

$$\implies x = 40 \times \frac{(\log_e 2 + \log_e 100)}{\log_e 100}$$

$$= 40 \times \frac{\log_e 200}{\log_e 100}$$

$$= 46.02$$

Correct Answer: *B*

61 votes

-- Praveen Saini (41.9k points)

### 9.41.2 Ratio Proportion: GATE CSE 2018 | Question: GA-7 top

<https://gateoverflow.in/204068>



✓  $pqr \neq 0$

$$p^{-x} = \frac{1}{q}$$

$$\text{Or, } \log(p^{-x}) = \log\left(\frac{1}{q}\right)$$

$$\text{Or, } -x \log(p) = \log(1) - \log(q) \quad \left[ \left[ \because \log_b(m^n) = n \cdot \log_b(m) \quad \log_b\left(\frac{m}{n}\right) = \log_b(m) - \log_b(n) \right] \right]$$

$$\text{Or, } x \log(p) = \log(q) \quad [\because \log(1) = 0]$$

$$\text{Or, } x = \frac{\log(q)}{\log(p)}$$

$$q^{-y} = \frac{1}{r}$$

$$\text{Or, } \log(q^{-y}) = \log\left(\frac{1}{r}\right)$$

$$\text{Or, } -y \log(q) = \log(1) - \log(r) \quad \left[ \left[ \because \log_b(m^n) = n \cdot \log_b(m) \quad \log_b\left(\frac{m}{n}\right) = \log_b(m) - \log_b(n) \right] \right]$$

$$\text{Or, } y \log(q) = \log(r) \quad [\because \log(1) = 0]$$

$$\text{Or, } y = \frac{\log(r)}{\log(q)}$$

$$r^{-z} = \frac{1}{p}$$

$$\text{Or, } \log(r^{-z}) = \log\left(\frac{1}{p}\right)$$

$$\text{Or, } -z \log(r) = \log(1) - \log(p) \quad \left[ \left[ \because \log_b(m^n) = n \cdot \log_b(m) \quad \log_b\left(\frac{m}{n}\right) = \log_b(m) - \log_b(n) \right] \right]$$

Or,  $z \log(r) = \log(p)$       $[\because \log(1) = 0]$

Or,  $z = \frac{\log(p)}{\log(r)}$

$$\therefore x \times y \times z = \frac{\log(q)}{\log(p)} \times \frac{\log(r)}{\log(q)} \times \frac{\log(p)}{\log(r)}$$

$$= 1$$

Correct Answer: C

9 votes

-- Subarna Das (11.3k points)

#### 9.41.3 Ratio Proportion: GATE CSE 2018 | Question: GA-8 top

<https://gateoverflow.in/204069>



- ✓ Assume 100 people are invited, so 60 men and 40 women invited.

During the party only 80 people showed up, and since all women attended  $\Rightarrow 80 = 40 + \text{men}$

Therefore, men = 40

men : women = 1:1

Correct Answer: B

19 votes

-- Wantei Warjri (269 points)

#### 9.41.4 Ratio Proportion: GATE CSE 2021 Set 1 | GA Question: 1 top

<https://gateoverflow.in/357476>



- ✓ Option C.

The number of boys is a multiple of 7 i.e.,  $7M$ , for some integer  $M$ .

The number of girls is a multiple of 3 i.e.,  $3M$ .

$\therefore$  The total number of students =  $7M + 3M = 10M$ , i.e., a multiple of 10.

Only option that fits is C.

3 votes

-- zxy123 (2.5k points)

#### 9.41.5 Ratio Proportion: GATE CSE 2021 Set 2 | GA Question: 8 top

<https://gateoverflow.in/357542>



- ✓ Let the three classes have  $3x$ ,  $13x$  and  $6x$  students respectively. 18 students are added in each class.

After that  $3x + 18$ ,  $13x + 18$  and  $6x + 18$  are the number of students in each class.

Given,  $3x + 18 : 13x + 18 : 6x + 18 = 15 : 35 : 21$

$$\implies \frac{3x+18}{6x+18} = \frac{15}{21}$$

$$\implies \frac{x+6}{2x+6} = \frac{5}{7}$$

$$\implies 7x + 42 = 10x + 30$$

$$\implies 3x = 12$$

$$\implies x = 4$$

So, the total number of students in all the three classes, in the beginning, =  $3 * 4 + 13 * 4 + 6 * 4 = 88$ .

**Option (C) is the correct answer.**

5 votes

-- Ashwani Kumar (12.8k points)

#### 9.41.6 Ratio Proportion: GATE Civil 2020 Set 2 | GA Question: 8 top

<https://gateoverflow.in/359832>



- ✓ Let the sum of the odd positive integers from 1 to 100 be ' $x'$ , and the sum of the even positive integers from 150 to 200 be ' $y'$ .

Now,  $x = 1 + 3 + 7 + \dots + 99$

Here, we have  $a = 1$ ,  $d = 2$ ,  $l = 99$

$$T_n = l = a + (n - 1)d$$

$$\implies 99 = 1 + (n - 1)2$$

$$\implies 2n - 2 = 98$$

$$\implies n = 50$$

$$\therefore x = \frac{50}{2}(1 + 99) = 2500 \quad [\because S_n = \frac{n}{2}(a + l)]$$

And,  $y = 150 + 152 + 154 + \dots + 200$

Here, we have  $a = 150, d = 2, l = 200$

$$T_n = l = a + (n - 1)d$$

$$200 = 150 + (n - 1)2$$

$$\implies 2n - 2 = 50$$

$$\implies n = 26$$

$$\therefore y = \frac{26}{2}(150 + 200) = 13 \cdot 350 = 4550$$

$$\text{Now, the required ratio} = \frac{x}{y} = \frac{2500}{4550} = \frac{50}{91}.$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)



#### 9.41.7 Ratio Proportion: GATE Mechanical 2020 Set 2 | GA Question: 9 top ↴

↗ <https://gateoverflow.in/359540>

- ✓ Given that,  $XY \propto Z \implies XY = kZ$ ; where  $k$  is constant.

Now, we can verify each and every option.

- A. For fixed  $Z$ ;  $X$  is proportional to  $Y$  – **False.**
  - $XY \propto Z$
  - For fixed  $Z$ , we can write  $XY \propto 1$
  - $X \propto \frac{1}{Y}$  (or)  $Y \propto \frac{1}{X}$
- B. For fixed  $Y$ ;  $X$  is proportional to  $Z$  – **True.**
  - $XY \propto Z$
  - For fixed  $Y$ , we can write  $X \propto Z$
- C. For fixed  $X$ ;  $Z$  is proportional to  $Y$  – **True.**
  - $XY \propto Z$
  - For fixed  $X$  we can write  $Y \propto Z$
- D.  $XY/Z$  is constant – **True.**
  - $XY \propto Z$
  - $\implies XY = kZ$ ; where  $k$  is constant.

So, the correct answer is A.

1 votes

-- Lakshman Patel (63.9k points)



#### 9.41.8 Ratio Proportion: GATE Mechanical 2021 Set 1 | GA Question: 8 top ↴

↗ <https://gateoverflow.in/359474>

- ✓ First we can calculate the number of hens, ducks and goats in farm  $Q$ .

- Number of hens in farm  $Q = \frac{5}{32} \times 416 = 65$
- Number of ducks in farm  $Q = \frac{14}{32} \times 416 = 182$

- Number of goats in farm  $Q = \frac{13}{32} \times 416 = 169$

Initially, the number of hens, ducks and goats in farm  $P$  are 65, 91 and 169 respectively.

All the hens, ducks, and goats are sent from farm  $Q$  to farm  $P$ .

Therefore, in farm  $P$ ,

- Number of hens =  $65 + 65 = 130$
- Number of ducks =  $91 + 182 = 273$
- Number of goats =  $169 + 169 = 338$

$\therefore$  The required ratio =  $130 : 273 : 338 = 10 : 21 : 26$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63,9k points)

#### 9.41.9 Ratio Proportion: GATE2011 AG: GA-8 top

<https://gateoverflow.in/312128>



- Let  $x$  be the number of toffees

Number of toffee taken by  $R = \frac{x}{3}$

$R$  returned 4 to bowl

So, number of toffees in bowl =  $2(\frac{x}{3}) + 4$

$S$  takes  $\frac{1}{4}$  of it

Number of toffees taken by  $S = \frac{1}{4}(\frac{2x}{3} + 4)$

$S$  returns 3 to bowl

So, number of toffees in bowl =  $\frac{3}{4}(\frac{2x}{3} + 4) + 3 = \frac{x}{2} + 6$

$T$  takes  $\frac{1}{2}$  of it

Number of toffees taken by  $T = \frac{1}{2}(\frac{x}{2} + 6)$

$T$  returns 2 to bowl

Number of toffees in bowl =  $\frac{1}{2}(\frac{x}{2} + 6) + 2 = \frac{x}{4} + 5$

Now it is given 17 toffees left in bowl

So,  $\frac{x}{4} + 5 = 17$

$x = 48$

Answer is C

15 votes

-- Pooja Palod (24k points)

#### 9.41.10 Ratio Proportion: GATE2011 GG: GA-4 top

<https://gateoverflow.in/40205>



- Ans should be D)

as we know Men and days are inversely proportional and work and days are directly proportional

so we can write  $\frac{M_1 D_1}{W_1} = \frac{M_2 D_2}{W_2}$

According to given data in question

$$\frac{m \times m}{m} = \frac{100 \times D_2}{100}$$

$D_2 = m$  days

10 votes

-- minal (1.3k points)

#### 9.41.11 Ratio Proportion: GATE2013 AE: GA-1 top

https://gateoverflow.in/40242



✓  $\frac{X}{Y}$  is minimum for the given range when  $X$  is minimum possible and  $Y$  is maximum possible i.e., 3/11

$\frac{X}{Y}$  is maximum for the given range when  $X$  is maximum possible and  $Y$  is minimum possible i.e., 5/8

So, answer is (B)

17 votes

-- Vivek Srivastava (3k points)

#### 9.41.12 Ratio Proportion: GATE2014 AE: GA-8 top

https://gateoverflow.in/40308



✓ Sum of the angles of a quadrilateral = 360

Therefore,  $3x + 4x + 5x + 6x = 360$

$$\Rightarrow 18x = 360$$

$$\Rightarrow x = 360/18 = 20$$

Therefore, smallest angle of quadrilateral =  $3 \times 20 = 60$

Largest angle of quadrilateral =  $6 \times 20 = 120$

Therefore, smallest angle of triangle =  $60 \times 2/3 = 40$

Largest angle of triangle =  $2 \times 40 = 80$

Therefore, third angle of triangle =  $180 - 40 - 80 = 60$

Required sum =  $60 + 120 = 180$

6 votes

-- Shubhgupta (6.4k points)

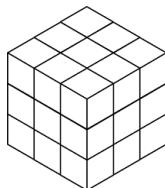
#### 9.41.13 Ratio Proportion: GATE2015 EC-1: GA-9 top

https://gateoverflow.in/39496



✓ Option C

Total  $27(3 \times 3 \times 3)$  small cubes of 1 unit each will be required to form a bigger cube of side 3 units



No. of faces per cube = 6

Total number of cubes =  $9 \times 3 = 27$

Total number of faces =  $27 \times 6 = 162$

Total number of non visible faces =  $162 - 54 = 108$

$$\frac{\text{No. of visible faces}}{\text{No. of non visible faces}} = \frac{54}{108} = \frac{1}{2}$$

Ref: <https://www.quora.com/A-cube-with-sides-of-3-units-is-formed-using-a-set-of-smaller-cubes-with-sides-of-1-unit-How-do-you-find-the-proportion-of-the-number-of-faces-of-the-smaller-cubes-visible-to-those-which-are-not-visible>

#### References



7 votes

-- Prasanna Ranganathan (4k points)

**9.41.14 Ratio Proportion: GATE2017 CE-2: GA-4** top ↴<https://gateoverflow.in/313415>

✓  $81 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$

$$\implies 9^2 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$$

$$\implies 9^2 \times \left(\frac{4}{5}\right)^{2(x+2)} \div \left(\frac{3}{5}\right)^{2(x+2)} = 12^2$$

$$\implies \left[9 \times \left(\frac{4}{5}\right)^{x+2} \div \left(\frac{3}{5}\right)^{x+2}\right]^2 = 12^2$$

$$\implies \left[9 \times \left(\frac{4}{5}\right)^{x+2} \div \left(\frac{3}{5}\right)^{x+2}\right] = 12$$

$$\implies \left[\left(\frac{4}{5}\right)^{x+2} \div \left(\frac{3}{5}\right)^{x+2}\right] = \frac{4}{3}$$

$$\implies \frac{\left(\frac{4}{5}\right)^{x+2}}{\left(\frac{3}{5}\right)^{x+2}} = \frac{4}{3}$$

$$\implies \left(\frac{4}{3}\right)^{x+2} = \left(\frac{4}{3}\right)^1$$

Compare both side and we get

$$x + 2 = 1$$

$$\implies x = -1$$

So, correct answer is option (B).

3 votes

-- Lakshman Patel (63.9k points)

**9.41.15 Ratio Proportion: GATE2018 CE-1: GA-7** top ↴<https://gateoverflow.in/313254>

- ✓ Price is proportional to the square of the length of wire i.e.  $P \propto L^2$

$$P_1 = 1600, L_1 = 10m, L_2 = 4m, L_3 = 6m$$

We can write like this  $\frac{P_1}{P_2} = \frac{L_1^2}{L_2^2}$

$$\implies \frac{1600}{P_2} = \frac{10^2}{4^2}$$

$$\implies P_2 = \frac{1600 \times 16}{100} = 256$$

$$\text{and } \frac{P_1}{P_3} = \frac{L_1^2}{L_3^2}$$

$$\implies \frac{1600}{P_3} = \frac{10^2}{6^2}$$

$$\implies P_3 = \frac{1600 \times 36}{100} = 576$$

$$\implies P_1 + P_2 = 256 + 576 = 832$$

The correct answer is (B)

Alternate method:

The price of wire made of super alloy material is proportional to the square of its length.

$$\text{Price} \propto (\text{Length})^2$$

$$\implies P = k l^2$$

Length of wire = 10 m

According to the given condition,

$$1600 = k (10)^2 \implies 1600 = k(100) \implies k = 16$$

So, that price of two wires of length 4 m and 6 m is =  $k [l_1^2 + l_2^2] = 16 [4^2 + 6^2] = 16 [16 + 36] = 16 \times 52 = 832$

3 votes

-- Lakshman Patel (63.9k points)

#### 9.41.16 Ratio Proportion: GATE2018 CE-2: GA-6 top ↴

↳ <https://gateoverflow.in/313385>



- ✓ It is given that  $4900 \propto 7^2 \propto 49 \rightarrow (1)$

If  $x$  is the loss in Rupees for a deviation of 4 units,

$$x \propto 4^2 \propto 16 \rightarrow (2)$$

$$(2) \div (1) \implies x = \frac{16 \times 4900}{49} = 1600.$$

Correct Option: C

2 votes

-- Arjun Suresh (328k points)



#### 9.41.17 Ratio Proportion: GATE2018 EC: GA-7 top ↴

↳ <https://gateoverflow.in/205211>



- ✓ Alloy A is having Gold and Copper in the ratio 2 : 3

Alloy B is having Gold and Copper in the ratio 3 : 7

Let's Assume we're taking 1 kg of alloy A & 1 kg of alloy B

$\therefore$  in alloy A

- Gold will be  $\frac{2}{5}$  kg
- Copper will be  $\frac{3}{5}$  kg

In alloy B

- Gold will be  $\frac{3}{10}$  kg
- Copper will be  $\frac{7}{10}$  kg

$\therefore$  In alloy C Gold to Copper ratio will be

$$= \frac{\frac{2}{5} + \frac{3}{10}}{\frac{3}{5} + \frac{7}{10}} = \frac{\frac{7}{10}}{\frac{13}{10}} = \frac{7}{13} = 7 : 13$$

**Option (B)**

9 votes

-- Sukanya Das (9.9k points)



#### 9.41.18 Ratio Proportion: GATE2019 EE: GA-7 top ↴

↳ <https://gateoverflow.in/313564>



- ✓ Percentage of passed students =  $\frac{\text{Percentage of boys passed} \times \# \text{boys} + \text{Percentage of girls passed} \times \# \text{girls}}{\text{Total number of students}}$

Taking total number of students as  $x$  and from the given statements,

$$80 = \frac{\text{Percentage of boys passed} \times \frac{4}{4+3}x + 90 \times \frac{3}{4+3}x}{x}$$

$$\Rightarrow 80 \times 7 = 4 \times \text{Percentage of boys passed} + 3 \times 90$$

$$\Rightarrow \text{Percentage of boys passed} = \frac{560 - 270}{4} = \frac{290}{4} = 72.5$$

Correct Answer: B

1 votes

-- Arjun Suresh (328k points)

#### 9.41.19 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-1 top ↴

<https://gateoverflow.in/314545>

✓ → In *container 1* liquids A and B are in the ratio 4 : 1 i.e.  $\frac{4}{5}$  part is Liquid A and  $\frac{1}{5}$  part is Liquid B

→ In *container 2* liquids A and B are in the ratio 1 : 3 i.e.  $\frac{1}{4}$  part is Liquid A and  $\frac{3}{4}$  part is Liquid B

Option A.

→ It says that 5 parts from *container 1* and 6 parts from *container 2* should be mixed.

→ Then amount of A : B taken from *container 1* =  $5 * \frac{4}{5} : 5 * \frac{1}{5} = 4 : 1$

→ Then amount of A : B taken from *container 2* =  $6 * \frac{1}{4} : 6 * \frac{3}{4} = 1.5 : 4.5$

→ So ratio of A : B in the final Mixture =  $(4 + 1.5) : (1 + 4.5) = 5.5 : 5.5 = 1 : 1$

∴ Option A. 5 : 6 is the correct answer.

10 votes

-- Satbir Singh (20.9k points)

#### 9.41.20 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-3 top ↴

<https://gateoverflow.in/314540>

The revenue generated from the coconut and lemon trees were in the ratio 3 : 2

Since, coconut and lemon were planted on equal amount of land and the price of land being the same, their yield per acre will also be in the ratio

3 : 2.

2 votes

-- Arjun Suresh (328k points)

#### 9.41.21 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-5 top ↴

<https://gateoverflow.in/314537>

Time taken to strike an hour =  $\frac{5}{2} = 2.5$  seconds

So, time required to strike 10 =  $2.5 \times 10 = 25$  seconds.

2 votes

-- Arjun Suresh (328k points)

#### 9.41.22 Ratio Proportion: GATE2020 Practice Test 2: General Aptitude-6 top ↴

<https://gateoverflow.in/314535>

Since the price per item is lower for mangoes, one can only buy mangoes here.

No. of mangoes one can get for Rs. 1 =  $\frac{10}{100} = 0.1$

No. of mangoes one can get for Rs. 150 =  $150 \times 0.1 = 15$

4 votes

-- Arjun Suresh (328k points)

### 9.42

#### Round Table Arrangement (2) top ↴

#### 9.42.1 Round Table Arrangement: GATE CSE 2017 Set 1 | Question: GA-7 top ↴

<https://gateoverflow.in/118410>

Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is

- A. 2
- B. 3
- C. 4
- D. Cannot be determined

gate2017-cse-set1 quantitative-aptitude round-table-arrangement

Answer 

### 9.42.2 Round Table Arrangement: GATE2017 EC-1: GA-7 [top](#)

<https://gateoverflow.in/313521>



*S, T, U, V, W, X, Y and Z* are seated around a circular table. *T*'s neighbors are *Y* and *V*. *Z* is seated third to the left of *T* and second to the right of *S*. *U*'s neighbors are *S* and *Y*; and *T* and *W* are not seated opposite each other. Who is third to the left of *V*?

- A. *X*
- B. *W*
- C. *U*
- D. *T*

gate2017-ec-1 round-table-arrangement

Answer 

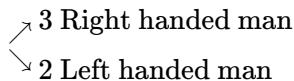
### Answers: Round Table Arrangement

#### 9.42.1 Round Table Arrangement: GATE CSE 2017 Set 1 | Question: GA-7 [top](#)

<https://gateoverflow.in/118410>



- 3 Right handed person.
- Every Person is left handed.
- Immediate right to woman is left handed person.
- As already given every woman is left handed. So, given 3 Right handed Person actually man.

So at this moment we have  
  
 ↗ 3 Right handed man  
 ↘ 2 Left handed man

We need 1 more person to make total 6 person and  
 that person may be either

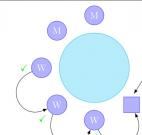
→ Woman with left handed. or → Man with either left handed or right handed.

#### Case – 1

Let us suppose that a person is a woman.

So, 3 Right handed Men

3 Left Handed Women



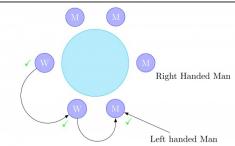
Now we have no more left-handed person to put here. So, this case is not possible.

#### Case – 2

3 Right handed Men.

2 Left handed Women.

1 Left-handed Man.



#### Case – 3

3 right-handed person (men)

2 left-handed women

1 right-handed man

This case is also not possible, as W\_\_W\_\_ - for this place we don't have any left-handed person. So this arrangement is not valid.

Correct Answer: A

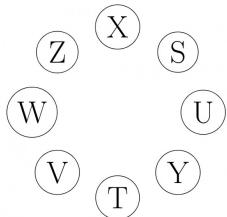
16 votes

-- 2018 (5.5k points)

**9.42.2 Round Table Arrangement: GATE2017 EC-1: GA-7** <https://gateoverflow.in/313521>

Answer A

Following is the arrangement of the circular table according to the statements given in the question.



3 votes

-- Ajay kumar soni (10.6k points)

**9.43****Sequence Series (7)** **9.43.1 Sequence Series: GATE CSE 2012 | Question: 65** <https://gateoverflow.in/2213>

Given the sequence of terms, *AD CG FK JP*, the next term is

- A. *OV*
- B. *OW*
- C. *PV*
- D. *PW*

[gate2012-cse](#) [quantitative-aptitude](#) [sequence-series](#) [easy](#)

Answer

**9.43.2 Sequence Series: GATE CSE 2018 | Question: GA-5** <https://gateoverflow.in/204066>

What is the missing number in the following sequence?

2, 12, 60, 240, 720, 1440, \_\_\_\_\_, 0

- A. 2880
- B. 1440
- C. 720
- D. 0

[gate2018-cse](#) [quantitative-aptitude](#) [sequence-series](#) [easy](#)

Answer

**9.43.3 Sequence Series: GATE2014 EC-4: GA-5** <https://gateoverflow.in/41467>

In a sequence of 12 consecutive odd numbers, the sum of the first 5 numbers is 425. What is the sum of the last 5 numbers in the sequence?

[gate2014-ec-4](#) [quantitative-aptitude](#) [sequence-series](#) [normal](#) [numerical-answers](#)

Answer

**9.43.4 Sequence Series: GATE2014 EC-4: GA-6** <https://gateoverflow.in/41468>

Find the next term in the sequence: 13M, 17Q, 19S, \_\_\_\_\_.

- A. 21W
- B. 21V
- C. 23W
- D. 23V

[gate2014-ec-4](#) [quantitative-aptitude](#) [sequence-series](#) [normal](#)

[Answer](#)**9.43.5 Sequence Series: GATE2016 ME-2: GA-8** [top](#)<https://gateoverflow.in/108300>

Find the missing sequence in the letter series.  $B, FH, LNP, \underline{\hspace{2cm}}$ .

- A. SUWY
- B. TUVW
- C. TVXZ
- D. TWXZ

[gate2016-me-2](#) [sequence-series](#) [quantitative-aptitude](#)
[Answer](#)**9.43.6 Sequence Series: GATE2019 EE: GA-3** [top](#)<https://gateoverflow.in/313558>

The missing number in the given sequence  $343, 1331, \underline{\hspace{2cm}}, 4913$  is

- A. 3375
- B. 2744
- C. 2197
- D. 4096

[gate2019-ee](#) [general-aptitude](#) [quantitative-aptitude](#) [sequence-series](#)
[Answer](#)**9.43.7 Sequence Series: GATE2019 ME-2: GA-3** [top](#)<https://gateoverflow.in/313588>

If IMHO=JNIP; IDK=JEL; and SO=TP, then IDC=  $\underline{\hspace{2cm}}$

- A. JDE
- B. JED
- C. JDC
- D. JCD

[gate2019-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [sequence-series](#) [easy](#)
[Answer](#)**Answers: Sequence Series****9.43.1 Sequence Series: GATE CSE 2012 | Question: 65** [top](#)<https://gateoverflow.in/2213>

A. OV

- AD - difference 2 (B,C)
- CG - difference 3 (D,E,F)
- FK - difference 4 and JP - difference 5

So, next term will have 6 difference

Again, each term starts with preceding term's second last letter.

So, JKLMNOP: next term will start with *O* and having 6 difference; it will be *OV*

12 votes

-- shreya ghosh (2.8k points)

**9.43.2 Sequence Series: GATE CSE 2018 | Question: GA-5** [top](#)<https://gateoverflow.in/204066>

- $2 \times 6 = 12$   
 $12 \times 5 = 60$   
 $60 \times 4 = 240$   
 $240 \times 3 = 720$   
 $720 \times 2 = 1440$   
 $1440 \times 1 = 1440$

So, option B, 1440 is the next term.

11 votes

-- Rakesh Kumar (2.4k points)

### 9.43.3 Sequence Series: GATE2014 EC-4: GA-5 [top](#)



- ✓ Let  $a$  be the first odd number.

So the terms of sequence will be

$$a, a+2, a+4, a+6, \dots, a+20, a+22$$

Sum of first 5 terms =  $a + a + 2 + a + 4 + a + 6 + a + 8 = 5a + 20 = 425$

We get,  $5a = 405$

$$\Rightarrow a = 81$$

$$\begin{aligned} \text{Sum of last 5 terms} &= a + 22 + a + 20 + a + 18 + a + 16 + a + 14 \\ &= 5a + 90 \end{aligned}$$

Now, we have  $a = 81$ . Substituting it we get,

$$\text{Answer as } 5 \times 81 + 90 = 405 + 90 = 495$$

**Answer: 495**

6 votes

-- Abhilash Panicker (7.6k points)

### 9.43.4 Sequence Series: GATE2014 EC-4: GA-6 [top](#)



- ✓ 13, 17, 19, 23 all are prime numbers

$13^{\text{th}}$  alphabet M

$17^{\text{th}}$  alphabet Q

$19^{\text{th}}$  alphabet S

$23^{\text{th}}$  alphabet W

Answer C. 23W

9 votes

-- Abhilash Panicker (7.6k points)

### 9.43.5 Sequence Series: GATE2016 ME-2: GA-8 [top](#)



- ✓  $B \xrightarrow[+2]{+4} F H \xrightarrow[+2+2]{+4} L N P \xrightarrow[+2+2+2]{+4} T V X Z$

The additions above refers to the position in the English alphabet set like  $B + 4$  gives the fourth letter after  $B$  which is  $F$ .

Correct answer: C.

3 votes

-- Arjun Suresh (328k points)

### 9.43.6 Sequence Series: GATE2019 EE: GA-3 [top](#)



- ✓ 343, 1331, \_\_\_\_\_, 4913

$$= 7^3, 11^3, \text{_____}, 17^3,$$

$\because 7, 11, 17$  are prime numbers

$\Rightarrow 13^3 = 2197$  should be the answer. ( $\because 13$  is also a prime number and is the only prime between 11 and 17)

Correct Answer: Option C

5 votes

-- Satbir Singh (20.9k points)

### 9.43.7 Sequence Series: GATE2019 ME-2: GA-3 [top](#)



- ✓ B. JED

From the examples, it's clear that the code is using next alphabet.

2 votes

-- Mukunda Madhava Nath (259 points)

**9.44****Simple Compound Interest (4)** **9.44.1 Simple Compound Interest: GATE ECE 2021 | GA Question: 1**  <https://gateoverflow.in/359806>

The current population of a city is 11,02,500 . If it has been increasing at the rate of 5% per annum, what was its population 2 years ago?

- A. 9,92,500
- B. 9,95,006
- C. 10,00,000
- D. 12,51,506

[gateec-2021](#) [quantitative-apptitude](#) [simple-compound-interest](#)

Answer

**9.44.2 Simple Compound Interest: GATE2010 MN: GA-5**  <https://gateoverflow.in/312013>

A person invest Rs.1000 at 10% annual compound interest for 2 years. At the end of two years, the whole amount is invested at an annual simple interest of 12% for 5 years. The total value of the investment finally is :

- A. 1776
- B. 1760
- C. 1920
- D. 1936

[general-apptitude](#) [quantitative-apptitude](#) [gate2010-mn](#) [simple-compound-interest](#)

Answer

**9.44.3 Simple Compound Interest: GATE2014 AG: GA-5**  <https://gateoverflow.in/41669>

The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

- A. 3 – 4 years
- B. 4 – 5 years
- C. 5 – 6 years
- D. 6 – 7 years

[gate2014-ag](#) [quantitative-apptitude](#) [simple-compound-interest](#) [normal](#)

Answer

**9.44.4 Simple Compound Interest: GATE2018 EC: GA-6**  <https://gateoverflow.in/205210>

Leila aspires to buy a car worth *Rs.* 10,00,000 after 5 years. What is the minimum amount in Rupees that she should deposit now in a bank which offers 10% annual rate of interest, if the interest was compounded annually?

- A. 5,00,000
- B. 6,21,000
- C. 6,66,667
- D. 7,50,000

[gate2018-ec](#) [general-apptitude](#) [quantitative-apptitude](#) [simple-compound-interest](#) [normal](#)

Answer

**Answers: Simple Compound Interest****9.44.1 Simple Compound Interest: GATE ECE 2021 | GA Question: 1**  <https://gateoverflow.in/359806>

- ✓ Given that, the current population of a city is 11,02,500, rate = 5%, and time = 2 years.

We know that,  $A = P \left(1 + \frac{r}{100}\right)^t$

Here,  $A = 11,02,500, r = 5\%, t = 2$  years.

$$\text{Now, } 1102500 = P \left(1 + \frac{5}{100}\right)^2$$

$$\implies 1102500 = P \left(\frac{105}{100}\right)^2$$

$$\implies 1102500 = P \left(\frac{21}{20}\right)^2$$

$$\implies 1102500 = P \left(\frac{441}{400}\right)$$

$$\implies P = \frac{1102500 \times 400}{441} = 10,00,000$$

**Short Method:** Let's assume, the two years ago the population was  $x$ .

$$\text{Now, } x \times \frac{105}{100} \times \frac{105}{100} = 1102500$$

$$\implies x = 10,00,000$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)



#### 9.44.2 Simple Compound Interest: GATE2010 MN: GA-5 top

→ <https://gateoverflow.in/312013>

✓ Principle ( $P$ ) = Rs. 1000, Rate( $R$ ) = 10%, Time( $T$ ) = 2 years and compounded annually.

Amount after 1<sup>st</sup> year =  $P + \text{Interest} = 1000 + (10\% \text{ of } 1000) = 1000 + 100 = \text{Rs. } 1100$ .

Amount after 2<sup>nd</sup> year =  $P_{\text{after 1st year}} + \text{Interest} = 1100 + (10\% \text{ of } 1100) = 1100 + 110 = \text{Rs. } 1210$ .

We can also get the final amount using the compound interest formula  $P \left(1 + \frac{r}{100}\right)^n = 1000 \times (1 + 0.1)^2 = \text{Rs. } 1210$

Now  $P = \text{Rs. } 1210, R = 12\%, T = 5$  years for SI.

$$SI = \left(\frac{PRT}{100}\right) = \left(\frac{1210 \times 12 \times 5}{100}\right) = 121 \times 6 = 726.$$

$$\text{Amount} = P + SI = 1210 + 726 = 1936.$$

∴ Option D is the correct answer.

4 votes

-- Satbir Singh (20.9k points)



#### 9.44.3 Simple Compound Interest: GATE2014 AG: GA-5 top

→ <https://gateoverflow.in/41669>



✓ Initial population  $P = 5M$

After 1 year.  $P = 5M \times 1.2 = 6M$

Now 2<sup>nd</sup> year,  $P = 6M$

Now after increment at end of 2 years,  $P = 6m \times 1.2 = 7.2M$

After 3 years  $P = 7.2m \times 1.2 = 8.64M$

After 4 years  $P = 8.64m \times 1.2 = 10.368M$

So, answer should be A.

12 votes

-- Manoj Kumar (26.7k points)

We can use the Compounding formula like below

$2P = P(1.2)^T$ , where  $T$  is the time in years and 1.2 is the effective value after every year ( $1 + r/100$ ).

$$\text{So, } \log 2 = T \log 1.2 \implies T = \frac{\log 2}{\log 1.2} \approx 3.8$$

So, option A is the answer here.

If the question was for years after which population gets doubled we will take ceil of 3.8 and get answer as 4.

8 votes

-- Arjun Suresh (328k points)

#### 9.44.4 Simple Compound Interest: GATE2018 EC: GA-6 [top](#)



✓ Let's assume the principal amount be  $P$ .

After getting an annual rate of interest as 10% which is compounded annually, 5 years later the amount should be 10,00,000

$$\text{So, } P \left(1 + \frac{10}{100}\right)^5 = 10,00,000$$

$$\implies P \left(\frac{11}{10}\right)^5 = 10^6$$

$$\implies P = \frac{10^6 * 10^5}{(11)^5} = \frac{10^{11}}{11^5}$$

$$P = 620921.323 \approx 621000$$

**Option (B)**

3 votes

-- Sukanya Das (9.9k points)

#### 9.45 Speed Time Distance (16) [top](#)

#### Speed Time Distance (16) [top](#)



#### 9.45.1 Speed Time Distance: GATE CSE 2013 | Question: 64 [top](#)

<https://gateoverflow.in/1568>

A tourist covers half of his journey by train at 60 km/h, half of the remainder by bus at 30 km/h and the rest by cycle at 10 km/h. The average speed of the tourist in km/h during his entire journey is

- A. 36
- B. 30
- C. 24
- D. 18

gate2013-cse quantitative-aptitude easy speed-time-distance

Answer

#### 9.45.2 Speed Time Distance: GATE CSE 2019 | Question: GA-3 [top](#)

<https://gateoverflow.in/302870>



Two cars start from the same location and go in the same direction. The speed of the first car is 50 km/h and the speed of the second car is 60 km/h. The number of hours it takes for the distance between the two cars to be 20 km is \_\_\_\_\_.

- A. 1
- B. 2
- C. 3
- D. 6

gate2019-cse general-aptitude quantitative-aptitude speed-time-distance

Answer

#### 9.45.3 Speed Time Distance: GATE Chemical 2020 | GA Question: 8 [top](#)

<https://gateoverflow.in/359812>



The distance between Delhi and Agra is 233 km. A car  $P$  started travelling from Delhi to Agra and another car  $Q$

started from Agra to Delhi along the same road 1 hour after the car  $P$  started. The two cars crossed each other 75 minutes after the car  $Q$  started. Both cars were travelling at constant speed. The speed of car  $P$  was 10 km/hr more than the speed of car  $Q$ . How many kilometers the car  $Q$  had travelled when the cars crossed each other?

- A. 66.6
- B. 75.2
- C. 88.2
- D. 116.5

[gate2020-ch](#) [quantitative-apptitude](#) [speed-time-distance](#)

Answer 

#### 9.45.4 Speed Time Distance: GATE2013 AE: GA-6 [top](#)

<https://gateoverflow.in/40247>



Velocity of an object fired directly in upward direction is given by  $V = 80 - 32t$ , where  $t$  (time) is in seconds. When will the velocity be between  $32 \text{ m/sec}$  and  $64 \text{ m/sec}$ ?

- A.  $\left(1, \frac{3}{2}\right)$
- B.  $\left(\frac{1}{2}, 1\right)$
- C.  $\left(\frac{1}{2}, \frac{3}{2}\right)$
- D.  $(1, 3)$

[gate2013-ae](#) [quantitative-apptitude](#) [speed-time-distance](#)

Answer 

#### 9.45.5 Speed Time Distance: GATE2013 EE: GA-9 [top](#)

<https://gateoverflow.in/40296>



A car travels  $8 \text{ km}$  in the first quarter of an hour,  $6 \text{ km}$  in the second quarter and  $16 \text{ km}$  in the third quarter. The average speed of the car in km per hour over the entire journey is

- A. 30
- B. 36
- C. 40
- D. 24

[gate2013-ee](#) [speed-time-distance](#) [quantitative-apptitude](#)

Answer 

#### 9.45.6 Speed Time Distance: GATE2014 EC-1: GA-8 [top](#)

<https://gateoverflow.in/41497>



A train that is 280 metres long, travelling at a uniform speed, crosses a platform in 60 seconds and passes a man standing on the platform in 20 seconds. What is the length of the platform in metres?

[gate2014-ec-1](#) [quantitative-apptitude](#) [speed-time-distance](#) [normal](#) [numerical-answers](#)

Answer 

#### 9.45.7 Speed Time Distance: GATE2014 EC-2: GA-10 [top](#)

<https://gateoverflow.in/41518>



It takes 30 minutes to empty a half-full tank by draining it at a constant rate. It is decided to simultaneously pump water into the half-full tank while draining it. What is the rate at which water has to be pumped in so that it gets fully filled in 10 minutes?

- A. 4 times the draining rate
- B. 3 times the draining rate
- C. 2.5 times the draining rate
- D. 2 times the draining rate

[gate2014-ec-2](#) [quantitative-apptitude](#) [speed-time-distance](#) [normal](#)

Answer 

**9.45.8 Speed Time Distance: GATE2014 EC-3: GA-8** [top ↴](#)<https://gateoverflow.in/41460>

A man can row at 8 km per hour in still water. If it takes him thrice as long to row upstream, as to row downstream, then find the stream velocity in km per hour.

[gate2014-ec-3](#) [quantitative-aptitude](#) [speed-time-distance](#) [normal](#) [numerical-answers](#)

Answer

**9.45.9 Speed Time Distance: GATE2015 EC-2: GA- 8** [top ↴](#)<https://gateoverflow.in/39509>

A tiger is 50 leaps of its own behind a tree. The tiger takes 5 leaps per minute to the deer's 4. If the tiger and the deer cover 8 meter and 5 meter per leap respectively, what distance in meters will the tiger have to run before it catches the deer?

[gate2015-ec-2](#) [quantitative-aptitude](#) [numerical-answers](#) [speed-time-distance](#)

Answer

**9.45.10 Speed Time Distance: GATE2016 EC-3: GA-5** [top ↴](#)<https://gateoverflow.in/110832>

It takes 10 s and 15 s, respectively, for two trains travelling at different constant speeds to completely pass a telegraph post. The length of the first train is 120 m and that of the second train is 150 m. The magnitude of the difference in the speeds of the two trains (in  $m/s$ ) is \_\_\_\_\_.

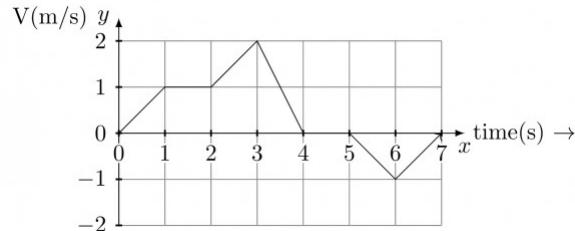
- A. 2.0
- B. 10.0
- C. 12.0
- D. 22.0

[gate2016-ec-3](#) [speed-time-distance](#) [quantitative-aptitude](#)

Answer

**9.45.11 Speed Time Distance: GATE2016 EC-3: GA-6** [top ↴](#)<https://gateoverflow.in/110834>

The velocity  $V$  of a vehicle along a straight line is measured in  $m/s$  and plotted as shown with respect to time in seconds. At the end of the 7 seconds, how much will the odometer reading increase by (in m)?



- A. 0
- B. 3
- C. 4
- D. 5

[gate2016-ec-3](#) [quantitative-aptitude](#) [speed-time-distance](#) [data-interpretation](#)

Answer

**9.45.12 Speed Time Distance: GATE2017 CE-2: GA-9** [top ↴](#)<https://gateoverflow.in/313418>

Budhan covers a distance of 19 km in 2 hours by cycling one fourth of the time and walking the rest. The next day he cycles (at the same speed as before) for half the time and walks the rest (at the same speed as before) and covers 26 km in 2 hours. The speed in km/h at which Budhan walk is

- A. 1
- B. 4
- C. 5
- D. 6

[gate2017-ce-2](#)
[speed-time-distance](#)
[quantitative-aptitude](#)
[Answer](#)

### 9.45.13 Speed Time Distance: GATE2017 EC-1: GA-8 [top](#)

<https://gateoverflow.in/313517>



Trucks (10 m long) and cars (5 m long) go on a single lane bridge. There must be a gap of at least 20 m after each truck and a gap of at least 15 m after each car. Trucks and cars travel at a speed of 36 km/h. If cars and trucks go alternately, what is the maximum number of vehicles that can use the bridge in one hour?

- A. 1440
- B. 1200
- C. 720
- D. 600

[gate2017-ec-1](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[speed-time-distance](#)
[Answer](#)

### 9.45.14 Speed Time Distance: GATE2018 CH: GA-6 [top](#)

<https://gateoverflow.in/205089>



An automobile travels from city  $A$  to city  $B$  and returns to city  $A$  by the same route. The speed of the vehicle during the onward and return journeys were constant at  $60\text{km}/\text{h}$  and  $90\text{km}/\text{h}$ , respectively. What is the average speed in  $\text{km}/\text{h}$  for the entire journey?

- A.  $72 \text{ km}/\text{h}$
- B.  $73 \text{ km}/\text{h}$
- C.  $74 \text{ km}/\text{h}$
- D.  $75 \text{ km}/\text{h}$

[gate2018-ch](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[normal](#)
[speed-time-distance](#)
[Answer](#)

### 9.45.15 Speed Time Distance: GATE2018 ME-1: GA-8 [top](#)

<https://gateoverflow.in/313652>



From the time the front of a train enters a platform, it takes 25 seconds for the back of the train to leave the platform, while traveling at a constant speed of  $54 \text{ km}/\text{h}$ . At the same speed, it takes 14 seconds to pass a man running at  $9 \text{ km}/\text{h}$  in the same direction as the train. What is the length of the train and that of the platform in meters, respectively?

- A. 210 and 140
- B. 162.5 and 187.5
- C. 245 and 130
- D. 175 and 200

[gate2018-me-1](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[speed-time-distance](#)
[Answer](#)

### 9.45.16 Speed Time Distance: GATE2019 IN: GA-9 [top](#)

<https://gateoverflow.in/313549>



Two trains started at 7AM from the same point. The first train travelled north at a speed of  $80\text{km}/\text{h}$  and the second train travelled south at a speed of  $100\text{km}/\text{h}$ . The time at which they were 540 km apart is \_\_\_\_\_ AM.

- A. 9
- B. 10
- C. 11
- D. 11.30

[gate2019-in](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[speed-time-distance](#)
[Answer](#)

## Answers: Speed Time Distance

**9.45.1 Speed Time Distance: GATE CSE 2013 | Question: 64** top ↗<https://gateoverflow.in/1568>

- Let the total distance be  $D$  then

$$\text{Avg speed} = \frac{D}{\text{total time taken}} \rightarrow (1)$$

$$\text{Total time taken} = \left( \frac{D}{2} \times \frac{1}{60} \right) + \left( \frac{D}{4} \times \frac{1}{30} \right) + \left( \frac{D}{4} \times \frac{1}{10} \right) = \frac{5D}{120} \rightarrow (2)$$

$$\text{Avg speed} = D \div (2) = \frac{120}{5} = 24.$$

Correct Answer: *C*

16 votes

-- Bhagirathi Nayak (11.7k points)

**9.45.2 Speed Time Distance: GATE CSE 2019 | Question: GA-3** top ↗<https://gateoverflow.in/302870>

- Let the required distance be reached at time  $T$ . Let Speed be ( $S_1 = 60, S_2 = 50$ )

According to the Question  $\rightarrow D_1 - D_2 = 20$

$$\therefore (60 * T) - (50 * T) = 20$$

$$T = 2$$

15 votes

-- Samarth Joshi (643 points)

**9.45.3 Speed Time Distance: GATE Chemical 2020 | GA Question: 8** top ↗<https://gateoverflow.in/359812>

- It is given that the distance between Delhi and Agra is 233 km.

Let the speed of  $Q$  be  $x$  km/hr. Then the speed of  $P$  will be  $(x + 10)$  km/hr.

$$\text{We know that, Speed (S)} = \frac{\text{Distance (D)}}{\text{Time (T)}}$$

In 1 hour, distance travelled by  $P = (x + 10) \times 1 = (x + 10)$  km

Now the remaining distance between  $P & Q = 233 - (x + 10)$  km

Both trains are going in the opposite direction and so the relative speed will be their sum of speeds.

$$\text{i.e., } x + x + 10 = (2x + 10) \text{ km/hr}$$

The two cars crossed each other 75 minutes after car  $Q$  started.

$$\text{So, } \frac{233 - (x + 10)}{2x + 10} = \frac{75}{60}$$

$$\implies \frac{233 - x - 10}{2x + 10} = \frac{5}{4}$$

$$\implies 892 - 4x = 10x + 50$$

$$\implies 14x = 842$$

$$\implies x = 60.142 \text{ km/hr}$$

$$\text{Now the distance travelled by } Q = 60.142 \times \frac{75}{60} = 60.142 \times \frac{5}{4} = 75.177 \approx 75.2 \text{ km.}$$

$\therefore$  Car  $Q$  had travelled 75.2 km, when the cars crossed each other.

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.45.4 Speed Time Distance: GATE2013 AE: GA-6 top ↗



✓ Given

$$32 < 80 - 32t < 64$$

$$-48 < -32t < -16$$

$$48 > 32t > 16$$

$$\frac{3}{2} > t > \frac{1}{2}$$

so ans is option c)  $\left(\frac{1}{2}, \frac{3}{2}\right)$

4 votes

-- minal (13k points)

<https://gateoverflow.in/40247>



#### 9.45.5 Speed Time Distance: GATE2013 EE: GA-9 top ↗



✓ 8 km in the first quarter of an hour, 6 km in the second quarter and 16 km in the third quarter.

Total distance = 30 km and total time =  $3/4$ . ( $1/4 + 1/4 + 1/4 = 3/4$ )

Average speed =  $\frac{\text{Total distance}}{\text{Total time}}$

$$= \frac{30}{3/4} = 30 \times (4/3) = 40 \text{ km/hr}$$

Correct Answer: C

8 votes

-- learner\_geek (1.1k points)

<https://gateoverflow.in/41497>



#### 9.45.6 Speed Time Distance: GATE2014 EC-1: GA-8 top ↗



✓ Speed of train =  $280/20 = 14 \text{ m/s}$

Let  $L$  be the length of platform

$280 + L$  covered in  $60s$

$$\frac{280+L}{14} = 60$$

$$280 + L = 840$$

$$L = 840 - 280$$

$$L = 560 \text{ m}$$

13 votes

-- Pooja Palod (24k points)

<https://gateoverflow.in/41518>



✓ Let the capacity of tank be 1 litre.

$$\text{Draining rate} = \frac{0.5 \text{ litre}}{30 \text{ minutes}} = \frac{1}{60} \text{ litre/min}$$

Let filling rate be  $x$  litre/min

In 1 min tank gets  $x - \left(\frac{1}{60}\right)$  litre filled.

To fill the remaining half part we need 10 minutes

$$x - \frac{1}{60} \text{ litre} \rightarrow 1 \text{ min}$$

$$0.5 \text{ litre} \rightarrow 10 \text{ mins}$$

$$\frac{0.5}{(x - \frac{1}{60})} = 10$$

Solving, we get  $x = \frac{4}{60}$  which is 4 times more than draining rate.

**So, option A**

16 votes

-- Motamarri Anusha (8.6k points)

#### 9.45.8 Speed Time Distance: GATE2014 EC-3: GA-8 [top](#)

» <https://gateoverflow.in/41460>



- ✓ Speed of man ( $m$ ) = 8 km/h

Let the speed of stream be  $s$

According to the question:

Speed of man upstream =  $S_1 = m - s$

Speed of man downstream =  $S_2 = m + s$

Speed = Distance/Time

Here, since the distance  $D$  is same,

$$D = S_1 \times T_1$$

$$D = S_2 \times T_2$$

$$S_1 \times T_1 = S_2 \times T_2$$

$$\frac{S_1}{S_2} = \frac{T_2}{T_1} = 3$$

$$m + s = 3(m - s)$$

$$\text{or, } 8 + s = 3(8 - s)$$

$$\implies s = 4 \text{ km/h}$$

8 votes

-- srestha (85k points)

#### 9.45.9 Speed Time Distance: GATE2015 EC-2: GA- 8 [top](#)

» <https://gateoverflow.in/39509>



- ✓ Tiger covers 40 meter/minute

Deer covers 20 meter/minute

Relative speed of tiger is 20 meter/minute

Deer is ahead of the tiger by  $50 \times 8 = 400$  meters

Time taken =  $400/20 = 20$  minutes

In 20 minutes tiger covers  $20 \times 40 = 800$  meters

Correct Answer: 800

7 votes

-- rajan (4.4k points)

#### 9.45.10 Speed Time Distance: GATE2016 EC-3: GA-5 [top](#)

» <https://gateoverflow.in/110832>



- ✓ Let  $x$  and  $y$  be the speeds of the two trains.

- $x = \frac{120}{10} = 12 \text{ m/s}$
- $y = \frac{150}{15} = 10 \text{ m/s}$

So, magnitude of their difference in speeds =  $|12 - 10| = 2 \text{ m/s}$

Correct Option: A.

1 votes

-- Arjun Suresh (328k points)

#### 9.45.11 Speed Time Distance: GATE2016 EC-3: GA-6 [top](#)

» <https://gateoverflow.in/110834>



- ✓ Odometer is a device used to measure distance traveled by an object.  
Area under Velocity-Time graph represents the distance traveled.

So, answer =  $0.5 + 1 + 1.5 + 1 + 0.5 + 0.5 = 5m$ .

Correct Answer: **D**

4 votes

-- Akash Sheoran (1.5k points)

#### 9.45.12 Speed Time Distance: GATE2017 CE-2: GA-9 [top](#)

<https://gateoverflow.in/313418>

- ✓ Let the speed by cycling be  $X$  km/h and speed of walking be  $Y$  km/h

$$\text{So, } \left(\frac{1}{2}\right)X + \left(\frac{3}{2}\right)Y = 19 \quad \rightarrow (1)$$

$$\text{And, } X + Y = 26 \quad \rightarrow (2)$$

Solving (i) & (ii) we get,  $X = 20$  and  $Y = 6$

Thus, the speed in km/h at which Budhan walk is 6.

Correct choice: option "D."

3 votes

-- Naveen Kumar (9.9k points)

#### 9.45.13 Speed Time Distance: GATE2017 EC-1: GA-8 [top](#)

<https://gateoverflow.in/313517>

- ✓ Length of a truck (including required gap) =  $10m + 20m \Rightarrow 30m$

$$\text{Length of a car (including required gap)} = 5m + 15m \Rightarrow 20m$$

$$\therefore \text{one pair of truck and car needs } 30m + 20m = 50m \text{ length}$$

Let  $n$  be the number of repetition of one pair of truck and car in 1 hour

Given speed = 36 km/hr = 36000 m/hr

$$\frac{50m \times n}{1 \text{ hr}} = 36000 \text{ m/hr}$$

$$\Rightarrow n = \frac{36000}{50} \Rightarrow 720 \text{ pairs of vehicles}$$

Total number of vehicles =  $720 \times 2 = 1440$  vehicles

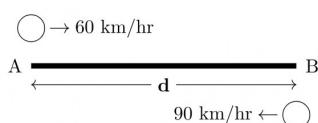
PS: We do not need the length of the bridge to solve this question as long as the length is at least 50 m.

7 votes

-- Jotheeswari (92.9k points)

#### 9.45.14 Speed Time Distance: GATE2018 CH: GA-6 [top](#)

<https://gateoverflow.in/205089>



$$\text{Average Speed} = \frac{\text{Total Distance travelled}}{\text{Total time taken}}$$

$$\text{Total Distance travelled} = 2d$$

$$\text{Total time taken} = \text{Time taken from } A \text{ to } B + \text{Time taken from } B \text{ to } A$$

$$= \frac{d}{60} + \frac{d}{90}$$

$$\text{Average speed} = \frac{2d}{\frac{d}{60} + \frac{d}{90}} = \frac{2d * 180}{5d} = 72 \text{ km/hr}$$

Hence, option (A) is correct

4 votes

-- Ashwani Kumar (12.8k points)

**9.45.15 Speed Time Distance: GATE2018 ME-1: GA-8**<https://gateoverflow.in/313652>

- ✓ Speed of train = 54 km/h  
Speed of man = 9 km/h  
Relative speed of train =  $54 - 9 = 45 \text{ km/h}$

Time taken by the train to pass the men = 14 sec

Distance Traveled = Length of train = Relative Speed  $\times$  Time

$$\text{Length of train} = 45 \times 14 \times \frac{1}{3600} \text{ km} = 175 \text{ m}$$

Time for traveling the length of the train and length of platform = 25 sec

$$\begin{aligned} \text{Distance traveled} &= \text{Length of Train} + \text{Length of Platform} = \text{Speed of train} \times \text{Time} \\ &= 54 \times 25 \times \frac{1}{3600} \text{ km} = 375 \text{ m} \end{aligned}$$

$$\text{Therefore, length of platform} = 375 - 175 = 200 \text{ m}$$

So, (D) is the correct answer.

1 votes

-- Lakshman Patel (63.9k points)

**9.45.16 Speed Time Distance: GATE2019 IN: GA-9**<https://gateoverflow.in/313549>

- ✓ The trains are traveling in opposite directions and so their relative speed is the sum of their individual speeds.

$$\text{Relative speed} = \text{Speed of Train 1} + \text{Speed of Train 2} = 80 + 100 = 180 \text{ kmph}$$

$$\text{Distance} = 540$$

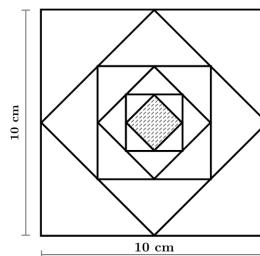
$$\text{Time taken} = \frac{\text{Distance}}{\text{Speed}} = \frac{540}{180} = 3$$

So, at 7am + 3 = 10am the trains will be separated by 540 kms.

Correct Answer: B

1 votes

-- Arjun Suresh (328k points)

**9.46****Squares (2)****9.46.1 Squares: GATE Electrical 2021 | GA Question: 7**<https://gateoverflow.in/359743>

In the figure shown above, each inside square is formed by joining the midpoints of the sides of the next larger square. The area of the smallest square (shaded) as shown, in  $\text{cm}^2$  is:

- A. 12.50
- B. 6.25
- C. 3.125
- D. 1.5625

Tags: gateee-2021, quantitative-aptitude, geometry, squares, area

Answer

**9.46.2 Squares: GATE2019 CE-1: GA-9**<https://gateoverflow.in/313441>

A square has side 5 cm smaller than the sides of a second square. The area of the larger square is four times the area of the smaller square. The side of the larger square is \_\_\_\_\_ cm.

- A. 18.50
- B. 15.10
- C. 10.00
- D. 8.50

[gate2019-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [geometry](#) [squares](#)

Answer 

### Answers: Squares

#### 9.46.1 Squares: GATE Electrical 2021 | GA Question: 7

 <https://gateoverflow.in/359743>



- ✓ It is given that the side of the outer square = 10 cm =  $\frac{10}{(\sqrt{2})^0}$  cm.

The side of the second outer square =  $\sqrt{5^2 + 5^2} = \sqrt{25 + 25} = \sqrt{50} = 5\sqrt{2}$  cm =  $\frac{10}{(\sqrt{2})^1}$  cm

The side of the third outer square =  $\sqrt{\left(\frac{5\sqrt{2}}{2}\right)^2 + \left(\frac{5\sqrt{2}}{2}\right)^2} = \sqrt{\frac{50}{4} + \frac{50}{4}} = \sqrt{\frac{100}{4}} = \sqrt{25} = 5$  cm =  $\frac{10}{(\sqrt{2})^2}$  cm

The side of the fourth outer square =  $\sqrt{\left(\frac{5}{2}\right)^2 + \left(\frac{5}{2}\right)^2} = \sqrt{\frac{25}{4} + \frac{25}{4}} = \sqrt{\frac{50}{4}} = \sqrt{\frac{25}{2}} = \frac{5}{\sqrt{2}}$  cm =  $\frac{10}{(\sqrt{2})^3}$  cm

The side of the fifth outer square =  $\sqrt{\left(\frac{5}{2\sqrt{2}}\right)^2 + \left(\frac{5}{2\sqrt{2}}\right)^2} = \sqrt{\frac{25}{8} + \frac{25}{8}} = \sqrt{\frac{50}{8}} = \sqrt{\frac{25}{4}} = \frac{5}{2}$  cm =  $\frac{10}{(\sqrt{2})^4}$  cm

The side of the inner (shaded) square =  $\sqrt{\left(\frac{5}{4}\right)^2 + \left(\frac{5}{4}\right)^2} = \sqrt{\frac{25}{16} + \frac{25}{16}} = \sqrt{\frac{50}{16}} = \sqrt{\frac{25}{8}} = \frac{5}{2\sqrt{2}}$  cm =  $\frac{10}{(\sqrt{2})^5}$  cm

∴ The area of the smallest square (shaded) =  $\left(\frac{5}{2\sqrt{2}}\right)^2 = \frac{25}{8} = 3.125$  cm<sup>2</sup>.

**PS:** The Pythagorean theorem states that if a triangle has one right angle, then the square of the longest side, called the hypotenuse, is equal to the sum of the squares of the lengths of the two shorter sides, called the legs. So if  $a$  and  $b$  are the lengths of the legs and  $c$  is the length of the hypotenuse, then  $a^2 + b^2 = c^2$ .

#### Short Method:

It is given that the side of the outer square = 10 cm.

Now, we can create some patterns, and find the area of inner (shaded) square.

- The area of outer square =  $10^2 = 100$  cm<sup>2</sup>
- The area of second outer square =  $\frac{100}{2} = 50$  cm<sup>2</sup>
- The area of third outer square =  $\frac{50}{2} = 25$  cm<sup>2</sup>
- The area of fourth outer square =  $\frac{25}{2} = 12.50$  cm<sup>2</sup>
- The area of fifth outer square =  $\frac{12.50}{2} = 6.25$  cm<sup>2</sup>
- The area of inner (shaded) square =  $\frac{6.25}{2} = 3.125$  cm<sup>2</sup>.

So, the correct answer is (C).

 1 votes

-- Lakshman Patel (63.9k points)

#### 9.46.2 Squares: GATE2019 CE-1: GA-9

 <https://gateoverflow.in/313441>



- ✓ Let  $x$  be the side of the larger square and  $y$  be the side of the smaller square.

According to the question:

- $y = x - 5 \rightarrow (1)$
- $x^2 = 4y^2 \rightarrow (2)$

Putting (1) in (2) we get

$$x^2 = 4(x - 5)^2$$

$$\begin{aligned} \Rightarrow x^2 &= 4(x^2 + 25 - 10x) \\ \Rightarrow 3x^2 - 40x + 100 &= 0 \\ \Rightarrow 3x^2 - 30x - 10x + 100 &= 0 \\ \Rightarrow 3x(x - 10) - 10(x - 10) &= 0 \\ \Rightarrow (x - 10)(3x - 10) &= 0 \\ \Rightarrow x = 10 \text{ cm } (\text{or}) x &= \frac{10}{3} \text{ cm} \end{aligned}$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

9.47

Statistics (7)

9.47.1 Statistics: GATE CSE 2012 | Question: 64

<https://gateoverflow.in/2212>



Which of the following assertions are **CORRECT**?

- P: Adding 7 to each entry in a list adds 7 to the mean of the list
- Q: Adding 7 to each entry in a list adds 7 to the standard deviation of the list
- R: Doubling each entry in a list doubles the mean of the list
- S: Doubling each entry in a list leaves the standard deviation of the list unchanged

- A. P, Q  
 B. Q, R  
 C. P, R  
 D. R, S

[gate2012-cse](#) [quantitative-aptitude](#) [statistics](#) [normal](#)

Answer

9.47.2 Statistics: GATE2012 AE: GA-5

<https://gateoverflow.in/40216>



The arithmetic mean of five different natural numbers is 12. The largest possible value among the numbers is

- A. 12  
 B. 40  
 C. 50  
 D. 60

[gate2012-ae](#) [statistics](#) [quantitative-aptitude](#)

Answer

9.47.3 Statistics: GATE2014 EC-1: GA-4

<https://gateoverflow.in/41493>



The statistics of runs scored in a series by four batsmen are provided in the following table. Who is the most consistent batsman of these four?

Batsman	Average	Standard deviation
K	31.2	5.21
L	46.0	6.35
M	54.4	6.22
N	17.9	5.90

- A.  $K$
- B.  $L$
- C.  $M$
- D.  $N$

gate2014-ec-1 statistics quantitative-aptitude

Answer ↗

#### 9.47.4 Statistics: GATE2016 ME-2: GA-6 top ↗

↗ <https://gateoverflow.in/108297>



Students taking an exam are divided into two groups, **P** and **Q** such that each group has the same number of students. The performance of each of the students in a test was evaluated out of 200 marks. It was observed that the mean of group **P** was 105, while that of group **Q** was 85. The standard deviation of group **P** was 25, while that of group **Q** was 5. Assuming that the marks were distributed on a normal distribution, which of the following statements will have the highest probability of being **TRUE**?

- A. No student in group **Q** scored less marks than any student in group **P**.
- B. No student in group **P** scored less marks than any student in group **Q**.
- C. Most students of group **Q** scored marks in a narrower range than students in group **P**.
- D. The median of the marks of group **P** is 100.

gate2016-me-2 probability statistics

Answer ↗

#### 9.47.5 Statistics: GATE2017 CE-1: GA-5 top ↗

↗ <https://gateoverflow.in/313483>



The following sequence of numbers is arranged in increasing order:  $1, x, x, x, x, y, y, 9, 16, 18$ . Given that the mean and median are equal, and are also equal to twice the mode, the value of  $y$  is

- A. 5
- B. 6
- C. 7
- D. 8

gate2017-ce-1 general-aptitude quantitative-aptitude statistics

Answer ↗

#### 9.47.6 Statistics: GATE2017 ME-1: GA-4 top ↗

↗ <https://gateoverflow.in/313659>



In a company with 100 employees, 45 earn *Rs.* 20,000 per month, 25 earn *Rs.* 30000, 20 earn *Rs.* 40000, 8 earn *Rs.* 60000, and 2 earn *Rs.* 150,000. The median of the salaries is

- A. *Rs.* 20,000
- B. *Rs.* 30,000
- C. *Rs.* 32,300
- D. *Rs.* 40,000

gate2017-me-1 general-aptitude quantitative-aptitude statistics

[Answer](#)**9.47.7 Statistics: GATE2020 Practice Test 2: General Aptitude-2** [top](#)<https://gateoverflow.in/314543>

Naveen wrote down all the different three-digit numbers that can be written using each of the numeral 1, 2 and 3 exactly once. What is the median of the numbers Naveen wrote down?

[gate2020-practise-2](#) [numerical-answers](#) [quantitative-aptitude](#) [statistics](#)[Answer](#)**Answers: Statistics****9.47.1 Statistics: GATE CSE 2012 | Question: 64** [top](#)<https://gateoverflow.in/2212>

- ✓ Suppose we double each entry of a list

$$\text{Initial Mean } (M_I) = \frac{\sum_{i=1}^n x_i}{n}$$

$$\text{New Mean } (M_N) = \frac{\sum_{i=1}^n 2 \times x_i}{n}$$

$$= \frac{2}{n} \sum_{i=1}^n x_i$$

So, when each entry in the list is doubled, mean also gets doubled.

$$\text{Standard Deviation } \sigma_I = \sqrt{\frac{1}{N} \sum_{i=1}^n (M_I - x_i)^2}$$

$$\begin{aligned} \text{New Standard Deviation } \sigma_N &= \sqrt{\frac{1}{N} \sum_{i=1}^n (M_N - 2 \times x_i)^2} \\ &= \sqrt{\frac{1}{N} \sum_{i=1}^n (2 \times (M_I - x_i))^2} \\ &= 2\sigma_I \end{aligned}$$

So, when each entry is doubled, standard deviation also gets doubled.

When we add a constant to each element of the list, it gets added to the mean as well. This can be seen from the formula of mean.

When we add a constant to each element of the list, the standard deviation (or variance) remains unchanged. This is because, the mean also gets added by the same constant and hence the deviation from the mean remains the same for each element.

So, here P and R are correct.

Correct Answer: **C**

[24 votes](#)[Arjun Suresh](#) (328k points)**9.47.2 Statistics: GATE2012 AE: GA-5** [top](#)<https://gateoverflow.in/40216>

- ✓ It is 50 obviously.

Total sum of 5 natural numbers =  $12*5 = 60$

If 60 is one natural number, then the other 4 numbers must be 0. As 0 is not a natural number(it is a whole number), 60 is not right, so next option remaining is 50.

and also in question they have told as different natural numbers. so 50, 1, 2, 3, 4 are the numbers.

Answer is 50, option **C**

[5 votes](#)[Sreyas S](#) (1.6k points)**9.47.3 Statistics: GATE2014 EC-1: GA-4** [top](#)<https://gateoverflow.in/41493>

- ✓ Answer is A. K

Average only gives the mean value, Standard Deviation gives how close to mean value (consistency) of a sample population distribution.

A standard deviation close to 0 means very close to mean value of a distribution.

Here K has the lowest SD (5.21)

10 votes

-- Sourav Mishra (सौरव मिश्रा) (1.1k points)

#### 9.47.4 Statistics: GATE2016 ME-2: GA-6 top

<https://gateoverflow.in/108297>



- ✓ Group Q students have less standard deviation than group P , means most students in group Q got less marks than group P but Not all students in group Q got less marks than group P .

That makes statement A and B incorrect .

Mean, Median and Mode of Normal Distribution is same , so option D is wrong .

Only option C is correct.

3 votes

-- Bikram (58.3k points)

#### 9.47.5 Statistics: GATE2017 CE-1: GA-5 top

<https://gateoverflow.in/313483>



- ✓ 1, x, x, x, y, y, 9, 16, 18

#### The mean

$$\bar{x} = \frac{\sum x}{N}$$

Here,

- $\sum$  represents the summation
- $x$  represents scores
- $N$  represents number of scores

$$\text{Mean} = \frac{1 + x + x + x + y + y + 9 + 16 + 18}{9} = \frac{3x + 2y + 44}{9}$$

#### The Median

(1) If the total number of numbers ( $n$ ) is an odd number, then the formula is given below :

$$\text{Median} = \left( \frac{n+1}{2} \right)^{\text{th}} \text{ term}$$

(2) If the total number of numbers( $n$ ) is an even number , then the formula is given below :

$$\text{Median} = \frac{\left( \frac{n}{2} \right)^{\text{th}} \text{ term} + \left( \frac{n}{2} + 1 \right)^{\text{th}} \text{ term}}{2}$$

Here in our question  $n = 9$ , which is odd. So, we apply the first formula and get the median

Write sequence in ascending or descending order

1, x, x, x, y, y, 9, 16, 18

$$\text{Median} = \left( \frac{9+1}{2} \right)^{\text{th}} \text{ term} = \left( \frac{10}{2} \right)^{\text{th}} \text{ term} = 5^{\text{th}} \text{ term}$$

Median =  $y$

#### The Mode

The mode is the most frequency occurring score or value.

1, x, x, x, y, y, 9, 16, 18

Here mode =  $x$

According to the question

$$\frac{3x + 2y + 44}{9} = y$$

$$\Rightarrow 3x + 2y + 44 = 9y$$

$$\Rightarrow 3x - 7y = -44 \quad \rightarrow (1)$$

and  $y = 2x \rightarrow (2)$

From (1) and (2) we get

$$3x - 14x = -44$$

$$\Rightarrow -11x = -44$$

$$\Rightarrow x = 4$$

$$y = 2x = 2 \times 4 = 8$$

The correct answer is (D)

4 votes

-- Lakshman Patel (63.9k points)

#### 9.47.6 Statistics: GATE2017 ME-1: GA-4 top ↴

↳ <https://gateoverflow.in/313659>



- ✓ Given that:

Employees	Salaries
45	20,000
25	30,000
20	40,000
8	60,000
2	150,000

#### The Median

(1) If the total number of numbers ( $n$ ) is an odd number, then the formula is given below (the numbers are assumed to be in ascending order):

$$\text{Median} = \left( \frac{n+1}{2} \right)^{\text{th}} \text{ term}$$

(2) If the total number of numbers( $n$ ) is an even number, then the formula is given below :

$$\text{Median} = \frac{\left( \frac{n}{2} \right)^{\text{th}} \text{ term} + \left( \frac{n}{2} + 1 \right)^{\text{th}} \text{ term}}{2}$$

Here,  $n = 100$

$$\text{Median} = \frac{\left( \frac{100}{2} \right)^{\text{th}} \text{ term} + \left( \frac{100}{2} + 1 \right)^{\text{th}} \text{ term}}{2}$$

$$\text{Median} = \frac{(50)^{\text{th}} \text{ term} + (51)^{\text{th}} \text{ term}}{2}$$

$$\text{Median} = \frac{30,000 + 30,000}{2} = 30,000$$

So, the correct answer is (B).

3 votes

-- Lakshman Patel (63.9k points)

#### 9.47.7 Statistics: GATE2020 Practice Test 2: General Aptitude-2 top ↴

↳ <https://gateoverflow.in/314543>



The numbers in ascending order will be 123, 132, 213, 231, 312, 321. Median will be  $\frac{213+231}{2} = 222$

2 votes

-- Arjun Suresh (328k points)

#### 9.48

#### System Of Equations (1) top ↴

#### 9.48.1 System Of Equations: GATE2011 GG: GA-6 top ↴

↳ <https://gateoverflow.in/40207>



The number of solutions for the following system of inequalities is

- $X_1 \geq 0$
- $X_2 \geq 0$

- $X_1 + X_2 \leq 10$
- $2X_1 + 2X_2 \geq 22$

- A. 0  
B. infinite  
C. 1  
D. 2

gate2011-gg quantitative-apptitude system-of-equations

Answer 

### Answers: System Of Equations

#### 9.48.1 System Of Equations: GATE2011 GG: GA-6

 <https://gateoverflow.in/40207>



$$\begin{aligned} \checkmark \quad X_1 &\geq 0 \rightarrow (1) \\ X_2 &\geq 0 \rightarrow (2) \\ X_1 + X_2 &\leq 10 \rightarrow (3) \\ 2X_1 + 2X_2 &\geq 22 \rightarrow (4) \end{aligned}$$

Now the equation (4) can be written as

$$X_1 + X_2 \geq 11 \rightarrow (5)$$

Now, equations (3) and (5) cannot hold true together since  $X_1 \geq 0$  and  $X_2 \geq 0$ .

Hence, system of inequalities can never be satisfied.

**Answer A. 0**

 8 votes

-- Abhilash Panicker (7,6k points)

Equations can be written in  $AX = B$  form.

Rank of augmented matrix  $AB$  is 3 and rank of  $A$  is 2 so the system of non-homogeneous equations is inconsistent.  
So, no solution exists.

Option A.

 2 votes

-- adactive18 (809 points)

#### 9.49

### Tabular Data (8)

#### 9.49.1 Tabular Data: GATE CSE 2014 Set 1 | Question: GA-9

 <https://gateoverflow.in/777>



In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter?

		Men	Women
Own vehicle	Car	40	34
Own vehicle	Scooter	30	20
Own vehicle	Both	60	46
Do not own vehicle		20	50

gate2014-cse-set1 quantitative-apptitude normal numerical-answers data-interpretation tabular-data

Answer 

#### 9.49.2 Tabular Data: GATE CSE 2014 Set 3 | Question: GA-5

 <https://gateoverflow.in/2028>



The table below has question-wise data on the performance of students in an examination. The marks for each question are also listed. There is no negative or partial marking in the examination.

Q No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1	2	21	17	6
2	3	15	27	2
3	2	23	18	3

What is the average of the marks obtained by the class in the examination?

- A. 1.34
- B. 1.74
- C. 3.02
- D. 3.91

gate2014-cse-set3 quantitative-aptitude normal data-interpretation tabular-data

Answer 

#### 9.49.3 Tabular Data: GATE CSE 2015 Set 1 | Question: GA-6

<https://gateoverflow.in/8010>



The number of students in a class who have answered correctly, wrongly, or not attempted each question in an exam, are listed in the table below. The marks for each question are also listed. There is no negative or partial marking.

Q No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1	2	21	17	6
2	3	15	27	2
3	1	11	29	4
4	2	23	18	3
5	5	31	12	1

What is the average of the marks obtained by the class in the examination?

- A. 2.290
- B. 2.970
- C. 6.795
- D. 8.795

gate2015-cse-set1 quantitative-aptitude easy data-interpretation tabular-data

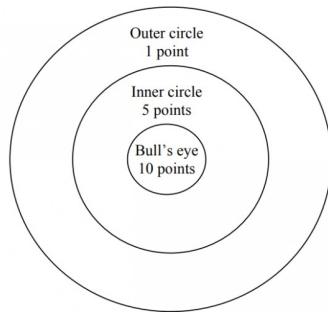
Answer 

#### 9.49.4 Tabular Data: GATE2011 MN: GA-64

<https://gateoverflow.in/31321>



Four archers P, Q, R, and S try to hit a bull's eye during a tournament consisting of seven rounds. As illustrated in the figure below, a player receives 10 points for hitting the bull's eye, 5 points for hitting within the inner circle and 1 point for hitting within the outer circle.



The final scores received by the players during the tournament are listed in the table below.

Round	P	Q	R	S
1	1	5	1	10
2	5	10	10	1
3	1	1	1	5
4	10	10	1	1
5	1	5	5	10
6	10	5	1	1
7	5	10	1	1

The most accurate and the most consistent players during the tournament are respectively

- A. P and S
- B. Q and R
- C. Q and Q
- D. R and Q

gate2011-mm data-interpretation quantitative-aptitude tabular-data

Answer ↗

#### 9.49.5 Tabular Data: GATE2013 AE: GA-7 top ↗

↗ <https://gateoverflow.in/40248>



Following table gives data on tourist from different countries visiting India in the year 2011

Country	Number of tourists
USA	2000
England	3500
Germany	1200
Italy	1100
Japan	2400
Australia	2300
France	1000

Which two countries contributed to the one third of the total number of tourists who visited India in 2011?

- A. USA and Japan
- B. USA and Australia
- C. England and France
- D. Japan and Australia

gate2013-ae quantitative-aptitude data-interpretation normal tabular-data

Answer ↗

#### 9.49.6 Tabular Data: GATE2013 CE: GA-8 top ↗

↗ <https://gateoverflow.in/40276>



Following table provides figures(in rupees) on annual expenditure of a firm for two years - 2010 and 2011.

Category	2010	2011
Raw material	5200	6240
Power & fuel	7000	9450
Salary & wages	9000	12600
Plant & machinery	20000	25000
Advertising	15000	19500
Research & Development	22000	26400

In 2011, which of the two categories have registered increase by same percentage?

- A. Raw material and Salary & wages.
- B. Salary & wages and Advertising.
- C. Power & fuel and Advertising.
- D. Raw material and research & Development.

[quantitative-aptitude](#) [gate2013-ce](#) [data-interpretation](#) [normal](#) [tabular-data](#)

Answer 

#### 9.49.7 Tabular Data: GATE2015 CE-2: GA-9 [top](#)

<https://gateoverflow.in/40185>



Read the following table giving sales data of five types of batteries for years 2006 to 2012:

Year	Type I	Type II	Type III	Type IV	Type V
2006	75	144	114	102	108
2007	90	126	102	84	126
2008	96	114	75	105	135
2009	105	90	150	90	75
2010	90	75	135	75	90
2011	105	60	165	45	120
2012	115	85	160	100	145

Out of the following , which type of battery achieved highest growth between the years 2006 and 2012?

- A. Type V
- B. Type III
- C. Type II
- D. Type I

[gate2015-ce-2](#) [general-aptitude](#) [quantitative-aptitude](#) [data-interpretation](#) [tabular-data](#)

Answer 

#### 9.49.8 Tabular Data: GATE2015 EC-2: GA-4 [top](#)

<https://gateoverflow.in/39505>



An electric bus has onboard instruments that report the total electricity consumed since the start of the trip, as well as the total distance, covered. During a single day of operation, the bus travels on stretches M, N, O, and P, in that order. The cumulative distances travelled and the corresponding electricity consumption are shown in the Table below:

Stretch	Cumulative distance (km)	Electricity used (kWh)
M	20	12
N	45	25
O	75	45
P	100	57

The stretch where the electricity consumption per km is minimum is

- A. M
- B. N
- C. O
- D. P

[gate2015-ec-2](#) [quantitative-aptitude](#) [data-interpretation](#) [tabular-data](#)

Answer 

#### Answers: Tabular Data

**9.49.1 Tabular Data: GATE CSE 2014 Set 1 | Question: GA-9** [top](#)<https://gateoverflow.in/777>

- ✓ Not having scooter from Men ( $40$  (car owner) +  $20$  (nothing owns)) =  $60$

Not having scooter from Women ( $34$  (car owner) +  $50$  (nothing owns)) =  $84$

$$\text{percentage} = \frac{(60 + 84)}{300} = 48 \text{ i.e. } 48\%$$

24 votes

-- Palash Nandi (1.2k points)

**9.49.2 Tabular Data: GATE CSE 2014 Set 3 | Question: GA-5** [top](#)<https://gateoverflow.in/2028>

- ✓ The question paper has only  $3$  questions. There are  $3$  ways a student can attempt a question.

1. Attempt correctly
2. Attempt wrongly
3. Not attempted

Each row lists number of students who attempted the question correctly, wrongly and who did not attempt. Sum of these, of any row gives the total strength of class,  $21 + 17 + 6 = 44$ .

Average marks obtained by the class in the examination,

$$\begin{aligned} &= \frac{(\text{Total marks(Q1)} + \text{Total marks(Q2)} + \text{Total marks(Q3)})}{\text{Total strength of class}} \\ &= \frac{((2 \times 21) + (3 \times 15) + (2 \times 23))}{44} \\ &= \frac{133}{44} = 3.02 \end{aligned}$$

**Note :** There is no negative or partial marking for the wrongly attempted and the non-attempted questions.

Correct Answer: *C*

22 votes

-- Srinath Jayachandran (2.9k points)

**9.49.3 Tabular Data: GATE CSE 2015 Set 1 | Question: GA-6** [top](#)<https://gateoverflow.in/8010>

$$\begin{aligned} \checkmark \quad \text{Avg. mark} &= \frac{(21 \times 2 + 15 \times 3 + 11 \times 1 + 23 \times 2 + 31 \times 5)}{(21 + 17 + 6)} \\ &= \frac{(42 + 45 + 11 + 46 + 155)}{44} \\ &= \frac{299}{44} \\ &= 6.795 \end{aligned}$$

Correct Answer: *C*

13 votes

-- Arjun Suresh (328k points)

**9.49.4 Tabular Data: GATE2011 MN: GA-64** [top](#)<https://gateoverflow.in/313211>

- ✓ → Here the **most accurate player** will be the one who makes the highest score.

→ *Q* has the maximum score of  $46$  points among all other players. So *Q* is the most accurate player.

→ Consistency for a series of data should mean their Standard Deviation is minimum. Standard deviation is given by the square root of the sum of the squares of the individual deviations from mean divided by the number of items. Here, mean values for *P*, *Q*, *R* and *S* are  $\frac{33}{7} = 4.71$ ,  $\frac{46}{7} = 6.57$ ,  $\frac{20}{7} = 2.85$  and  $\frac{29}{7} = 4.14$  respectively.

- For *P* the standard deviation is  $\sqrt{\frac{3 \times 3.71^2 + 2 \times 0.29^2 + 2 \times 5.29^2}{7}} = 3.73$
- For *Q* the standard deviation is  $\sqrt{\frac{1 \times 5.57^2 + 3 \times 1.57^2 + 3 \times 3.43^2}{7}} = 3.24$
- For *R* the standard deviation is  $\sqrt{\frac{5 \times 1.85^2 + 1 \times 2.15^2 + 1 \times 7.15^2}{7}} = 3.22$

- For  $S$  the standard deviation is  $\sqrt{\frac{4 \times 3.14^2 + 1 \times 0.86^2 + 2 \times 5.86^2}{7}} = 3.93$

→ The **most consistent player** will be the one who has the minimum standard deviation.

→  $R$  has the minimum standard deviation and is the most consistent.

∴ Option  $B$  is the right answer.

**NOTE:-** For calculating Standard deviation <https://www.mathsisfun.com/data/standard-deviation-formulas.html>.

### References



5 votes

-- Satbir Singh (20.9k points)

#### 9.49.5 Tabular Data: GATE2013 AE: GA-7 [top](#)

► <https://gateoverflow.in/40248>



- ✓ Total number of tourists who visited India in 2011 = 13500

One third of total tourists =  $13500 \div 3 = 4500$

OPTION A: USA and Japan = 4400

OPTION B: USA and Australia = 4300

OPTION D: Japan and Australia = 4700

OPTION C: England and France = 4500 which is one third of total tourists. **Hence C is the answer.**

8 votes

-- minal (13k points)

#### 9.49.6 Tabular Data: GATE2013 CE: GA-8 [top](#)

► <https://gateoverflow.in/40276>



- ✓ Answer is D.

$$\% \text{ increase in Raw material} = \frac{6240 - 5200}{5200} = 20\%$$

$$\% \text{ increase in Power & fuel} = \frac{9450 - 7000}{7000} = 35\%$$

$$\% \text{ increase in Salary & wages} = \frac{9000 - 12600}{9000} = 40\%$$

$$\% \text{ increase in Plant & machinery} = \frac{20000 - 25000}{20000} = 25\%$$

$$\% \text{ increase in Advertising} = \frac{19500 - 15000}{15000} = 30\%$$

$$\% \text{ increase in Research & Developement} = \frac{26400 - 22000}{22000} = 20\%$$

4 votes

-- richa07 (751 points)

#### 9.49.7 Tabular Data: GATE2015 CE-2: GA-9 [top](#)

► <https://gateoverflow.in/40185>



Year	Type I	Type II	Type III	Type IV	Type V
2006	75	144	114	102	108
2012	115	85	160	100	145
Inc. in sale	+40	-59	+46	-2	+39
Growth	$\frac{40}{75} \times 100 = 53.3\%$	(-ve)	40.35%	(-ve)	36.11%

Hence, Type – 1 battery has achieved the highest growth

Ans. (D) Type – 1

4 votes

-- Ram Swaroop1 (4.6k points)

**9.49.8 Tabular Data: GATE2015 EC-2: GA-4** [top ↴](#)<https://gateoverflow.in/39505>

- ✓ Reaching point  $M$  the bus traveled 20 km and consumed 12 units of electricity, So, electricity consumption per km =  $\frac{12}{20}$ .

From point  $M$  to point  $N$  distance traveled =  $45 - 20 = 25$ , electricity consumed =  $25 - 12 = 13$ . So, electricity consumption per km =  $\frac{13}{25}$ .

Likewise at point  $O$ , electricity consumption per km =  $\frac{20}{30}$  and at point  $P$  it is  $\frac{12}{25}$ . So, least electricity consumption per km is at point  $P$ .

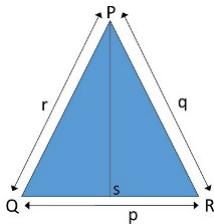
Answer is D

14 votes

-- Teja (295 points)

**9.50****Triangles (6)** [top ↴](#)**9.50.1 Triangles: GATE CSE 2015 Set 2 | Question: GA-8** [top ↴](#)<https://gateoverflow.in/8039>

In a triangle  $PQR$ ,  $PS$  is the angle bisector of  $\angle QPR$  and  $\angle QPS = 60^\circ$ . What is the length of  $PS$ ?



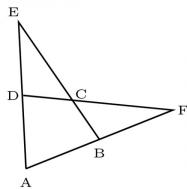
- A.  $\left( \frac{(q+r)}{qr} \right)$
- B.  $\left( \frac{qr}{q+r} \right)$
- C.  $\sqrt{(q^2 + r^2)}$
- D.  $\left( \frac{(q+r)^2}{qr} \right)$

[gate2015-cse-set2](#) [quantitative-aptitude](#) [geometry](#) [difficult](#) [triangles](#)

Answer

**9.50.2 Triangles: GATE CSE 2018 | Question: GA-9** [top ↴](#)<https://gateoverflow.in/204070>

In the figure below,  $\angle DEC + \angle BFC$  is equal to \_\_\_\_\_



- A.  $\angle BCD - \angle BAD$
- B.  $\angle BAD + \angle BCF$
- C.  $\angle BAD + \angle BCD$
- D.  $\angle CBA + \angle ADC$

[gate2018-cse](#) [quantitative-aptitude](#) [geometry](#) [normal](#) [triangles](#)

Answer

**9.50.3 Triangles: GATE Civil 2021 Set 2 | GA Question: 10** [top](#)<https://gateoverflow.in/359891>

In an equilateral triangle PQR, side PQ is divided into four equal parts, side QR is divided into six equal parts and side PR is divided into eight equals parts. The length of each subdivided part in cm is an integer. The minimum area of the triangle PQR possible, in  $\text{cm}^2$ , is

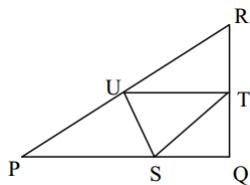
- A. 18
- B. 24
- C.  $48\sqrt{3}$
- D.  $144\sqrt{3}$

[gatcivil-2021-set2](#) [quantitative-aptitude](#) [geometry](#) [triangles](#)

Answer

**9.50.4 Triangles: GATE2015 ME-3: GA-8** [top](#)<https://gateoverflow.in/40175>

In the given figure angle Q is a right angle,  $PS : QS = 3 : 1$ ,  $RT : QT = 5 : 2$  and  $PU : UR = 1 : 1$ . If area of triangle QTS is  $20 \text{ cm}^2$ , then the area of triangle PQR in  $\text{cm}^2$  is \_\_\_\_\_



[gate2015-me-3](#) [quantitative-aptitude](#) [numerical-answers](#) [triangles](#)

Answer

**9.50.5 Triangles: GATE2015 ME-3: GA-9** [top](#)<https://gateoverflow.in/40173>

Right triangle PQR is to be constructed in the xy - plane so that the right angle is at P and line PR is parallel to the x-axis. The x and y coordinates of P, Q, and R are to be integers that satisfy the inequalities:  $-4 \leq x \leq 5$  and  $6 \leq y \leq 16$ . How many different triangles could be constructed with these properties?

- A. 110
- B. 1,100
- C. 9,900
- D. 10,000

[gate2015-me-3](#) [quantitative-aptitude](#) [triangles](#)

Answer

**9.50.6 Triangles: GATE2018 CH: GA-4** [top](#)<https://gateoverflow.in/205085>

The area of an equilateral triangle is  $\sqrt{3}$ . What is the perimeter of the triangle ?

- A. 2
- B. 4
- C. 6
- D. 8

[gate2018-ch](#) [general-aptitude](#) [quantitative-aptitude](#) [easy](#) [geometry](#) [triangles](#)

Answer

**Answers: Triangles****9.50.1 Triangles: GATE CSE 2015 Set 2 | Question: GA-8** [top](#)<https://gateoverflow.in/8039>

- ✓ As per Angle Bisector theorem,

$$\begin{aligned}\frac{QS}{SR} &= \frac{r}{q} \\ \frac{QS}{(p - QS)} &= \frac{r}{q} \\ QS &= \frac{pr}{(q + r)} \quad \rightarrow (1)\end{aligned}$$

We have in a triangle  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$$\begin{aligned}\text{So, from } \triangle QPS, \quad \frac{QS}{\sin 60} &= \frac{PS}{\sin Q} \\ PS &= \frac{QS \times \sin Q}{\sin 60} \quad \rightarrow (2)\end{aligned}$$

$$\begin{aligned}\text{From } \triangle PQR, \quad \frac{p}{\sin 120} &= \frac{q}{\sin Q} \\ p &= \frac{q \times \sin 120}{\sin Q} = \frac{\sin 60}{\sin Q} \quad \rightarrow (3)\end{aligned}$$

So, from (1), (2) and (3),

$$PS = \frac{qr}{(q + r)}$$

**B choice.**

[http://en.wikipedia.org/wiki/Angle\\_bisector\\_theorem](http://en.wikipedia.org/wiki/Angle_bisector_theorem)

References



35 votes

-- Arjun Suresh (328k points)

$$\text{Area of a } \triangle = \frac{1}{2} \times ac \sin B = \frac{1}{2} \times bc \sin A = \frac{1}{2} ab \sin C$$

so, Here area ( $\triangle PQR$ ) = area ( $\triangle PQS$ ) + area ( $\triangle PRS$ )

$$\frac{1}{2} rq \sin 120 = \frac{1}{2} PS \times r \sin 60 + \frac{1}{2} PS \times q \sin 60$$

$$\Rightarrow PS = \frac{rq}{(r + q)}$$

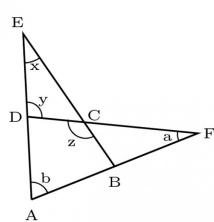
so, choice (B) is correct..

58 votes

-- Himanshu Agarwal (12.4k points)

## 9.50.2 Triangles: GATE CSE 2018 | Question: GA-9

<https://gateoverflow.in/204070>



$$\angle z = \angle x + \angle y$$

This is a triangle property that tells us that "the exterior angle of a triangle is the sum of the two opposite interior angles."

Similarly,

$$\angle y = \angle a + \angle b$$

By substituting, we get,

$$\angle Z = \angle x + \angle a + \angle b.$$

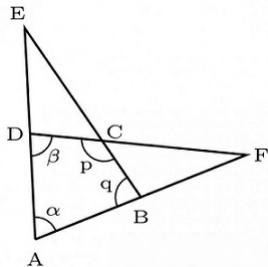
$$\text{Now } \angle Z = \angle BCD$$

$$\angle b = \angle BAD \quad \angle BCD - \angle BAD = \angle Z - \angle b \quad = \angle x + \angle a + \angle b - \angle b \quad = \angle x + \angle a \quad = \angle DEC$$

So, **option A** is the answer.

25 votes

-- Hemant Parihar (11.8k points)



$\angle E + \angle F = ?\alpha + q + E = 180 \rightarrow (1)\alpha + \beta + F = 180 \rightarrow (2)\alpha + \beta + p + q = 360 \rightarrow (3)$  Equation (1) + (2) = (3) $\alpha$ . Thus, Correct answer is option A.

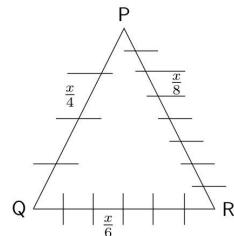
54 votes

-- Sivarajesh Anantharaj (285 points)

### 9.50.3 Triangles: GATE Civil 2021 Set 2 | GA Question: 10 top ↗

<https://gateoverflow.in/359891>

- ✓ Let the side length of an equilateral triangle be ' $x'$  cm.



As mentioned in the question, the length of each subdivided part in cm is an integer. So, the side length must be the LCM of (4, 6, 8)  $\Rightarrow x = 24$  cm.

$$\text{Now, the area of an equilateral triangle of side } x \text{ cm} = \frac{\sqrt{3}}{4} x^2 = \frac{\sqrt{3}}{4} 24^2 = 144\sqrt{3} \text{ cm}^2.$$

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

### 9.50.4 Triangles: GATE2015 ME-3: GA-8 top ↗

<https://gateoverflow.in/40175>

$$\checkmark \frac{RT}{QT} = \frac{5x}{2x} \Rightarrow RQ = 7x$$

$$\frac{PS}{QS} = \frac{3y}{1y} \Rightarrow PQ = 4y$$

$$\text{Area of Triangle } QTS = \frac{1}{2} \times QS \times QT = 20 \text{ cm}^2$$

$$\frac{1}{2} \times 1y \times 2x = 20 \text{ cm}^2$$

$$\Rightarrow xy = 20 \text{ cm}^2$$

$$\text{Area of Triangle } PQR = \frac{1}{2} \times PQ \times RQ$$

$$\frac{1}{2} \times 4y \times 7x$$

$$= 14xy = 14 \times 20\text{cm}^2 = 280\text{cm}^2$$

15 votes

-- Praveen Saini (41.9k points)

$$\frac{\overline{PS}}{\overline{QS}} = \frac{3}{1} \implies \frac{\overline{PS} + \overline{QS}}{\overline{QS}} = \frac{3+1}{1} = 4 \implies \overline{PQ} = 4 \cdot \overline{QS}$$

Similarly,

$$\frac{\overline{RT}}{\overline{QT}} = \frac{5}{2} \implies \frac{\overline{RT} + \overline{QT}}{\overline{QT}} = \frac{5+2}{2} = \frac{7}{2} \implies \overline{RQ} = \frac{7}{2} \cdot \overline{QT}$$

Now,

$$\text{Area of } \triangle PQR = \frac{1}{2} \cdot \overline{PQ} \cdot \overline{RQ} = \frac{1}{2} \cdot (4 \cdot \overline{QS}) \cdot \left(\frac{7}{2} \cdot \overline{QT}\right) = \frac{1}{2} \cdot (\overline{QS} \cdot \overline{QT}) \cdot 4 \cdot \frac{7}{2} = 20 \text{ cm}^2 \cdot 14 = 280 \text{ cm}^2$$

5 votes

-- Pragy Agarwal (18.3k points)

#### 9.50.5 Triangles: GATE2015 ME-3: GA-9

<https://gateoverflow.in/40173>

- ✓ Here  $PR$  is parallel to  $x$ -axis so  $y$ -coordinate of vertex  $P$  and  $R$  would always be the same.

For ex- If  $P = (-1, 7)$  then  $R = (2, 7)$  or  $(5, 7)$

So total number of possible  $x$ -coordinate of  $P$  and  $R$  for a particular  $y$  ( $-4 \leq x \leq 5$ ) =  ${}^{10}P_2 = 90$ .

Similarly, for 11 different  $y$ -coordinates, total coordinates of  $P$  and  $R = 11 \times 90 = 990$ .

Now since, its a right angle at  $P$  so vertex  $Q$  has same  $x$ -coordinate as  $P$ . So total possible coordinates for vertex  $Q$  ( $6 \leq y \leq 16$ ) =  ${}^{10}C_1 = 10$ .

For ex- If  $P = (-1, 7)$  then  $Q = (-1, 8)$  or  $(-1, 16)$  but not  $(-1, 7)$ .

Total number of triangles =  $10 * 990 = 9900$

Ans- C

17 votes

-- Dhananjay Kumar Sharma (18.8k points)

#### 9.50.6 Triangles: GATE2018 CH: GA-4

<https://gateoverflow.in/205085>

- ✓ C) Area of equilateral triangle is given by  $\frac{\sqrt{3}}{4}a^2 = \sqrt{3}a = 2\text{Perimeter} = 3a = 6$

3 votes

-- Tuhin Dutta (9.1k points)

### 9.51

#### Trigonometry (1)

#### 9.51.1 Trigonometry: GATE2018 CH: GA-3

<https://gateoverflow.in/205083>

For  $0 \leq x \leq 2\pi$ ,  $\sin x$  and  $\cos x$  are both decreasing functions in the interval \_\_\_\_\_.

- $\left(0, \frac{\pi}{2}\right)$
- $\left(\frac{\pi}{2}, \pi\right)$
- $\left(\pi, \frac{3\pi}{2}\right)$
- $\left(\frac{3\pi}{2}, 2\pi\right)$

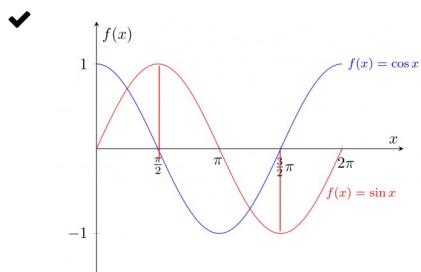
[gate2018-ch](#) [quantitative-aptitude](#) [functions](#) [trigonometry](#)

Answer

## Answers: Trigonometry

### 9.51.1 Trigonometry: GATE2018 CH: GA-3 top ↴

[➡ https://gateoverflow.in/205083](https://gateoverflow.in/205083)



Both functions are decreasing in the interval  $(\pi/2, \pi)$

3 votes

-- Pankaj Kumar (7.8k points)

### 9.52

### Unit Digit (1) top ↴

### 9.52.1 Unit Digit: GATE Civil 2020 Set 1 | GA Question: 9 top ↴

[➡ https://gateoverflow.in/359850](https://gateoverflow.in/359850)



The unit's place in  $26591749^{110016}$  is \_\_\_\_\_.

- A. 1
- B. 3
- C. 6
- D. 9

[gate2020-ce-1](#) [quantitative-apptitude](#) [number-system](#) [unit-digit](#)

Answer

## Answers: Unit Digit

### 9.52.1 Unit Digit: GATE Civil 2020 Set 1 | GA Question: 9 top ↴

[➡ https://gateoverflow.in/359850](https://gateoverflow.in/359850)



✓ We can write, the unit's place in  $26591749^{110016}$  = the unit's place in  $9^{110016}$

Now, we know that the unit place of  $9^1 = 9, 9^2 = 1, 9^3 = 9, \dots$

$\therefore$  The cyclicity of 9 is 2.

And, 110016 is divisible by 2, so the unit place of  $9^2 = 1$ .

(Or)

The unit place of  $9^{\text{odd}} = 9, 9^{\text{even}} = 1$ .

The number 110016 is even, so the unit place of  $9^{\text{even}} = 1$ .

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

### 9.53

### Venn Diagrams (13) top ↴

### 9.53.1 Venn Diagrams: GATE CSE 2010 | Question: 59 top ↴

[➡ https://gateoverflow.in/2367](https://gateoverflow.in/2367)



25 persons are in a room. 15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is:

- A. 2
- B. 17
- C. 13
- D. 3

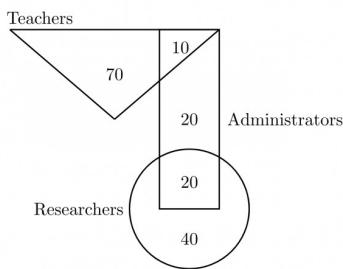
[gate2010-cse](#)
[quantitative-aptitude](#)
[easy](#)
[set-theory&algebra](#)
[venn-diagrams](#)
Answer
✍
**9.53.2 Venn Diagrams: GATE CSE 2016 Set 2 | Question: GA-06**
top ↗
↗
<https://gateoverflow.in/39536>


Among 150 faculty members in an institute, 55 are connected with each other through Facebook and 85 are connected through Whatsapp. 30 faculty members do not have Facebook or Whatsapp accounts. The numbers of faculty members connected only through Facebook accounts is \_\_\_\_\_.

- A. 35
- B. 45
- C. 65
- D. 90

[gate2016-cse-set2](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
[easy](#)
Answer
✍
**9.53.3 Venn Diagrams: GATE CSE 2019 | Question: GA-7**
top ↗
↗
<https://gateoverflow.in/302866>


In the given diagram, teachers are represented in the triangle, researchers in the circle and administrators in the rectangle. Out of the total number of the people, the percentage of administrators shall be in the range of \_\_\_\_\_.



- A. 0 to 15
- B. 16 to 30
- C. 31 to 45
- D. 46 to 60

[gate2019-cse](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
Answer
✍
**9.53.4 Venn Diagrams: GATE CSE 2019 | Question: GA-9**
top ↗
↗
<https://gateoverflow.in/302864>


In a college, there are three student clubs, 60 students are only in the Drama club, 80 students are only in the Dance club, 30 students are only in Maths club, 40 students are in both Drama and Dance clubs, 12 students are in both Dance and Maths clubs, 7 students are in both Drama and Maths clubs, and 2 students are in all clubs. If 75% of the students in the college are not in any of these clubs, then the total number of students in the college is \_\_\_\_\_.

- A. 1000
- B. 975
- C. 900
- D. 225

[gate2019-cse](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
Answer
✍
**9.53.5 Venn Diagrams: GATE Civil 2020 Set 2 | GA Question: 9**
top ↗
↗
<https://gateoverflow.in/359830>


In a school of 1000 students, 300 students play chess and 600 students play football. If 50 students play both chess and football, the number of students who play neither is \_\_\_\_\_.

- A. 200
- B. 150
- C. 100
- D. 50

[gate2020-ce-2](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.6 Venn Diagrams: GATE Civil 2021 Set 1 | GA Question: 3 [top](#)

<https://gateoverflow.in/359885>


In a company, 35% of the employees drink coffee, 40% of the employees drink tea and 10% of the employees drink both tea and coffee. What % of employees drink neither tea nor coffee?

- A. 15
- B. 25
- C. 35
- D. 40

[gatcivil-2021-set1](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.7 Venn Diagrams: GATE2010 TF: GA-8 [top](#)

<https://gateoverflow.in/312027>


A gathering of 50 linguists discovered that 4 knew Kannada, Telugu and Tamil , 7 knew only Telugu and Tamil , 5 knew only Kannada and Tamil , 6 knew only Telugu and Kannada . If the number of linguists who knew Tamil is 24 and those who knew Kannada is also 24, how many linguists knew only Telugu?

- A. 9
- B. 10
- C. 11
- D. 8

[general-aptitude](#)
[quantitative-aptitude](#)
[gate2010-tf](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.8 Venn Diagrams: GATE2011 GG: GA-7 [top](#)

<https://gateoverflow.in/40208>


In a class of 300 students in an M.Tech programme, each student is required to take at least one subject from the following three:

- M600: Advanced Engineering Mathematics
- C600: Computational Methods for Engineers
- E600: Experimental Techniques for Engineers

The registration data for the M.Tech class shows that 100 students have taken M600, 200 students have taken C600, and 60 students have taken E600. What is the maximum possible number of students in the class who have taken all the above three subjects?

- A. 20
- B. 30
- C. 40
- D. 50

[gate2011-gg](#)
[quantitative-aptitude](#)
[set-theory&algebra](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.9 Venn Diagrams: GATE2015 CE-2: GA-10 [top](#)

<https://gateoverflow.in/40184>


There are 16 teachers who can teach Thermodynamics (TD), 11 who can teach Electrical Sciences (ES), and 5 who can teach both TD and Engineering Mechanics (EM). There are a total of 40 teachers. 6 cannot teach any of the three subjects, i.e. EM, ES or TD. 6 can teach only ES. 4 can teach all three subjects, i.e. EM, ES and TD. 4 can teach ES and TD. How many can teach both ES and EM but not TD?

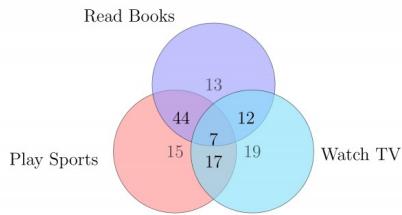
- A. 1
- B. 2
- C. 3
- D. 4

[gate2015-ce-2](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.10 Venn Diagrams: GATE2016 EC-2: GA-6 [top](#)

<https://gateoverflow.in/108484>


The Venn diagram shows the preference of the student population for leisure activities.



From the data given, the number of students who like to read books or play sports is \_\_\_\_\_.

- A. 44
- B. 51
- C. 79
- D. 108

[gate2016-ec-2](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.11 Venn Diagrams: GATE2017 EC-2: GA-5 [top](#)

<https://gateoverflow.in/313509>


500 students are taking one or more course out of Chemistry, Physics, and Mathematics. Registration records indicate course enrollment as follows: Chemistry (329), Physics (186), and Mathematics (295). Chemistry and Physics (83), Chemistry and Mathematics (217), and Physics and Mathematics (63). How many students are taking all 3 subjects?

- A. 37
- B. 43
- C. 47
- D. 53

[gate2017-ec-2](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.12 Venn Diagrams: GATE2018 ME-2: GA-6 [top](#)

<https://gateoverflow.in/313609>


Forty students watched films A, B and C over a week. Each student watched either only one film or all three. Thirteen students watched film A, sixteen students watched film B and nineteen students watched film C. How many students watched all three films?

- A. 0
- B. 2
- C. 4
- D. 8

[gate2018-me-2](#)
[general-aptitude](#)
[quantitative-aptitude](#)
[venn-diagrams](#)
[Answer](#)

### 9.53.13 Venn Diagrams: GATE2019 CE-1: GA-7 [top](#)

<https://gateoverflow.in/313440>


In a sports academy of 300 peoples, 105 play only cricket, 70 play only hockey, 50 play only football, 25 play both cricket and hockey, 15 play both hockey and football and 30 play both cricket and football. The rest of them play all three sports. What is the percentage of people who play at least two sports?

- A. 23.30
- B. 25.00
- C. 28.00
- D. 50.00

gate2019-ce-1 general-aptitude quantitative-aptitude venn-diagrams easy

Answer 

### Answers: Venn Diagrams

#### 9.53.1 Venn Diagrams: GATE CSE 2010 | Question: 59

 <https://gateoverflow.in/2367>



✓ D.3

No. of persons who play either football or hockey =  $15 + 17 - 10 = 22$

No. of persons playing neither hockey nor football =  $25 - 22 = 3$

 14 votes

-- shreya ghosh (2.8k points)

#### 9.53.2 Venn Diagrams: GATE CSE 2016 Set 2 | Question: GA-06

 <https://gateoverflow.in/39536>



✓ Let  $F$  denotes Facebook users,

$W$  denotes Whatsapp users ,

$F'$  denotes those not using Facebook, and

$W'$  denotes those not using Whatsapp.

$U$  denotes universal set.

Total faculties in institute,  $n(U) = 150$

Facebook users,  $n(F) = 55$

Whatsapp users,  $n(W) = 85$

Faculty members not using Facebook or Whatsapp  $n(F' \cap W') = 30$

Faculty members using either Facebook or Whatsapp

$n(F \cup W) = n(U) - n(F' \cap W') = 150 - 30 = 120$

Faculty members using both Facebook and Whatsapp

$n(F \cap W) = n(F) + n(W) - n(F \cup W) = 55 + 85 - 120 = 20$

Faculty members using Facebook only

$n(F \cap W') = n(F) - n(F \cap W) = 55 - 20 = 35$

 27 votes

-- Praveen Saini (41.9k points)

#### 9.53.3 Venn Diagrams: GATE CSE 2019 | Question: GA-7

 <https://gateoverflow.in/302866>



✓ → No of administrator =  $10 + 20 + 20 = 50$

→ Total no of person =  $80 + 20 + 20 + 40 = 160$

→ Required % =  $(50/160) * 100 = 31.25\%$

∴ Option C. 31 to 45 is the correct answer.

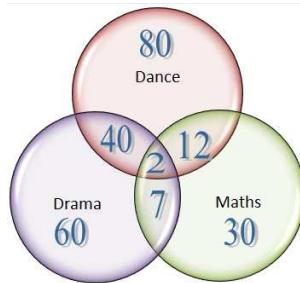
 23 votes

-- Khushboo Mishra (571 points)

#### 9.53.4 Venn Diagrams: GATE CSE 2019 | Question: GA-9

 <https://gateoverflow.in/302864>





Read question carefully. We cannot directly use the formula

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C) - P(C \cap A) + P(A \cap B \cap C)$$

because of the **only** keyword which means we do not directly know what is  $P(A)$ ,  $P(B)$  or  $P(C)$

Here, according to question statement, we can calculate total number of students belonging to at least one club :

$$P(A \cup B \cup C) = 60 + 80 + 30 + (40 - 2) + (12 - 2) + (7 - 2) + 2 = 225$$

This is just 25% of the total no of students since 75% do not belong to any club.

$$\text{So, total number of students} = 225 \div 25\% = 225 \times 4 = 900.$$

15 votes

-- Tuhin Dutta (9.1k points)

#### 9.53.5 Venn Diagrams: GATE Civil 2020 Set 2 | GA Question: 9 top ↴

<https://gateoverflow.in/359830>

- Given that, the number of students in school  $n(U) = 1000$ , the number of students who play chess  $n(C) = 300$ , the number of students who play football  $n(F) = 600$ , and the number of students who play both chess and football  $n(C \cap F) = 50$ .

Now, the number of students who play either chess or football  $n(C \cup F) = n(C) + n(F) - n(C \cap F)$

$$\implies n(C \cup F) = 300 + 600 - 50 = 850.$$

$\therefore$  The number of students who play neither chess nor football  $\overline{n(C \cup F)} = n(U) - n(C \cup F) = 1000 - 850 = 150$ .

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.53.6 Venn Diagrams: GATE Civil 2021 Set 1 | GA Question: 3 top ↴

<https://gateoverflow.in/359885>

- Given that, the percentage of employees who drink coffee  $n(C) = 35\%$ , the percentage of employees who drink tea  $n(T) = 40\%$ , and the percentage of employees who drink both tea and coffee  $n(C \cap T) = 10\%$ .

Total employee  $n(U) = 100\%$ .

The percentage of employees who drink either tea or coffee  $n(C \cup T) = n(C) + n(T) - n(C \cap T)$

$$\implies n(C \cup T) = 35 + 40 - 10 = 65\%.$$

Now, the percentage of employees who drink neither tea nor coffee  $\overline{n(C \cup T)} = n(U) - n(C \cup T)$

$$\implies \overline{n(C \cup T)} = 100 - 65 = 35\%.$$

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.53.7 Venn Diagrams: GATE2010 TF: GA-8 top ↴

<https://gateoverflow.in/312027>

- Let  $K_a$  denote Kannada,  $T_a$  denote Tamil and  $T_e$  denote Telugu.

$$n(K_a \cup T_a \cup T_e) = n(K_a) + n(T_a) + n(T_e) - n(K_a \cap T_a) - n(K_a \cap T_e) - n(T_e \cap T_a) + n(K_a \cap T_a \cap T_e)$$

$$\implies 50 = 24 + 24 + n(T_e) - (5 + 4) - (6 + 4) - (7 + 4) + 4$$

$$\implies 50 = 48 + n(T_e) - 26$$

$$\implies n(T_e) = 28.$$

$\therefore$  Number of people who know Telegu,  $n(T_e) = 28$ .

Number of people who know only Telegu

$$\begin{aligned} &= n(T_e) - n(K_a \cap T_e) - n(T_e \cap T_a) + n(K_a \cap T_a \cap T_e) \\ &= 28 - (6 + 4) - (7 + 4) + 4 \\ &= 11 \end{aligned}$$

Correct Option: C.

15 votes

-- Arjun Suresh (328k points)

#### 9.53.8 Venn Diagrams: GATE2011 GG: GA-7 top ↴

↳ <https://gateoverflow.in/40208>



- ✓ Let the no. of students who took all courses be  $x$ .

Since every one must take at least 1 course, we have

$$200 - x + 100 - x + 60 - x \geq 300 - x \implies 360 - 2x \geq 300 \implies x \leq 30.$$

Correct Answer: B

15 votes

-- Arjun Suresh (328k points)

#### 9.53.9 Venn Diagrams: GATE2015 CE-2: GA-10 top ↴

↳ <https://gateoverflow.in/40184>



- ✓ A total of 11 teachers can teach ES.

Now the question says, 6 teachers can teach **only** ES so the number of teachers teaching both ES and EM has to be less than or equal to  $(11 - 6)$  i.e., 5.

Also, 4 teachers can teach **all three subjects**.

The question asks for the number of teachers who **can teach ES and EM but not TD**.

Subtract 4 from the 5 derived earlier.

**Ans 1.** Option A

7 votes

-- Ganesh K (329 points)

#### 9.53.10 Venn Diagrams: GATE2016 EC-2: GA-6 top ↴

↳ <https://gateoverflow.in/108484>



- ✓ The number of students who like to read books **or** play sports will be the sum of students who belong to both sets  
 $= 13 + 12 + 44 + 7 + 17 + 15 = 108$ .

Answer will be D

3 votes

-- சுநாரீடு (1.3k points)

#### 9.53.11 Venn Diagrams: GATE2017 EC-2: GA-5 top ↴

↳ <https://gateoverflow.in/313509>



- ✓ Answer: D. 53

$$\text{Total number of students} = n(P) + n(C) + n(M) - n(P \cap C) - n(P \cap M) - n(C \cap M) + n(P \cap C \cap M)$$

$$\begin{aligned} \implies 500 &= 329 + 295 + 186 - 217 - 83 - 63 + x \\ \implies x &= 53. \end{aligned}$$

2 votes

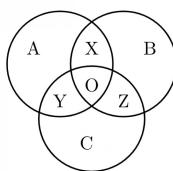
-- Naveen Kumar (9.9k points)

#### 9.53.12 Venn Diagrams: GATE2018 ME-2: GA-6 top ↴

↳ <https://gateoverflow.in/313609>



- ✓ Total Students who watched Film = 40



Let

- $A$  = Students who watched Film "A" alone
- $B$  = Students who watched Film "B" alone
- $C$  = Students who watched Film "C" alone
- $X$  = Students who watched Both Film "A" and "B" but not Film "C"
- $Y$  = Students who watched Both Film "A" and "C" but not Film "B"
- $Z$  = Students who watched Both Film "B" and "C" but not Film "A"
- $O$  = Students who watched all the 3 Films

By Principle of Inclusion and Exclusion, we have

$$\text{Total Students who watched Film} = A + B + C + X + Y + Z + O$$

Now from the Venn diagram it is clear that  $13 = A + X + Y + O$

No student watched exactly 2 films. Hence,  $X = Y = Z = 0$

Therefore,  $13 = A + 0 + 0 + O$

$$\Rightarrow 13 - O = A$$

Similarly,  $B = 16 - O$  and  $C = 19 - O$

So, Total Students who watched Film =  $A + B + C + X + Y + Z + O$

$$\Rightarrow 40 = A + B + C + 0 + 0 + 0 + O$$

$$\Rightarrow 40 = A + B + C + O$$

$$\Rightarrow 40 = (13 - O) + (16 - O) + (19 - O) + O$$

$$\Rightarrow 40 = 48 - 2O$$

$$\Rightarrow -8 = -2O$$

$$\Rightarrow O = 4.$$

**Hence, C is correct.**

5 votes

-- Balaji Jegan (3.5k points)

### 9.53.13 Venn Diagrams: GATE2019 CE-1: GA-7 top

→ <https://gateoverflow.in/313440>



- ✓ Since everyone plays at least one sports, to get the number of people who plays at least two sports we can do

Total – No. of people playing only one game

$$= 300 - (105 + 70 + 50)$$

$$= 75.$$

So, percentage of people who play at least 2 sports =  $\frac{75}{300} \times 100\% = 25\%$ .

Correct Answer: Option B.

5 votes

-- Arjun Suresh (328k points)

### 9.54

### Volume (1) top

#### 9.54.1 Volume: GATE CSE 2021 Set 1 | GA Question: 6 top

→ <https://gateoverflow.in/357471>



We have 2 rectangular sheets of paper, M and N, of dimensions  $6 \text{ cm} \times 1 \text{ cm}$  each. Sheet M is rolled to form an open cylinder by bringing the short edges of the sheet together. Sheet N is cut into equal square patches and assembled to form the largest possible closed cube. Assuming the ends of the cylinder are closed, the ratio of the volume of the cylinder to that of the cube is \_\_\_\_\_.

A.  $\frac{\pi}{2}$

- B.  $\frac{3}{\pi}$   
 C.  $\frac{9}{\pi}$   
 D.  $3\pi$

gate2021-cse-set1 quantitative-aptitude mensuration volume

Answer 

### Answers: Volume

#### 9.54.1 Volume: GATE CSE 2021 Set 1 | GA Question: 6

<https://gateoverflow.in/357471>



Sheet M is rolled to form an open cylinder by bringing the shorter edge of the sheet together

So the longer side becomes the circumference of the base of the cylinder and shorter side becomes the height.

$$\therefore 2 \times \pi \times r = 6 \implies r = \frac{3}{\pi}$$

$$\text{Volume of cylinder} = \pi \times r^2 \times h = \pi \times \left(\frac{3}{\pi}\right)^2 \times 1 = \frac{9}{\pi}$$

Sheet N is cut into equal square patches and assembled to form the largest possible closed cube

So the entire area of the sheet is converted into surface area of the cube, i.e.

$$6 \times a^2 = 6 \times 1 \implies a^2 = 1 \implies a = 1$$

$$\text{Volume of cube} = a^3 = (1)^3 = 1$$

$$\frac{\text{Volume of cylinder}}{\text{Volume of cube}} = \frac{\frac{9}{\pi}}{1} = \frac{9}{\pi}$$

#### Option C

 3 votes

-- zxy123 (2.5k points)

#### 9.55

### Work Time (16)

<https://gateoverflow.in/2372>



#### 9.55.1 Work Time: GATE CSE 2010 | Question: 64

5 skilled workers can build a wall in 20 days; 8 semi-skilled workers can build a wall in 25 days; 10 unskilled workers can build a wall in 30 days. If a team has 2 skilled, 6 semi-skilled and 5 unskilled workers, how long it will take to build the wall?

- A. 20 days  
 B. 18 days  
 C. 16 days  
 D. 15 days

gate2010-cse quantitative-aptitude normal work-time

Answer 

#### 9.55.2 Work Time: GATE CSE 2011 | Question: 64

<https://gateoverflow.in/2174>



A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the end of the 4<sup>th</sup> day he can clear all the orders. Alternatively, if he uses only 3 trucks, then all the orders are cleared at the end of the 10<sup>th</sup> day. What is the minimum number of trucks required so that there will be no pending order at the end of 5<sup>th</sup> day?

- A. 4  
 B. 5  
 C. 6  
 D. 7

gate2011-cse quantitative-aptitude normal work-time

**Answer****9.55.3 Work Time: GATE CSE 2013 | Question: 65** top ↗<https://gateoverflow.in/1569>

The current erection cost of a structure is Rs. 13,200. If the labour wages per day increase by 1/5 of the current wages and the working hours decrease by 1/24 of the current period, then the new cost of erection in Rs. is

- A. 16,500
- B. 15,180
- C. 11,000
- D. 10,120

[gate2013-cse](#) [quantitative-aptitude](#) [normal](#) [work-time](#)**Answer****9.55.4 Work Time: GATE Mechanical 2020 Set 2 | GA Question: 8** top ↗<https://gateoverflow.in/359542>

IT was estimated that 52 men can complete a strip in a newly constructed highway connecting cities  $P$  and  $Q$  in 10 days. Due to an emergency, 12 men were sent to another project. How many number of days, more than the original estimate, will be required to complete the strip?

- A. 3 days
- B. 5 days
- C. 10 days
- D. 13 days

[gateme-2020-set2](#) [quantitative-aptitude](#) [work-time](#)**Answer****9.55.5 Work Time: GATE2016 CE-2: GA-10** top ↗<https://gateoverflow.in/110924>

Ananth takes 6 hours and Bharath takes 4 hours to read a book. Both started reading copies of the book at the same time. After how many hours is the number of pages to be read by Ananth, twice that to be read by Bharath? Assume Ananth and Bharath read all the pages with constant pace.

- A. 1
- B. 2
- C. 3
- D. 4

[gate2016-ce-2](#) [work-time](#) [quantitative-aptitude](#)**Answer****9.55.6 Work Time: GATE2016 EC-1: GA-10** top ↗<https://gateoverflow.in/108094>

**P, Q, R and S** are working on a project. **Q** can finish the task in 25 days, working alone for 12 hours a day. **R** can finish the task in 50 days, working alone for 12 hours per day. **Q** worked 12 hours a day but took sick leave in the beginning for two days. **R** worked 18 hours a day on all days. What is the ratio of work done by **Q** and **R** after 7 days from the start of the project?

- A. 10 : 11
- B. 11 : 10
- C. 20 : 21
- D. 21 : 20

[gate2016-ec-1](#) [quantitative-aptitude](#) [work-time](#)**Answer****9.55.7 Work Time: GATE2016 EC-2: GA-5** top ↗<https://gateoverflow.in/108483>

**S, M, E and F** are working in shifts in a team to finish a project. **M** works with twice the efficiency of others but for half as many days as **E** worked. **S** and **M** have 6 hour shifts in a day, whereas **E** and **F** have 12 hours shifts. What is the ratio of contribution of **M** to contribution of **E** in the project?

- A. 1 : 1
- B. 1 : 2
- C. 1 : 4
- D. 2 : 1

[gate2016-ec-2](#) [quantitative-aptitude](#) [work-time](#)

Answer 

### 9.55.8 Work Time: GATE2017 CE-1: GA-9 top ↴

☞ <https://gateoverflow.in/313481>



Two machine  $M_1$  and  $M_2$  are able to execute any of four jobs  $P, Q, R$  and  $S$ . The machines can perform one job on one object at a time. Jobs  $P, Q, R$  and  $S$  take 30 minutes, 20 minutes, 60 minutes and 15 minutes each respectively. There are 10 objects each requiring exactly 1 job. Job  $P$  is to be performed on 2 objects. Job  $Q$  on 3 objects, Job  $R$  on 1 object and Job  $S$  on 4 objects. What is the minimum time needed to complete all the jobs?

- A. 2 hours
- B. 2.5 hours
- C. 3 hours
- D. 3.5 hours

[gate2017-ce-1](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer 

### 9.55.9 Work Time: GATE2017 EC-2: GA-8 top ↴

☞ <https://gateoverflow.in/313511>



1200 men and 500 women can build a bridge in 2 weeks. 900 men and 250 women will take 3 weeks to build the same bridge. How many men will be needed to build the bridge in one week?

- A. 3000
- B. 3300
- C. 3600
- D. 3900

[gate2017-ec-2](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer 

### 9.55.10 Work Time: GATE2017 ME-2: GA-7 top ↴

☞ <https://gateoverflow.in/313672>



$X$  bullocks and  $Y$  tractors take 8 days to plough a field. If we have half the number of bullocks and double the number of tractors, it takes 5 days to plough the same field. How many days will it take  $X$  bullocks alone to plough the field?

- A. 30
- B. 35
- C. 40
- D. 45

[gate2017-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer 

### 9.55.11 Work Time: GATE2018 ME-1: GA-3 top ↴

☞ <https://gateoverflow.in/313643>



Seven machines take 7 minutes to make 7 identical toys. At the same rate, how many minutes would it take for 100 machine to make 100 toys?

- A. 1
- B. 7
- C. 100
- D. 700

[gate2018-me-1](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer 

**9.55.12 Work Time: GATE2018 ME-2: GA-8** top ↗<https://gateoverflow.in/313615>

A contract is to be completed in 52 days and 125 identical robots were employed, each operational for 7 hours a day. After 39 days, five-seventh of the work was completed. How many additional robots would be required to complete the work on time, if each robot is now operational for 8 hours a day?

- A. 50
- B. 89
- C. 146
- D. 175

[gate2018-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer

**9.55.13 Work Time: GATE2019 CE-2: GA-9** top ↗<https://gateoverflow.in/313374>

An oil tank can be filled by pipe  $X$  in 5 hours and pipe  $Y$  in 4 hours, each pump working on its own. When the oil tank is full and the drainage hole is open, the oil is drained in 20 hours. If initially the tank was empty and someone started the two pumps together but left the drainage hole open, how many hours will it take for the tank to be filled? (Assume that the rate of drainage is independent of the Head)

- A. 1.50
- B. 2.00
- C. 2.50
- D. 4.00

[gate2019-ce-2](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer

**9.55.14 Work Time: GATE2019 EC: GA-3** top ↗<https://gateoverflow.in/313531>

It would take one machine 4 hours to complete a production order and another machine 2 hours to complete the same order. If both machines work simultaneously at their respective constant rates, the time taken to complete the same order is \_\_\_\_\_ hours.

- A.  $2/3$
- B.  $3/4$
- C.  $4/3$
- D.  $7/3$

[gate2019-ec](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer

**9.55.15 Work Time: GATE2019 EE: GA-4** top ↗<https://gateoverflow.in/313560>

It takes two hours for a person  $X$  to mow the lawn.  $Y$  can mow the same lawn in four hours. How long (in minutes) will it take  $X$  and  $Y$ , if they work together to mow the lawn?

- A. 60
- B. 80
- C. 90
- D. 120

[gate2019-ee](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer

**9.55.16 Work Time: GATE2019 ME-2: GA-7** top ↗<https://gateoverflow.in/313579>

Two pipes  $P$  and  $Q$  can fill a tank in 6 hours and 9 hours respectively, while a third pipe  $R$  can empty the tank in 12 hours. Initially,  $P$  and  $R$  are open for 4 hours, Then  $P$  is closed and  $Q$  is opened. After 6 more hours  $R$  is closed. The total time taken to fill the tank (in hours) is \_\_\_\_\_

- A. 13.50

- B. 14.50
- C. 15.50
- D. 16.50

[gate2019-me-2](#) [general-aptitude](#) [quantitative-aptitude](#) [work-time](#)

Answer 

### Answers: Work Time

#### 9.55.1 Work Time: GATE CSE 2010 | Question: 64 top ↗

<https://gateoverflow.in/2372>



- ✓ D. 15 days

1 skilled person can do  $\frac{1}{20 \times 5} = 1/100$  of work in 1 day, so 2 skilled person do  $2/100$  of work in a day.

Similarly, 6 semi-skilled and 5 unskilled person can do  $6/200$  and  $5/300$  of work respectively in 1 day.

So, together they do  $\frac{2}{100} + \frac{6}{200} + \frac{5}{300} = \frac{1}{15}$  of work together in 1 day, which gives required number of day to complete the work = 15.

 30 votes

-- shreya ghosh (2.8k points)

#### 9.55.2 Work Time: GATE CSE 2011 | Question: 64 top ↗

<https://gateoverflow.in/2174>



- ✓ Let the amount of orders received per day be  $x$ , the amount of pending orders be  $y$  and the amount of orders carried by a truck each day be  $z$ .

$$7z \times 4 = 4x + y \rightarrow (1)$$

$$3z \times 10 = 10x + y \rightarrow (2)$$

$$(2) - (1) \implies 2z = 6x, z = 3x, y = 80x$$

We want to find the number of trucks to finish the orders in 5 days. Let it be A.

$$Az \times 5 = 5x + y$$

$$15Ax = 5x + 80x$$

$$A = \lceil 85/15 \rceil = \lceil 17/3 \rceil = 6$$

So, minimum 6 trucks must be used.

Correct Answer: C

 59 votes

-- Arjun Suresh (328k points)

#### 9.55.3 Work Time: GATE CSE 2013 | Question: 65 top ↗

<https://gateoverflow.in/1569>



Since wages per day increase by  $\frac{1}{5}$  of current wages, new wages per day becomes  $\frac{6}{5}$  of current wages.

Similarly, new working hours are  $\frac{23}{24}$  of current working hours.

So new erection cost becomes  $13200 \times \frac{6}{5} \times \frac{23}{24} = 15180$ .

**So option (B) is correct.**

 20 votes

-- Happy Mittal (8.2k points)

Working hours per day decreased. So, no. of working days should increase assuming workers work at same efficiency.

New no. of working days \* new no. of hours per day = Old no. of working days \* old no. of hours per day

New no. of working days \* 23/24 old no. of hours per day = Old no. of working days \* old no. of hours per day

New no. of working days = 24/23 \* Old no. of working days

New cost = New working days \* New wage

= 24/23 \* Old working days \* old wage \* 6/5

= Old working days \* old wage \* 144/115

= Old cost \* 144/115

= 13,200 \* 144/115

= 16,528.69

This is assuming workers work with same efficiency and hence requiring more days to complete the work. But as per GATE official key answer is 15,180 which means with an increase in wage workers got motivated and hence finished the task in same no. of days.

10 votes

-- Arjun Suresh (328k points)

#### 9.55.4 Work Time: GATE Mechanical 2020 Set 2 | GA Question: 8 top

<https://gateoverflow.in/359542>



- If  $M_1$  number of people can do  $W_1$  work, in  $D_1$  days, working  $T_1$  hours each day and the  $M_2$  number of people can do  $W_2$  work, in  $D_2$  days, working  $T_2$  hours each day, then the relation between them will be

$$\frac{M_1 \times D_1 \times T_1}{W_1} = \frac{M_2 \times D_2 \times T_2}{W_2}$$

Now,  $52M \times 10D = 40M \times xD$

$\implies x = 13$  days.

The number of days, more than the original estimate, that will be required to complete the strip = 13 – 10 = 3 days.

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

#### 9.55.5 Work Time: GATE2016 CE-2: GA-10 top

<https://gateoverflow.in/110924>



- Assume the book is of 240 pages.

Ananth reads 40 pages per hour and Bharath reads 60 pages per hour.

Number of pages Ananth will complete at the end of each hour – 40, 80, 120, 160, 200, 240.

Number of pages Bharath will complete at the end of each hour – 60, 120, 180, 240.

At the end of 3<sup>rd</sup> hour, Bharath is left with 60 pages and Ananth is left with 120 pages.

So, 3 is the answer.

Correct Answer: C

12 votes

-- Adithya Kasarla (133 points)

#### 9.55.6 Work Time: GATE2016 EC-1: GA-10 top

<https://gateoverflow.in/108094>



- Correct answer is C.

Q can finish the task in 25 days, working alone for 12 hours a day.

What can we learn from this line??

That Q, in  $25 \times 12$  hours can complete the work alone.

That is, his rate of doing work per hour is  $\frac{1}{25 \times 12} = \frac{1}{300}$ .

R can finish the task in 50 days, working alone for 12 hours per day.

Now, similarly, R's per hour work is  $\frac{1}{600}$ .

Now, Q has worked for 5 days of 12 hours (60 hours) and R for 7 days of 18 hours (126 hours).

We finally know, how many hours both worked, and their capacity for an hour.

Ratio of work done by Q and R after 77 days from the start of the project

$$= \frac{\text{Work done by Q}}{\text{Work done by R}} = \frac{60 \times \frac{1}{300}}{126 \times \frac{1}{600}} = \frac{20}{21}.$$

9 votes

-- Lucky Sunda (3.1k points)

#### 9.55.7 Work Time: GATE2016 EC-2: GA-5 top

<https://gateoverflow.in/108483>



- ✓ Let the efficiency of S, E and F be r units/hour.  
So the efficiency of M = 2r units/hour.

Let the number of days E works be d.

The amount of work done by M,  $W_m = 2r \times (d/2) \times 6$ .

(As M is working 6 hours per day)

The amount of work done by E,  $W_e = r \times d \times 12$ .

$$W_m : W_e = \frac{2r \times (d/2) \times 6}{r \times d \times 12} = 1 : 2.$$

Correct Answer: B

10 votes

-- Hemant Parihar (11.8k points)

#### 9.55.8 Work Time: GATE2017 CE-1: GA-9 top

<https://gateoverflow.in/313481>



- ✓ At first, machine  $M_1$  will be associated with 2 object of job P( $30 \times 2 = 60$  minutes) and simultaneously, machine  $M_2$  will do 1 object of job R. So, in 1 hour jobs P and R are completed.

Now, machine  $M_1$  will do 3 objects of job Q for next hour ( $20 \times 3 = 60$  minutes) while, machine  $M_2$  will simultaneously complete 4 objects of job S( $15 \times 4 = 60$  minutes).

Thus, minimum time needed to complete all the jobs =  $1 + 1 = 2$  hours.

Correct Answer: A

3 votes

-- Naveen Kumar (9.9k points)

#### 9.55.9 Work Time: GATE2017 EC-2: GA-8 top

<https://gateoverflow.in/313511>



- ✓ Assume a man can build the bridge in  $x$  weeks and, a woman can build the bridge in  $y$  weeks  
We get,

$$\begin{aligned} \bullet \frac{1200}{x} + \frac{500}{y} &= \frac{1}{2} \quad \rightarrow (1) \\ \bullet \frac{900}{x} + \frac{250}{y} &= \frac{1}{3} \quad \rightarrow (2) \end{aligned}$$

$$2 \times (2) - (1) \implies \frac{600}{x} = \frac{1}{6} \implies x = 3600.$$

Hence, Correct Answer is C. 3600 Men

2 votes

-- Naveen Kumar (9.9k points)

#### 9.55.10 Work Time: GATE2017 ME-2: GA-7 top

<https://gateoverflow.in/313672>



- ✓ Rate of work of  $X + Y$  (in fraction of field ploughed per day) =  $\frac{1}{8}$

Rate of work of  $\frac{X}{2} + 2Y$  (in fraction of field ploughed per day) =  $\frac{1}{5}$

We can write

- $(X + Y) \propto \frac{1}{8} \rightarrow (1)$
- $(\frac{X}{2} + 2Y) \propto \frac{1}{5} \rightarrow (2)$

From (1), (2)

$$8X + 8Y = \frac{5X}{2} + 10Y$$

$$\implies 11X = 4Y$$

Putting in (1) we get

$$(X + \frac{11}{4}X) \propto \frac{1}{8}$$

$$\implies \frac{15X}{4} \propto \frac{1}{8}$$

$$\implies X \propto \frac{1}{30}.$$

i.e., Rate of work of  $X$  bullock is  $\frac{1}{30}$  ploughs per day and so it will take 30 days for  $X$  bullocks alone to plough the field.

Correct Option: A.

1/2 votes

-- Arjun Suresh (328k points)

#### 9.55.11 Work Time: GATE2018 ME-1: GA-3 [top](#)

<https://gateoverflow.in/313643>



- ✓ Rate of work of a machine =  $\frac{7}{7 \times 7} = \frac{1}{7}$  toys per minute

With 100 machines to make 100 toys we need  $\frac{100}{100 \times \text{Rate of work of a machine}}$  minutes

$$= \frac{1}{\frac{1}{7}} = 7 \text{ minutes}$$

1/3 votes

-- Arjun Suresh (328k points)

#### 9.55.12 Work Time: GATE2018 ME-2: GA-8 [top](#)

<https://gateoverflow.in/313615>



- ✓ Let  $y$  be the speed of work of a robot per hour and  $S$  be the total amount of work done.

$\frac{5}{7}$  of work is completed in 39 days with 7 hours a day. So,

$$\frac{5}{7}S = 125 \times 39 \times y \times 7 \rightarrow (1)$$

Remaining work =  $\frac{2}{7}S$  and now we have 13 more days and 8 hours per day. So,

$$\frac{2}{7}S = x \times 13 \times y \times 8 \rightarrow (2)$$

where  $x$  is the number of robots required.

$$(1)/(2) \implies \frac{5}{2}x \times 8 = 125 \times 3 \times 7.$$

$$x = \frac{1050}{8} = 131.25.$$

So number of robots required =  $\lceil 131.25 \rceil = 132$ . We have 125 already and so the no. of additional robots required =  $132 - 125 = 7$ .

1/1 votes

-- Arjun Suresh (328k points)

#### 9.55.13 Work Time: GATE2019 CE-2: GA-9 [top](#)

<https://gateoverflow.in/313374>



- ✓ Part filled by pipe  $X$  in 1 hour =  $\frac{1}{5}$

Part filled by pipe  $Y$  in 1 hour =  $\frac{1}{4}$

Part emptied by drainage hole in 1 hour =  $\frac{1}{20}$

Net part filled by pipes  $X$  &  $Y$  and when drainage hole is left open in 1 hour =  $\frac{1}{5} + \frac{1}{4} - \frac{1}{20} = \frac{2}{5}$

So, the oil tank can be filled in  $\frac{1}{\frac{2}{5}} = 2.5$  hours

Correct Answer: C

4 votes

-- Naveen Kumar (9.9k points)

#### 9.55.14 Work Time: GATE2019 EC: GA-3 [top](#)



- ✓ Machine  $A$  takes 4 hours and machine  $B$  takes 2 hours to complete the work.
- Efficiency =  $\frac{\text{Work}}{\text{Time}}$

Let the amount of work be  $X$ .

$$\begin{aligned}\text{Efficiency of } A &= \frac{X}{4} \\ \text{Efficiency of } B &= \frac{X}{2}\end{aligned}$$

If both machines work simultaneously at their respective constant rates, then

$$\text{Effective Efficiency} = \text{Efficiency of } A + \text{Efficiency of } B = \frac{X}{4} + \frac{X}{2} = \frac{3X}{4}$$

$$\text{Effective Time} = \frac{X}{\frac{3X}{4}} = \frac{4}{3} \text{ hours.}$$

So, the correct answer is (C).

3 votes

-- Lakshman Patel (63.9k points)

#### 9.55.15 Work Time: GATE2019 EE: GA-4 [top](#)



- ✓ Speed of  $X = \frac{1}{2}$ , where the unit is number of times lawn is mowed in an hour.
- Speed of  $Y = \frac{1}{4}$

$$\text{Effective speed of } X + Y = \frac{1}{2} + \frac{1}{4} = \frac{3}{4}.$$

$$\text{So, time for both } X \text{ and } Y \text{ to mow the lawn} = \frac{1}{\frac{3}{4}} = \frac{4}{3} \text{ hours} = 80 \text{ minutes}$$

Correct Answer: Option B.

2 votes

-- Arjun Suresh (328k points)

$X$  takes 2 hours to mow the lawn

$\Rightarrow$  In 1 hour he can mow  $\frac{1}{2}$  of the lawn.

$Y$  takes 4 hours to mow the lawn

$\Rightarrow$  In 1 hour he can mow  $\frac{1}{4}$  of the lawn.

So in 1 hr  $X$  and  $Y$  together can mow  $\frac{1}{2} + \frac{1}{4} = \frac{2+1}{4} = \frac{3}{4}$  of the lawn.

$X$  and  $Y$  together can mow  $\frac{3}{4}$  of the lawn in 1 hour

$\Rightarrow$   $X$  and  $Y$  together can mow 1 lawn in  $1 * \frac{4}{3}$  hour =  $60 * \frac{4}{3} = 80$  minutes.

So Option B 80 is the right answer.

2 votes

-- Satbir Singh (20.9k points)

#### 9.55.16 Work Time: GATE2019 ME-2: GA-7 [top](#)



- ✓ P can fill the tank in 6 hours

$\Rightarrow$  In 1 hr P can fill  $\frac{1}{6}$  of the tank.

Q can fill the tank in 9 hours

$\Rightarrow$  In 1 hr Q can fill  $\frac{1}{9}$  of the tank.

R can empty the tank in 12 hours

$\Rightarrow$  In 1 hr R can empty  $\frac{1}{12}$  of the tank.

P and R are opened for 4 hours

$\Rightarrow$  They fill  $4 * \left(\frac{1}{6} - \frac{1}{12}\right) = 4 * \frac{1}{12} = \frac{1}{3}$  of the tank.

$\Rightarrow 1 - \frac{1}{3} = \frac{2}{3}$  of the tank is still empty.

Then P is closed and Q is opened. After 6 more hours R is closed.

$\Rightarrow$  Q and R are opened together for 6 hours.

$\Rightarrow$  They fill  $6 * \left(\frac{1}{9} - \frac{1}{12}\right) = 6 * \frac{1}{36} = \frac{1}{6}$  of the tank.

$\Rightarrow \frac{2}{3} - \frac{1}{6} = \frac{4-1}{6} = \frac{1}{2}$  of the tank is still empty.

Now only Q is opened

$\therefore$  Q can fill a tank in 9 hr

$\Rightarrow$  Q can fill  $\frac{1}{2}$  of the tank in  $9 * \frac{1}{2}$  hours = 4.5 hours.

$\therefore$  Total Time to fill the tank = 4 hours + 6 hours + 4.5 hours = 14.5 hours

So, Option B. 14.50 is the correct answer.

3 votes

-- Satbir Singh (20.9k points)

## Answer Keys

9.1.1	D
9.1.6	B
9.3.3	B
9.4.3	A
9.5.4	C
9.6.2	A
9.6.7	D
9.7.1	C
9.8.5	B
9.10.2	B
9.10.7	D
9.11.5	D
9.11.10	C
9.12.3	C
9.14.1	C
9.15.3	C
9.16.4	C
9.19.3	2006
9.19.8	B
9.19.13	B

9.1.2	B
9.2.1	D
9.3.4	B
9.4.4	D
9.5.5	D
9.6.3	B
9.6.8	C
9.8.1	B
9.9.1	D
9.10.3	A
9.11.1	B
9.11.6	B
9.11.11	D
9.12.4	0.4895 : 0.4897
9.14.2	C
9.15.4	1300
9.17.1	B
9.19.4	B
9.19.9	A
9.20.1	D

9.1.3	D
9.2.2	D
9.3.5	B
9.5.1	C
9.5.6	C
9.6.4	B
9.6.9	D
9.8.2	C
9.9.2	C
9.10.4	D
9.11.2	C
9.11.7	4536
9.11.12	B
9.12.5	B
9.14.3	B
9.16.1	C
9.18.1	A
9.19.5	C
9.19.10	C
9.20.2	B

9.1.4	B
9.3.1	B
9.4.1	A
9.5.2	B
9.5.7	C
9.6.5	C
9.6.10	C
9.8.3	C
9.9.3	A
9.10.5	B
9.11.3	D
9.11.8	B
9.12.1	B
9.12.6	B
9.15.1	A
9.16.2	A
9.19.1	D
9.19.6	C
9.19.11	C
9.20.3	C

9.1.5	B
9.3.2	D
9.4.2	C
9.5.3	B
9.6.1	C
9.6.6	C
9.6.11	A
9.8.4	A
9.10.1	A
9.10.6	B
9.11.4	C
9.11.9	C
9.12.2	B
9.13.1	A
9.15.2	A
9.16.3	D
9.19.2	140
9.19.7	A
9.19.12	C
9.20.4	C

9.20.5	B	9.21.1	B	9.21.2	C	9.22.1	8	9.22.2	C
9.22.3	B	9.22.4	C	9.22.5	B	9.22.6	A	9.22.7	D
9.22.8	A	9.22.9	C	9.22.10	A	9.22.11	C	9.22.12	A
9.23.1	6	9.23.2	D	9.23.3	A	9.23.4	C	9.23.5	2.06
9.23.6	D	9.23.7	B	9.23.8	B	9.23.9	D	9.23.10	C
9.23.11	22.2 : 22.3	9.23.12	D	9.23.13	C	9.23.14	B	9.23.15	B
9.23.16	A	9.23.17	C	9.23.18	C	9.23.19	A	9.23.20	C
9.24.1	B	9.25.1	C	9.25.2	B	9.25.3	B	9.25.4	D
9.25.5	D	9.25.6	A	9.25.7	B	9.25.8	B	9.25.9	C
9.26.1	B	9.26.2	D	9.26.3	A	9.26.4	C	9.26.5	A
9.26.6	B	9.26.7	A	9.26.8	C	9.27.1	B	9.27.2	C
9.27.3	C	9.27.4	A	9.28.1	D	9.28.2	B	9.29.1	B
9.29.2	C	9.29.3	C	9.29.4	B	9.29.5	D	9.29.6	725
9.29.7	45	9.29.8	16	9.29.9	C	9.29.10	D	9.30.1	D
9.31.1	C	9.31.2	D	9.31.3	X	9.31.4	A	9.31.5	D
9.32.1	D	9.32.2	96	9.32.3	D	9.32.4	B	9.32.5	A
9.32.6	B	9.32.7	B	9.32.8	A	9.32.9	B	9.32.10	A
9.32.11	D	9.32.12	163	9.32.13	A	9.32.14	A	9.32.15	D
9.32.16	B	9.32.17	B	9.32.18	D	9.32.19	D	9.32.20	C
9.32.21	X	9.33.1	850	9.33.2	D	9.33.3	D	9.33.4	A
9.33.5	B	9.33.6	D	9.33.7	C	9.33.8	D	9.33.9	B
9.33.10	D	9.33.11	A	9.33.12	A	9.33.13	C	9.33.14	D
9.33.15	C	9.33.16	D	9.33.17	C	9.33.18	A	9.33.19	A
9.34.1	C	9.34.2	C	9.34.3	D	9.34.4	B	9.35.1	32
9.35.2	C	9.35.3	X	9.35.4	D	9.35.5	C	9.35.6	D
9.35.7	D	9.35.8	D	9.35.9	20000	9.35.10	22	9.35.11	B
9.36.1	B	9.36.2	C	9.36.3	D	9.37.1	D	9.37.2	A
9.37.3	C	9.37.4	D	9.37.5	C	9.37.6	C	9.37.7	D
9.37.8	A	9.37.9	C	9.37.10	C	9.37.11	A	9.37.12	25
9.37.13	B	9.37.14	0.81	9.37.15	B	9.37.16	B	9.37.17	C
9.37.18	B	9.37.19	C	9.37.20	X	9.37.21	B	9.38.1	D
9.39.1	C	9.39.2	A	9.39.3	C	9.39.4	D	9.40.1	D
9.40.2	B	9.40.3	B	9.40.4	C	9.40.5	C	9.40.6	B
9.40.7	B	9.40.8	C	9.40.9	C	9.40.10	D	9.41.1	B
9.41.2	C	9.41.3	B	9.41.4	C	9.41.5	C	9.41.6	C
9.41.7	A	9.41.8	C	9.41.9	C	9.41.10	D	9.41.11	B
9.41.12	180	9.41.13	C	9.41.14	B	9.41.15	B	9.41.16	C
9.41.17	B	9.41.18	B	9.41.19	A	9.41.20	A	9.41.21	25
9.41.22	15	9.42.1	A	9.42.2	A	9.43.1	A	9.43.2	B
9.43.3	495	9.43.4	C	9.43.5	C	9.43.6	C	9.43.7	B
9.44.1	C	9.44.2	D	9.44.3	A	9.44.4	B	9.45.1	C

9.45.2	B
9.45.7	A
9.45.12	D
9.46.1	C
9.47.4	C
9.49.1	48
9.49.6	D
9.50.3	D
9.52.1	A
9.53.5	B
9.53.10	D
9.55.1	D
9.55.6	C
9.55.11	B
9.55.16	A

9.45.3	B
9.45.8	4
9.45.13	A
9.46.2	C
9.47.5	D
9.49.2	C
9.49.7	D
9.50.4	280
9.53.1	D
9.53.6	C
9.53.11	D
9.55.2	C
9.55.7	B
9.55.12	X

9.45.4	C
9.45.9	800
9.45.14	A
9.47.1	C
9.47.6	B
9.49.3	C
9.49.8	D
9.50.5	C
9.53.2	A
9.53.7	C
9.53.12	C
9.55.3	B
9.55.8	A
9.55.13	C
9.55.14	C

9.45.6	560
9.45.11	D
9.45.16	B
9.47.3	A
9.48.1	A
9.49.5	C
9.50.2	A
9.51.1	B
9.53.4	C
9.53.9	A
9.54.1	C
9.55.5	C
9.55.10	A
9.55.15	B

## 10

## General Aptitude: Spatial Aptitude (12)



Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping, Paper folding, cutting, and patterns in 2 and 3 dimensions

Mark Distribution in Previous GATE

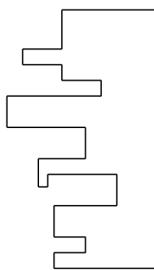
Year	2021-1	2021-2	Minimum	Average	Maximum
1 Mark Count	2	1	1	1.5	2
2 Marks Count	0	1	1	0.5	1
Total Marks	2	3	2	2.5	3

## 10.1

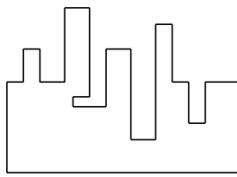
Assembling Pieces (2) top ↗

10.1.1 Assembling Pieces: GATE CSE 2021 Set 2 | GA Question: 7 top ↗

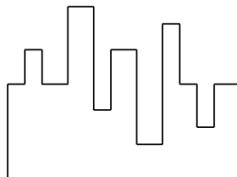
► <https://gateoverflow.in/357543>



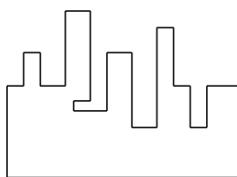
A jigsaw puzzle has 2 pieces. One of the pieces is shown above. Which one of the given options for the missing piece when assembled will form a rectangle? The piece can be moved, rotated or flipped to assemble with the above piece.



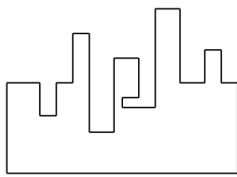
A.



B.



C.



D.

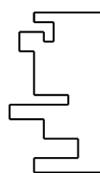
[gate2021-cse-set2](#) [spatial-aptitude](#) [assembling-pieces](#)

Answer

10.1.2 Assembling Pieces: GATE Mechanical 2021 Set 1 | GA Question: 7 top ↗

► <https://gateoverflow.in/359476>





A jigsaw puzzle has 2 pieces. One of the pieces is shown above. Which one of the given options for the missing piece when assembled will form a rectangle? The piece can be moved, rotated or flipped to assemble with the above piece.

- A.
- B.
- C.
- D.

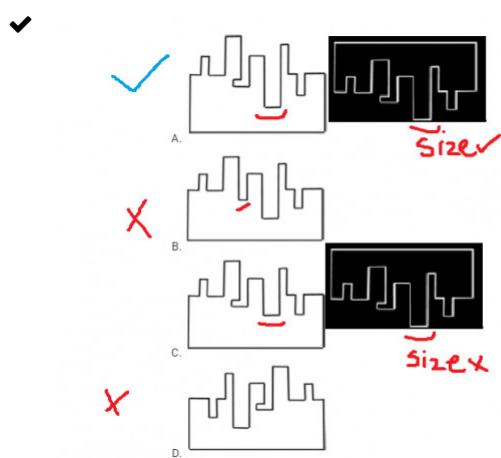
[gateme-2021-set1](#) [spatial-aptitude](#) [assembling-pieces](#)

Answer

### Answers: Assembling Pieces

#### 10.1.1 Assembling Pieces: GATE CSE 2021 Set 2 | GA Question: 7 top ↗

→ <https://gateoverflow.in/357543>



I have flipped and rotated the image given in the question.

7 votes

-- Gourav Sachdev (217 points)

#### 10.1.2 Assembling Pieces: GATE Mechanical 2021 Set 1 | GA Question: 7 top ↗

→ <https://gateoverflow.in/359476>



- ✓ In the given figure both the end sides are flat. So, this rules out option D which has a dent on right side.

Now, if we draw a horizontal line from the end positions of the given figure (both end positions are at same level), we can see 2 rectangle projections and 3 dents out of which 2 are L shaped but not with same orientation. So, the correct option should complement this.

- Option A: satisfies the required criteria of having 3 projections out of which 2 are L shaped having different orientation and 2 rectangle dents.
- Option B: has only one dent.
- Option C: the orientation of the 2 L shapes are the same ans so cannot fit the given figure.

Correct Option: A.

1 votes

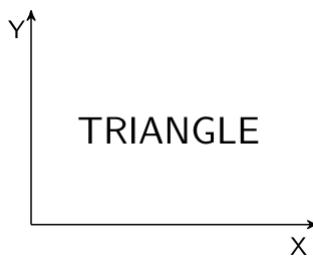
-- Arjun Suresh (328k points)

10.2

Mirror Image (2) top ↗

10.2.1 Mirror Image: GATE Civil 2021 Set 1 | GA Question: 2 top ↗

► <https://gateoverflow.in/359887>



The mirror image of the above test about the X-axis is

A.

B.

C.

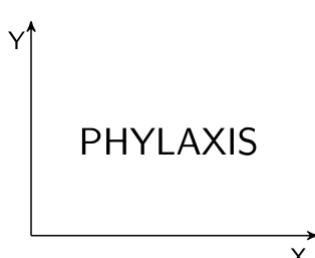
D.

gatecivil-2021-set1 mirror-image

Answer

10.2.2 Mirror Image: GATE Civil 2021 Set 2 | GA Question: 2 top ↗

► <https://gateoverflow.in/359907>



The mirror image of the above text about the x-axis is

A.

B.

C.

## BHΛΓΧΙΣ

D.

gatecivil-2021-set2 mirror-image

Answer 

### Answers: Mirror Image

#### 10.2.1 Mirror Image: GATE Civil 2021 Set 1 | GA Question: 2 top ↴

<https://gateoverflow.in/359887>



- ✓ The image of an object as seen in a mirror is its mirror reflection or mirror image. In such an image, the right side of the object appears on the left side and vice versa. Any object that has bilateral symmetry will have its mirror image the same as that of the object.

So, the correct answer is (B).

 1 votes

-- Lakshman Patel (63.9k points)

#### 10.2.2 Mirror Image: GATE Civil 2021 Set 2 | GA Question: 2 top ↴

<https://gateoverflow.in/359907>



- ✓ The image of an object as seen in a mirror is its mirror reflection or mirror image. In such an image, the right side of the object appears on the left side and vice versa. Any object that has bilateral symmetry will have its mirror image the same as that of the object.

So, the correct answer is (B).

 1 votes

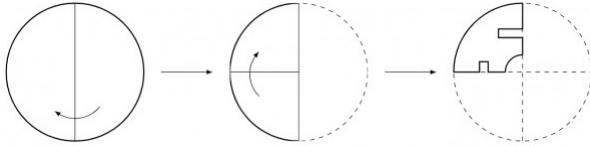
-- Lakshman Patel (63.9k points)

### 10.3

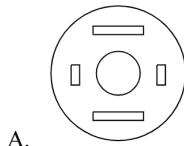
### Paper Folding (5) top ↴

#### 10.3.1 Paper Folding: GATE CSE 2021 Set 1 | GA Question: 4 top ↴

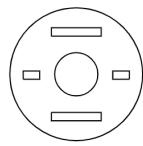
<https://gateoverflow.in/357473>



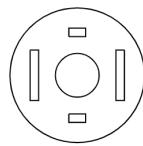
A circular sheet of paper is folded along the lines in the directions shown. The paper, after being punched in the final folded state as shown and unfolded in the reverse order of folding, will look like \_\_\_\_\_.



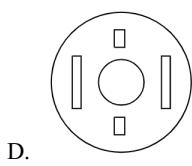
A.



B.



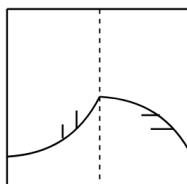
C.



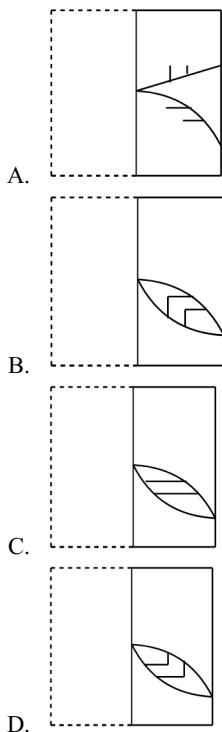
D.

[gate2021-cse-set1](#) [spatial-aptitude](#) [paper-folding](#)

Answer

10.3.2 Paper Folding: GATE CSE 2021 Set 2 | GA Question: 2 [top](#)<https://gateoverflow.in/357548>

A transparent square sheet shown above is folded along the dotted line. The folded sheet will look like \_\_\_\_\_.


[gate2021-cse-set2](#) [spatial-aptitude](#) [paper-folding](#)

Answer

10.3.3 Paper Folding: GATE Civil 2021 Set 1 | GA Question: 7 [top](#)<https://gateoverflow.in/359877>

Consider two rectangular sheets, Sheet M and Sheet N of dimensions  $6 \text{ cm} \times 4 \text{ cm}$  each.

- Folding operation 1 : The sheet is folded into half by joining the short edges of the current shape.
- Folding operation 2 : The sheet is folded into half by joining the long edges of the current shape.

Folding operation 1 is carried out on Sheet M three times.

Folding operation 2 is carried out on Sheet N three times.

The ratio of perimeters of the final folded shape of Sheet N to the final folded shape of Sheet M is \_\_\_\_\_.

A. 13 : 7

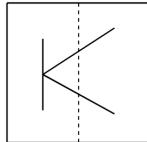
- B. 3 : 2  
C. 7 : 5  
D. 5 : 13

gatecivil-2021-set1 spatial-aptitude paper-folding

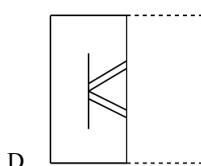
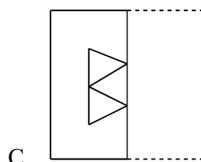
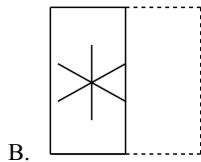
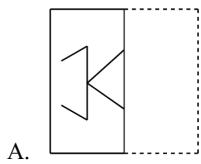
Answer 

**10.3.4 Paper Folding: GATE Electrical 2021 | GA Question: 2** top ↗

► <https://gateoverflow.in/359755>



A transparent square sheet shown above is folded along the dotted line. The folded sheet will look like \_\_\_\_\_.



gateee-2021 spatial-aptitude paper-folding

Answer 

**10.3.5 Paper Folding: GATE Mechanical 2021 Set 2 | GA Question: 9** top ↗

► <https://gateoverflow.in/359492>



Consider a square sheet of side 1 unit. The sheet is first folded along the main diagonal. This is followed by a fold along its line of symmetry. The resulting folded shape is again folded along its line of symmetry. The area of each face of the final folded shape, in square units, equal to \_\_\_\_\_

- A.  $\frac{1}{4}$   
B.  $\frac{1}{8}$   
C.  $\frac{1}{16}$   
D.  $\frac{1}{32}$

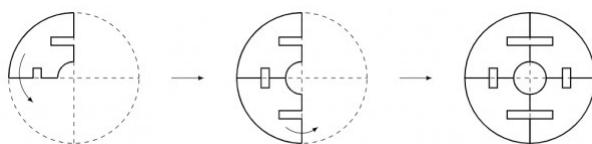
gateme-2021-set2 spatial-aptitude paper-folding area

Answer 

**Answers: Paper Folding**

**10.3.1 Paper Folding: GATE CSE 2021 Set 1 | GA Question: 4** top ↗<https://gateoverflow.in/357473>

- ✓ Unfold the paper sheet back.

**(A) is correct.**

3 votes

-- Nikhil Dhama (2.3k points)

**10.3.2 Paper Folding: GATE CSE 2021 Set 2 | GA Question: 2** top ↗<https://gateoverflow.in/357548>

- ✓ Option B

The orientation (horizontal/vertical) of lines should not change on folding.

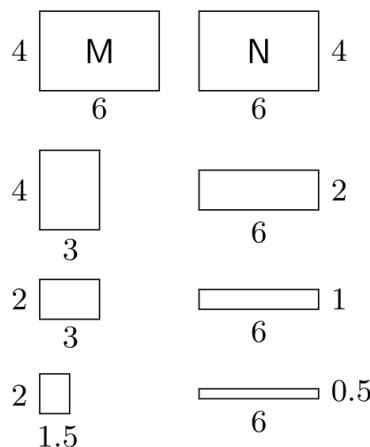
5 votes

-- zxy123 (2.5k points)

**10.3.3 Paper Folding: GATE Civil 2021 Set 1 | GA Question: 7** top ↗<https://gateoverflow.in/359877>

- ✓ Sheet M and sheet N are of dimensions  $6 \text{ cm} \times 4 \text{ cm}$  each.

On Sheets  $M$  and  $N$ , if we perform the given operations, we get as follows.



Now, the perimeter of the final folded shape of sheet  $M = 2(1.5 + 2) = 7 \text{ cm}$ , and the perimeter of the final folded shape of sheet  $N = 2(0.5 + 6) = 13 \text{ cm}$ .

$\therefore$  The ratio of perimeters of the final folded shape of sheet  $N$  to the final folded shape of sheet  $M$  is  $= 13 : 7$ .

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

**10.3.4 Paper Folding: GATE Electrical 2021 | GA Question: 2** top ↗<https://gateoverflow.in/359755>

- ✓ It will be folded along the dotted lines, the line on the right sheet will become exact opposite when it will come to left sheet. Hence the pattern formed after folding the paper is same as in the option C.

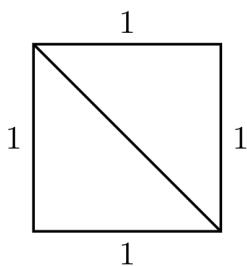
So, the correct answer is (C).

1 votes

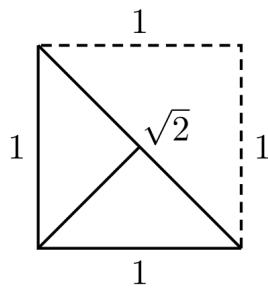
-- Lakshman Patel (63.9k points)

**10.3.5 Paper Folding: GATE Mechanical 2021 Set 2 | GA Question: 9** top ↗<https://gateoverflow.in/359492>

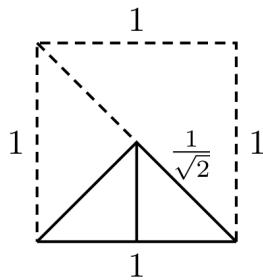
- ✓ Given that a square sheet has a side length of 1 unit.



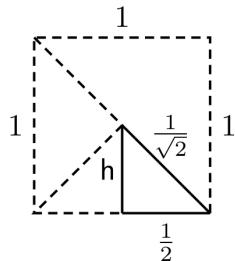
Now, the sheet is first folded along the main diagonal.



Again, this is followed by a fold along its line of symmetry. And this operation is performed two times.



We get the final folded sheet.



Let the height of the triangle be  $h$  units.

Using the Pythagorean theorem, we get.

$$\left(\frac{1}{\sqrt{2}}\right)^2 = h^2 + \left(\frac{1}{2}\right)^2$$

$$\implies \frac{1}{2} = h^2 + \frac{1}{4}$$

$$\implies h^2 = \frac{1}{2} - \frac{1}{4}$$

$$\implies h^2 = \frac{2-1}{4} = \frac{1}{4}$$

$$\implies h = \frac{1}{2}$$

Now, the area of triangle  $\Delta = \frac{1}{2} \times \text{Base} \times \text{Height}$

$$\implies \Delta = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8} \text{ unit}^2.$$

**Short Method:** Area follows the symmetry.

- Initially the area of square = 1
- Folded first time, then the area of square =  $\frac{1}{2}$
- Folded second time, then the area of square =  $\frac{1}{4}$
- Folded third time, then the area of square =  $\frac{1}{8}$

So, the correct answer is (B).

1 votes

-- Lakshman Patel (63.9k points)

## 10.4

### Patterns In Three Dimensions (1) top ↗

#### 10.4.1 Patterns In Three Dimensions: GATE Electrical 2021 | GA Question: 3 top ↗

<https://gateoverflow.in/359752>



For a regular polygon having 10 sides, the interior angle between the sides of the polygon, in degrees, is:

- A. 396
- B. 324
- C. 216
- D. 144

gateee-2021 spatial-aptitude patterns-in-three-dimensions

Answer

### Answers: Patterns In Three Dimensions

#### 10.4.1 Patterns In Three Dimensions: GATE Electrical 2021 | GA Question: 3 top ↗

<https://gateoverflow.in/359752>



- ✓ The interior angle between the sides of the polygon =  $\frac{(n-2) \times 180^\circ}{n}$ , where  $n$  = number of sides of the polygon.

$$\text{Here, } n = 10, \text{ therefore the interior angle between the sides of the polygon} = \frac{(10-2) \times 180^\circ}{10}$$

$$= 8 \times 18^\circ = 144^\circ.$$

So, the correct answer is (D).

1 votes

-- Lakshman Patel (63.9k points)

## 10.5

### Patterns In Two Dimensions (2) top ↗

#### 10.5.1 Patterns In Two Dimensions: GATE CSE 2021 Set 1 | GA Question: 2 top ↗

<https://gateoverflow.in/357475>



A polygon is convex if, for every pair of points, P and Q belonging to the polygon, the line segment PQ lies completely inside or on the polygon.

Which one of the following is NOT a convex polygon?



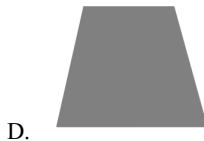
A.



B.



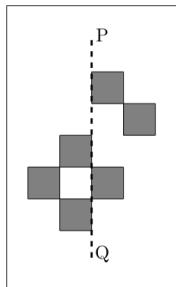
C.



D.

[gate2021-cse-set1](#) [spatial-aptitude](#) [patterns-in-two-dimensions](#)

Answer

10.5.2 Patterns In Two Dimensions: GATE ECE 2021 | GA Question: 3 [top](#)<https://gateoverflow.in/359801>

The least number of squares that must be added so that the line  $P - Q$  becomes the line of symmetry is \_\_\_\_\_

- A. 4
- B. 3
- C. 6
- D. 7

[gateec-2021](#) [spatial-aptitude](#) [patterns-in-two-dimensions](#)

Answer

## Answers: Patterns In Two Dimensions

10.5.1 Patterns In Two Dimensions: GATE CSE 2021 Set 1 | GA Question: 2 [top](#)<https://gateoverflow.in/357475>

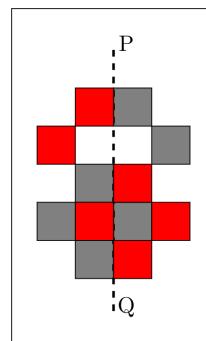
- ✓ Option A is not a convex polygon as if we choose P and Q on the left-most tail the line segment PQ will not be inside the polygon.

5 votes

-- zxy123 (2.5k points)

10.5.2 Patterns In Two Dimensions: GATE ECE 2021 | GA Question: 3 [top](#)<https://gateoverflow.in/359801>

- ✓ A line of symmetry is a line that cuts a shape exactly in half. This means that if you were to fold the shape along the line, both halves would match exactly.



The least number of squares that must be added = 6.

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

## Answer Keys

10.1.1	A
10.3.2	B
10.5.1	A

10.1.2	A
10.3.3	A
10.5.2	C

10.2.1	B
10.3.4	C

10.2.2	B
10.3.5	B

10.3.1	A
10.4.1	D



**Syllabus:** English grammar, Sentence completion, Verbal analogies, Word groups, Instructions, Critical reasoning and Verbal deduction

#### Mark Distribution in Previous GATE

Year	2021-1	2021-2	2020	2019	2018	2017-1	2017-2	2016-1	2016-2	Min.	Avg.	Max.
<b>1 Mark Count</b>	2	2	4	3	2	3	2	4	3	2	2.7	4
<b>2 Marks Count</b>	1	1	1	2	0	1	1	2	2	0	1.2	2
<b>Total Marks</b>	4	4	6	7	2	5	4	8	7	2	5.2	8

## 11.1

Closest Word (3) top ↗11.1.1 Closest Word: GATE2013 CE: GA-3 top ↗<https://gateoverflow.in/40270>

Which of the following options is the closest in meaning to the word given below: **Primeval**

- A. Modern
- B. Historic
- C. Primitive
- D. Antique

[gate2013-ce](#) [closest-word](#) [most-appropriate-word](#)

Answer

11.1.2 Closest Word: GATE2013 EE: GA-1 top ↗<https://gateoverflow.in/40288>

They were requested not to **quarrel** with others.

Which one of the following options is the closest in meaning to the word **quarrel**?

- A. make out
- B. call out
- C. dig out
- D. fall out

[gate2013-ee](#) [verbal-aptitude](#) [closest-word](#)

Answer

11.1.3 Closest Word: GATE2014 AE: GA-1 top ↗<https://gateoverflow.in/40300>

A student is required to demonstrate a high level of comprehension of the subject, especially in the social sciences. The word closest in meaning to **comprehension** is

- A. understanding
- B. meaning
- C. concentration
- D. stability

[gate2014-ae](#) [closest-word](#) [verbal-aptitude](#)

Answer

## Answers: Closest Word

11.1.1 Closest Word: GATE2013 CE: GA-3 top ↗<https://gateoverflow.in/40270>

✓ "Primeval" comes from the Latin words *primus*, meaning "first", and *aevum*, meaning "age." In Latin, those terms were brought together to form "primaevus," a word that means "of or relating to the earliest ages."

Other English words that descend from "primus" include "prime" and "primary," "primordial" (a synonym of "primeval"), and "primitive." "Primus" also gave rise to some terms for folks who are number one in charge, including "prince" and

"principal"

Antique comes from the Latin word "ante" which means "before or preceding".

So, best option: C Primitive.

8 votes

-- Akash Dinkar (27.9k points)

### 11.1.2 Closest Word: GATE2013 EE: GA-1 top ↴

<https://gateoverflow.in/40288>



✓ quarrel means having an argument.  
option (D) **fall out** means the same.

- make out - make progress
- call out - to shout something
- dig out - to get something out of a place

Correct option: D.

18 votes

-- Monanshi Jain (7k points)

### 11.1.3 Closest Word: GATE2014 AE: GA-1 top ↴

<https://gateoverflow.in/40300>



✓ comprehension means understanding.  
option A.

14 votes

-- Monanshi Jain (7k points)

## 11.2

### Comparative Forms (1) top ↴

#### 11.2.1 Comparative Forms: GATE Civil 2021 Set 1 | GA Question: 1 top ↴

<https://gateoverflow.in/359889>



Getting to the top is \_\_\_\_\_ than staying on top.

- A. more easy
- B. much easy
- C. easiest
- D. easier

[gatecivil-2021-set1](#) [verbal-aptitude](#) [english-grammar](#) [comparative-forms](#)

Answer

### Answers: Comparative Forms

#### 11.2.1 Comparative Forms: GATE Civil 2021 Set 1 | GA Question: 1 top ↴

<https://gateoverflow.in/359889>



✓ Since "than" is followed we need the comparative form of "easy" which is easier.

Correct option: D

1 votes

-- Arjun Suresh (328k points)

## 11.3

### English Grammar (41) top ↴

#### 11.3.1 English Grammar: GATE CSE 2014 Set 3 | Question: GA-1 top ↴

<https://gateoverflow.in/2024>



While trying to collect an envelope from under the table, Mr. X fell down and was losing consciousness.

I

II

III

IV

Which one of the above underlined parts of the sentence is NOT appropriate?

- A. I
- B. II
- C. III
- D. IV

[gate2014-cse-set3](#) [verbal-aptitude](#) [easy](#) [english-grammar](#)

Answer

**11.3.2 English Grammar: GATE CSE 2015 Set 1 | Question: GA-1** top ↗<https://gateoverflow.in/7995>

Didn't you buy \_\_\_\_\_ when you went shopping?

- A. any paper
- B. much paper
- C. no paper
- D. a few paper

[gate2015-cse-set1](#) [verbal-aptitude](#) [easy](#) [english-grammar](#)

Answer 

**11.3.3 English Grammar: GATE CSE 2015 Set 2 | Question: GA-1** top ↗<https://gateoverflow.in/8028>

We \_\_\_\_\_ our friend's birthday and we \_\_\_\_\_ how to make it up to him.

- A. completely forgot --- don't just know
- B. forgot completely --- don't just know
- C. completely forgot --- just don't know
- D. forgot completely --- just don't know

[gate2015-cse-set2](#) [verbal-aptitude](#) [easy](#) [english-grammar](#)

Answer 

**11.3.4 English Grammar: GATE CSE 2015 Set 3 | Question: GA-2** top ↗<https://gateoverflow.in/8300>

The Tamil version of \_\_\_\_\_ John Abraham-starrer *Madras Cafe* \_\_\_\_\_ cleared by the Censor Board with no cuts last week, but the film's distributor \_\_\_\_\_ no takers among the exhibitors for a release in Tamilnadu \_\_\_\_\_ this Friday.

- A. Mr., was, found, on
- B. a, was, found, at
- C. the, was, found, on
- D. a, being, find at

[gate2015-cse-set3](#) [verbal-aptitude](#) [normal](#) [english-grammar](#)

Answer 

**11.3.5 English Grammar: GATE CSE 2016 Set 1 | Question: GA03** top ↗<https://gateoverflow.in/39606>

Archimedes said, "Give me a lever long enough and a fulcrum on which to place it, and I will move the world."

The sentence above is an example of a \_\_\_\_\_ statement.

- A. figurative
- B. collateral
- C. literal
- D. figurine

[gate2016-cse-set1](#) [verbal-aptitude](#) [normal](#) [english-grammar](#)

Answer 

**11.3.6 English Grammar: GATE CSE 2016 Set 2 | Question: GA-01** top ↗<https://gateoverflow.in/39529>

The man who is now Municipal Commissioner worked as \_\_\_\_\_.

- A. the security guard at a university
- B. a security guard at the university
- C. a security guard at university
- D. the security guard at the university

[gate2016-cse-set2](#) [verbal-aptitude](#) [english-grammar](#) [normal](#)

Answer 

**11.3.7 English Grammar: GATE CSE 2017 Set 1 | Question: GA-2** top ↗<https://gateoverflow.in/118405>

Research in the workplace reveals that people work for many reasons \_\_\_\_\_.

- A. money beside
- B. beside money
- C. money besides
- D. besides money

[gate2017-cse-set1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.8 English Grammar: GATE CSE 2017 Set 2 | Question: GA-2** top ↗<https://gateoverflow.in/118416>

Saturn is \_\_\_\_\_ to be seen on a clear night with the naked eye.

- A. enough bright
- B. bright enough
- C. as enough bright
- D. bright as enough

[gate2017-cse-set2](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.9 English Grammar: GATE CSE 2019 | Question: GA-2** top ↗<https://gateoverflow.in/302871>

The search engine's business model \_\_\_\_\_ around the fulcrum of trust.

- A. revolves
- B. plays
- C. sinks
- D. bursts

[gate2019-cse](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.10 English Grammar: GATE CSE 2020 | Question: GA-1** top ↗<https://gateoverflow.in/333240>

Raman is confident of speaking English \_\_\_\_\_ six months as he has been practising regularly \_\_\_\_\_ the last three weeks

- A. during, for
- B. for, since
- C. for, in
- D. within, for

[gate2020-cse](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.11 English Grammar: GATE CSE 2021 Set 1 | GA Question: 3** top ↗<https://gateoverflow.in/357474>

Consider the following sentences:

- i. Everybody in the class is prepared for the exam.
- ii. Babu invited Danish to his home because he enjoys playing chess.

Which of the following is the CORRECT observation about the above two sentences?

- A. (i) is grammatically correct and (ii) is unambiguous
- B. (i) is grammatically incorrect and (ii) is unambiguous
- C. (i) is grammatically correct and (ii) is ambiguous
- D. (i) is grammatically incorrect and (ii) is ambiguous

[gate2021-cse-set1](#)
[verbal-aptitude](#)
[english-grammar](#)
[Answer](#)
**11.3.12 English Grammar: GATE CSE 2021 Set 2 | GA Question: 1**
top ↗
<https://gateoverflow.in/357549>


Gauri said that she can play the keyboard \_\_\_\_\_ her sister.

- A. as well as
- B. as better as
- C. as nicest as
- D. as worse as

[gate2021-cse-set2](#)
[verbal-aptitude](#)
[english-grammar](#)
[Answer](#)
**11.3.13 English Grammar: GATE Civil 2021 Set 2 | GA Question: 1**
top ↗
<https://gateoverflow.in/359909>


- i. Arun and Aparna are here.
- ii. Arun and Aparna is here.
- iii. Arun's families is here.
- iv. Arun's family is here.

Which of the above sentences are grammatically CORRECT?

- A. (i) and (ii)
- B. (i) and (iv)
- C. (ii) and (iv)
- D. (iii) and (iv)

[gatecivil-2021-set2](#)
[verbal-aptitude](#)
[english-grammar](#)
[easy](#)
[Answer](#)
**11.3.14 English Grammar: GATE ECE 2020 | GA Question: 2**
top ↗
<https://gateoverflow.in/359780>


He was not only accused of theft \_\_\_\_\_ of conspiracy.

- A. rather
- B. but also
- C. but even
- D. rather than

[gate2020-ec](#)
[verbal-aptitude](#)
[english-grammar](#)
[Answer](#)
**11.3.15 English Grammar: GATE Electrical 2020 | GA Question: 1**
top ↗
<https://gateoverflow.in/359733>


This book, including all its chapters, \_\_\_\_\_ interesting. The students as well as the instructor \_\_\_\_\_ in agreement about it.

- A. is, was
- B. are, are
- C. is, are
- D. were, was

[gate2020-ee](#)
[verbal-aptitude](#)
[english-grammar](#)
[Answer](#)
**11.3.16 English Grammar: GATE Electrical 2021 | GA Question: 1**
top ↗
<https://gateoverflow.in/359757>


The people \_\_\_\_\_ were at the demonstration were from all sections of society.

- A. whose
- B. which
- C. who
- D. whom

gateee-2021 verbal-aptitude english-grammar easy

Answer 

### 11.3.17 English Grammar: GATE Mechanical 2020 Set 1 | GA Question: 2 top ↗

<https://gateoverflow.in/359534>



Jofra Archer, the England fast bowler, is \_\_\_\_\_ than accurate.

- A. more fast
- B. faster
- C. less fast
- D. more faster

gateme-2020-set1 verbal-aptitude english-grammar

Answer 

### 11.3.18 English Grammar: GATE Mechanical 2021 Set 1 | GA Question: 1 top ↗

<https://gateoverflow.in/359488>



Consider the following sentences:

- i. After his surgery, Raja hardly could walk.
- ii. After his surgery, Raja could barely walk.
- iii. After his surgery, Raja barely could walk.
- iv. After his surgery, Raja could hardly walk.

Which of the above sentences are grammatically CORRECT?

- A. (i) and (ii)
- B. (i) and (iii)
- C. (iii) and (iv)
- D. (ii) and (iv)

gateme-2021-set1 verbal-aptitude english-grammar

Answer 

### 11.3.19 English Grammar: GATE Mechanical 2021 Set 2 | GA Question: 2 top ↗

<https://gateoverflow.in/359509>



Consider the following sentences:

- i. The number of candidates who appear for the GATE examination is staggering.
- ii. A number of candidates from my class are appearing for the GATE examination.
- iii. The number of candidates who appear for the GATE examination are staggering.
- iv. A number of candidates from my class is appearing for the GATE examination.

Which of the above sentences are grammatically CORRECT?

- A. (i) and (ii)
- B. (i) and (iii)
- C. (ii) and (iii)
- D. (ii) and (iv)

gateme-2021-set2 verbal-aptitude english-grammar

Answer 

### 11.3.20 English Grammar: GATE2012 AR: GA-4 top ↗

<https://gateoverflow.in/40225>



Which one of the parts (A, B, C, D) in the sentence contains an **ERROR**?

No sooner had the doctor seen the results of the blood test, than he suggested the patient to see the specialist.

- A. no sooner had
- B. results of the blood test
- C. suggested the patient
- D. see the specialist

[gate2012-ar](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

### 11.3.21 English Grammar: GATE2012 CY: GA-2 [top](#)

► <https://gateoverflow.in/40233>



One of the parts (*A, B, C, D*) in the sentence given below contains an ERROR. Which one of the following is INCORRECT?

I requested that he should be given the driving test today instead of tomorrow .

- A. requested that
- B. should be given
- C. the driving test
- D. instead of tomorrow

[gate2012-cy](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

### 11.3.22 English Grammar: GATE2013 AE: GA-4 [top](#)

► <https://gateoverflow.in/40245>



All engineering students should learn mechanics, mathematics and how to do computation.

I                    II                    III                    IV

Which of the above underlined parts of the sentence is not appropriate?

- a. I
- b. II
- c. III
- d. IV

[gate2013-ae](#) [english-grammar](#) [verbal-aptitude](#)

Answer 

### 11.3.23 English Grammar: GATE2013 CE: GA-2 [top](#)

► <https://gateoverflow.in/40269>



The professor ordered to the students to go out of the class.

I                    II                    III                    IV

Which of the above underlined parts of the sentence is grammatically incorrect?

- A. I
- B. II
- C. III
- D. IV

[gate2013-ce](#) [english-grammar](#) [verbal-aptitude](#)

Answer 

### 11.3.24 English Grammar: GATE2014 EC-2: GA-2 [top](#)

► <https://gateoverflow.in/41509>



Which of the options given below best completes the following sentence?

She will feel much better if she \_\_\_\_\_.

- A. Will get some rest
- B. Gets some rest
- C. Will be getting some rest
- D. Is getting some rest

[gate2014-ec-2](#) [verbal-aptitude](#) [english-grammar](#) [normal](#)

**Answer****11.3.25 English Grammar: GATE2015 EC-1: GA-6** [top](#)<https://gateoverflow.in/39494>

The following question presents a sentence, part of which is underlined. Beneath the sentence, you find four ways of phrasing the underlined part. Following the requirements of the standard written English, select the answer that produces the most effective sentence.

Tuberculosis, together with its effects, ranks one of the leading causes of death in India.

- A. ranks as one of the leading causes of death
- B. rank as one of the leading causes of death
- C. has the rank of one of the leading causes of death
- D. are one of the leading causes of death

[gate2015-ec-1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)**Answer****11.3.26 English Grammar: GATE2015 EC-3: GA-6** [top](#)<https://gateoverflow.in/39519>

Ram and Shyam shared a secret and promised to each other that it would remain between them. Ram expressed himself in one of the following ways as given in the choices below. Identify the correct way as per standard English.

- A. It would remain between you and me.
- B. It would remain between I and you.
- C. It would remain between you and I.
- D. It would remain with me.

[gate2015-ec-3](#) [english-grammar](#) [verbal-aptitude](#)**Answer****11.3.27 English Grammar: GATE2015 ME-3: GA-6** [top](#)<https://gateoverflow.in/40171>

Select the appropriate option in place of underlined part of the sentence.

Increased productivity necessary reflects greater efforts made by the employees.

- A. Increase in productivity necessary
- B. Increase productivity is necessary
- C. Increase in productivity necessarily
- D. No improvement required

[gate2015-me-3](#) [verbal-aptitude](#) [english-grammar](#)**Answer****11.3.28 English Grammar: GATE2016 CE-2: GA-1** [top](#)<https://gateoverflow.in/110868>

If I were you, I \_\_\_\_\_ that laptop. It's much too expensive.

- A. Won't buy
- B. Shan't buy
- C. Wouldn't buy
- D. Would buy

[gate2016-ce-2](#) [verbal-aptitude](#) [english-grammar](#) [most-appropriate-word](#)**Answer****11.3.29 English Grammar: GATE2016 EC-1: GA-1** [top](#)<https://gateoverflow.in/108061>

Which of the following is CORRECT with respect to grammar and usage?

Mount Everest is \_\_\_\_\_.

- A. The highest peak in the world

- B. Highest peak in the world
- C. One of highest peak in the world
- D. One of the highest peak in the world

[gate2016-ec-1](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

### 11.3.30 English Grammar: GATE2016 EC-2: GA-1 [top](#)

» <https://gateoverflow.in/108474>



Based on the given statements, select the appropriate option with respect to grammar and usage.

Statements

- (i) The height of Mr. X is 6 feet.
- (ii) The height of Mr. Y is 5 feet.
- A. Mr. X is longer than Mr. Y.
- B. Mr. X is more elongated than Mr. Y.
- C. Mr. X is taller than Mr. Y.
- D. Mr. X is lengthier than Mr. Y.

[gate2016-ec-2](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

### 11.3.31 English Grammar: GATE2016 EC-3: GA-1 [top](#)

» <https://gateoverflow.in/110820>



An apple costs Rs. 10. An onion costs Rs. 8.

Select the most suitable sentence with respect to grammar and usage.

- A. The price of an apple is greater than an onion.
- B. The price of an apple is more than onion.
- C. The price of an apple is greater than that of an onion.
- D. Apples are more costlier than onions.

[gate2016-ec-3](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

### 11.3.32 English Grammar: GATE2017 EC-2: GA-2 [top](#)

» <https://gateoverflow.in/313515>



It is \_\_\_\_\_ to read this year's textbook \_\_\_\_\_ the last year's.

- A. easier, than
- B. most easy, than
- C. easier, from
- D. easiest, from

[gate2017-ec-2](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

### 11.3.33 English Grammar: GATE2017 ME-1: GA-1 [top](#)

» <https://gateoverflow.in/313663>



He was one of my best \_\_\_\_\_ and I felt his loss \_\_\_\_\_.

- A. friend, keenly
- B. friends, keen
- C. friend, keener
- D. friends, keenly

[gate2017-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.34 English Grammar: GATE2017 ME-2: GA-1** top ↗<https://gateoverflow.in/313675>

The ways in which this game can be played \_\_\_\_\_ potentially infinite.

- A. is
- B. is being
- C. are
- D. are being

[gate2017-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.35 English Grammar: GATE2018 ME-1: GA-1** top ↗<https://gateoverflow.in/313655>

"Going by the \_\_\_\_\_ that many hands make light work, the school \_\_\_\_\_ involved all the students in the task."

The words that best fill the blanks in the above sentence are

- A. principle, principal
- B. principal, principle
- C. principle, principle
- D. principal, principal

[gate2018-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.36 English Grammar: GATE2019 CE-1: GA-1** top ↗<https://gateoverflow.in/313442>

The lecture was attended by quite \_\_\_\_\_ students, so the hall was not very \_\_\_\_\_.

- A. a few, quite
- B. few, quiet
- C. a few, quiet
- D. few, quite

[gate2019-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.37 English Grammar: GATE2019 CE-1: GA-2** top ↗<https://gateoverflow.in/313443>

They have come a long way in \_\_\_\_\_ trust among the users.

- A. creating
- B. created
- C. creation
- D. create

[gate2019-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#) [easy](#)

Answer 

**11.3.38 English Grammar: GATE2019 CE-1: GA-5** top ↗<https://gateoverflow.in/313444>

The CEO's decision to quit was as shocking to the Board as it was to \_\_\_\_\_.

- A. I
- B. me
- C. my
- D. myself

[gate2019-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.39 English Grammar: GATE2019 EC: GA-1** top ↗<https://gateoverflow.in/313543>

The strategies that the company \_\_\_\_\_ to sell its products \_\_\_\_\_ house-to-house marketing.

- A. use, includes
- B. uses, include
- C. used, includes
- D. uses, including

[gate2019-ec](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.40 English Grammar: GATE2019 IN: GA-1** top ↗<https://gateoverflow.in/313550>

The fisherman, \_\_\_\_\_ the flood victims owed their lives, were rewarded by the government.

- A. whom
- B. to which
- C. to whom
- D. that

[gate2019-in](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#)

Answer 

**11.3.41 English Grammar: GATE2020 Practice Test 2: General Aptitude-9** top ↗<https://gateoverflow.in/314532>

Pick the sentence which is grammatically incorrect

- A. Walking in the park it began to rain
- B. She was waiting for you but you never came
- C. We were to have a party here
- D. But I did do my homework!

[gate2020-practise-2](#) [english-grammar](#)

Answer 

**Answers: English Grammar****11.3.1 English Grammar: GATE CSE 2014 Set 3 | Question: GA-1** top ↗<https://gateoverflow.in/2024>

✓ Answer D.

While trying to collect an envelope from under the table, Mr. X fell down and was losing consciousness.

A :Mr. X is trying to collect an envelope from under the table (Present continuous tense)

B :Mr. X fell down (Simple past tense)

C :Mr. X was losing consciousness. (Past continuous tense)

While A, B and C

What is wrong is the usage of sentences B and C together.

"We use the past continuous tense with the simple past tense when we want to show that one thing happened in the middle of another thing."

eg-I was taking a bath and the telephone rang.

Here it says..

"Mr. X fell down and was losing consciousness."

i.e B is done.. and C starts. Where as the usage says.. C should have happened in the middle of B.

It should have been Mr. X fell down and lost consciousness.

Source - <http://www.5minuteenglish.com/nov12.htm>

## References



21 votes

-- Srinath Jayachandran (2.9k points)

### 11.3.2 English Grammar: GATE CSE 2015 Set 1 | Question: GA-1 top ↗

<https://gateoverflow.in/7995>



✓ Answer is (A)

We can use "any" in negative sentences with plural **countable** nouns

e.g., Aren't there any **books**?

We can use "any" in negative sentences with **uncountable** nouns

e.g., Isn't there any **paper**? - here paper is uncountable

9 votes

-- Prateek kumar (6.7k points)

### 11.3.3 English Grammar: GATE CSE 2015 Set 2 | Question: GA-1 top ↗

<https://gateoverflow.in/8028>



✓ We **completely forgot** our friends' birthday and we **just don't know** how to make it up to him.

**Option C is correct.**

6 votes

-- Akash Verma (2.4k points)

### 11.3.4 English Grammar: GATE CSE 2015 Set 3 | Question: GA-2 top ↗

<https://gateoverflow.in/8300>



✓ Answer is (C). Here, we are talking about the movie and not about John Abraham.

Article "the" is used to define a particular object here(The Movie).

'Madras Cafe' in Tamil gets censors' nod, thumbs down from exhibitors

The Tamil version of the John Abraham-starrer *Madras Café* was cleared by the censors with no cuts on Thursday, but the film's distributors found no takers among the exhibitors for a release in Tamil Nadu on Friday.

This question is taken as it is from "The Hindu" newspaper.

14 votes

-- Krithiga2101 (7.9k points)

### 11.3.5 English Grammar: GATE CSE 2016 Set 1 | Question: GA03 top ↗

<https://gateoverflow.in/39606>



✓ Here, we are using metamorphic meaning of words to explain thoughts instead of the literal use of them. So, it is a **figurative** sentence.

- figurative: metaphorical
- collateral: bond
- literal: taking words in their usual
- figurine: a statuette, typically of a human

Option A is correct.

10 votes

-- Arjun Suresh (328k points)

Here, we are talking about the figure of speech. So, figurative is the figure of speech meaning: Use of metamorphic meaning of words to explain your thoughts instead of the literal use of them.

figurative(लाक्षणिक), collateral (संपार्श्विक), literal (सचमुच्च)figurine (मूर्ति)

option A is correct.

20 votes

-- Akash Verma (2.4k points)

### 11.3.6 English Grammar: GATE CSE 2016 Set 2 | Question: GA-01 top ↗

<https://gateoverflow.in/39529>



✓ University considered as an organization that's why article **the** used before university.  
And Post of security is a general post, so article **a** has been used for security guard.

So, option (B) is true.

4 votes

-- Akash Verma (2.4k points)

**11.3.7 English Grammar: GATE CSE 2017 Set 1 | Question: GA-2** <https://gateoverflow.in/118405>

- ✓ Answer is (D)

The spelling difference between *beside* and *besides* is a small one, but their meanings and uses are quite different!

**BESIDE**, with no “s” at the end, is used only as a preposition, which means there is always a noun following it. It means either “next to” or “compared to,” as shown in the examples below. The first meaning, “next to,” is more common.

- She sat *beside* (= next to) him during dinner.
- These problems seem unimportant *beside* (= compared to) the potential benefits of the new system.

**BESIDES** with an “s” at the end can also be used as a preposition, but it means “except” or “in addition to,” as in these examples:

- There's no one here *besides* (= except) me.
- She wants to learn other languages *besides* (= in addition to) English and French.
- *Besides* (= in addition to) its famous cakes, the bakery also makes delicious breads and cookies.

23 votes

-- 2018 (5.5k points)

**11.3.8 English Grammar: GATE CSE 2017 Set 2 | Question: GA-2** <https://gateoverflow.in/118416>

- ✓ With adjectives and adverbs, **enough** comes after adjectives and adverbs.  
With nouns, **enough** comes before noun.

In the given question, enough is used with bright which is an adjective, so enough will come after the adjective.  
So, **bright enough** is the **correct option(B)**.

12 votes

-- Akash Verma (2.4k points)

**11.3.9 English Grammar: GATE CSE 2019 | Question: GA-2** <https://gateoverflow.in/302871>

- ✓ The answer for the above question is  
option A. Revolves

the actual meaning of Revolves in this context is to 'treat as the most important element'.

So the above meaning of the sentence goes:

The business model of any search engine is entirely dependent on trust.

OR

Trust is the most important factor of the business model of any search engine.

7 votes

-- Tarulekha Das (151 points)

**11.3.10 English Grammar: GATE CSE 2020 | Question: GA-1** <https://gateoverflow.in/333240>

- ✓ 'within' is used to state that something will occur in a specified time period.

The second blank is interesting with respect to **for** vs **since**.

The preposition 'for' is used with a period of time specifying **the length of time** (two years, one week, etc) whereas 'since' is used to refer to a time period **from a specific point in time** (last year, 2010, etc)

First blank itself is sufficient to eliminate all incorrect options.

Correct option is D.

19 votes

-- NabilSayyad (761 points)

### 11.3.11 English Grammar: GATE CSE 2021 Set 1 | GA Question: 3 [top](#)



- i. 'Everybody in the class is prepared for the exam.'

The above statement is correct as when we say *everybody* or *everyone*, we are considering the class as a unit. So singular form of the verb "is" is correct.

- ii. 'Babu invited Danish to his house because he enjoys playing chess.'

The above statement is ambiguous because we are not sure who "he" refers to – it can be either Babu or Danish.

Option C follows from the above.

6 votes

-- cherrywood55 (161 points)

### 11.3.12 English Grammar: GATE CSE 2021 Set 2 | GA Question: 1 [top](#)



- ✓ Option A. as well as

as nice as, as good as, **as well as**, as perfect as, as cute as, as joyful as, as pretty as

All will fit in as all are in their FIRST degree.

Adjective	Comparative	Superlative
good	better	best
bad	worse	worst
little	less	least
much	more	most

4 votes

-- Shashank Rustagi (5k points)

### 11.3.13 English Grammar: GATE Civil 2021 Set 2 | GA Question: 1 [top](#)



- ✓ As opposed to "as well as" which considers only the first subject, "and" considers both the subjects before and after it and so the verb usage must be "plural". So, (i) is correct and (ii) is wrong.

Arun's "family" is correct as one can have only one family. So, (iv) is correct.

Correct option: B

1 votes

-- Arjun Suresh (328k points)

### 11.3.14 English Grammar: GATE ECE 2020 | GA Question: 2 [top](#)



- ✓ Option B. but also.

Not only / but also is a common usage.

References



1 votes

-- Arjun Suresh (328k points)

### 11.3.15 English Grammar: GATE Electrical 2020 | GA Question: 1 [top](#)



- C. is, are

- 'is' because "this book" is singular

- ‘are’ because for “as well as” the verb should agree with the noun preceding “as well as” which here is “the students”.

5 votes

-- Electrical\_PP (240 points)

### 11.3.16 English Grammar: GATE Electrical 2021 | GA Question: 1 top ↴

<https://gateoverflow.in/359757>



- ✓ To refer to “people” which is plural we must use “who” and not “whom”.

“whose” is used to refer to some object or property being associated with a person which is not applicable here.

“which” and “that” are the relative pronouns for animals and objects (not humans).

Correct option: C

#### References



1 votes

-- Arjun Suresh (328k points)

### 11.3.17 English Grammar: GATE Mechanical 2020 Set 1 | GA Question: 2 top ↴

<https://gateoverflow.in/359534>



- ✓ Due to “than” we need a comparative form here. But options A, B and C are comparative forms while option D is wrong usage as “faster” itself is comparative and so “more faster” is needless.

Now we have to see what is being compared. The comparison is with “accurate.” So, it should be either “more fast” or “less fast”. Since “accuracy” is a positive point, it should be “more fast” as “more fast” is expected to be better from a “fast bowler”.

PS: The following usage is correct because there we are comparing Archer with Bumrah.

Jofra Archer, the England fast bowler, is **faster** than Bumrah.

Correct Answer: A.

1 votes

-- Arjun Suresh (328k points)

### 11.3.18 English Grammar: GATE Mechanical 2021 Set 1 | GA Question: 1 top ↴

<https://gateoverflow.in/359488>



- ✓ **Hardly/barely** is an adverb and means “almost not true”.

Hardly/barely comes before the main verb of a sentence, but when there is a modal or auxiliary verb, hardly usually comes after it:

- After his surgery, Raja **could** hardly **walk**.
  - Here, could is the auxiliary verb and hardly/barely should follow it.

Correct option: D

<https://www.macmillandictionary.com/dictionary/british/hardly>

#### References



1 votes

-- Arjun Suresh (328k points)

### 11.3.19 English Grammar: GATE Mechanical 2021 Set 2 | GA Question: 2 top ↴

<https://gateoverflow.in/359509>



- ✓ “The number of candidates” is singular and refers to the actual number. So, “**is** staggering” is correct.

“A number of candidates” is plural as here the number refers to a group of possibilities (from  $\{1, 2, 3, 4, \dots n\}$ ) and is hence plural. So, “**are** appearing” is correct.

Correct option: A.

1 votes

-- Arjun Suresh (328k points)

**11.3.20 English Grammar: GATE2012 AR: GA-4** top ↴[▪ https://gateoverflow.in/40225](https://gateoverflow.in/40225)**✓ Answer (D) see the specialist**

Who is the specialist here? Not clear- it must be one of the specialist for that particular disease. So, "to see a specialist" is correct.

Rest all are fine in the sentence. "No sooner had- than" means the first part happened and the second part followed immediately. The first part uses past perfect tense and the second part uses simple past tense - which is as required.

<http://www.englishgrammar.org/rewrite-sooner/>

**References**

14 votes

-- Arjun Suresh (328k points)

**11.3.21 English Grammar: GATE2012 CY: GA-2** top ↴[▪ https://gateoverflow.in/40233](https://gateoverflow.in/40233)**✓ option B is correct because "Should" – not to be used in a request**

5 votes

-- Akash Verma (2.4k points)

**11.3.22 English Grammar: GATE2013 AE: GA-4** top ↴[▪ https://gateoverflow.in/40245](https://gateoverflow.in/40245)**✓ Answer is (D)**

All engineering students should learn mechanics, mathematics and computation.

or possibly

All engineering students should learn how to do mechanics, mathematics and computation.

13 votes

-- Kathleen Bankson (51.6k points)

**11.3.23 English Grammar: GATE2013 CE: GA-2** top ↴[▪ https://gateoverflow.in/40269](https://gateoverflow.in/40269)**✓ According to the question, in given sentence part II is a grammatical error. it should be ' ordered' instead of 'ordered to'.**

The professor **ordered** the students to go out of the class.

Explanation:

Use of '**ordered**' <http://sentence.yourdictionary.com/ordered>

You should use '**ordered to**' when someone is issuing a command. For example, *I was ordered to order a pizza*. This means that someone instructed you to order a pizza.

Correct Answer: **B**

**References**

12 votes

-- Akash Verma (2.4k points)

**11.3.24 English Grammar: GATE2014 EC-2: GA-2** top ↴[▪ https://gateoverflow.in/41509](https://gateoverflow.in/41509)**✓ She will feel much better if she gets some rest.**

If clause (condition) - If + simple present - if she gets some rest

Main clause (result) - simple future - She will feel much better

As in all conditional sentences, the order of the clauses is not fixed. You may have to rearrange the pronouns and adjust punctuation when you change the order of the clauses, but the meaning is identical.

More on Conditional Sentences - <http://www.ef.com/english-resources/english-grammar/type-1-conditional/>

Hence, option B is correct.

**References**



7 votes

-- Akash Verma (2.4k points)

### 11.3.25 English Grammar: GATE2015 EC-1: GA-6 [top](#)



- ✓ Tuberculosis, together with its effects,  
A) ranks as one of the leading causes of death

<http://dictionary.cambridge.org/dictionary/english/rank>

7 votes

-- srestha (85k points)

### 11.3.26 English Grammar: GATE2015 EC-3: GA-6 [top](#)



- ✓ (A) is the right answer.

Option (D) is incorrect because the secret is between them and not solely with Ram so its contradicting with the original statement.

Options (B) and (C) are false because "I" is incorrect usage as object, it should be "me".

5 votes

-- Ritaban Basu (519 points)

### 11.3.27 English Grammar: GATE2015 ME-3: GA-6 [top](#)



- ✓ <https://dictionary.cambridge.org/dictionary/english/necessarily>

necessary :- Adjective

necessarily :- Adverb

Option C.

#### References



5 votes

-- Rupendra Choudhary (11.3k points)

### 11.3.28 English Grammar: GATE2016 CE-2: GA-1 [top](#)



- ✓ If I were you, I **wouldn't buy** that laptop. It's much too expensive .

you can visit this site for more knowledge about conditional

sentence.[http://www.myenglishpages.com/site\\_php\\_files/grammar-lesson-conditionals.php](http://www.myenglishpages.com/site_php_files/grammar-lesson-conditionals.php)

#### References



4 votes

-- Akash Verma (2.4k points)

### 11.3.29 English Grammar: GATE2016 EC-1: GA-1 [top](#)



- ✓ An adjective can exist in three forms – positive, **comparative** and **superlative**. The positive **form** is the base **form** of the adjective. The **comparative form** expresses a higher **degree** of some quality. The **superlative form** expresses the highest **degree**.

Rules for superlative degree- <https://www.englishgrammar.org/positive-comparative-superlative-degrees/>

Here, Mount Everest is **the highest** peak in the world. Option (A) is correct.

#### References



7 votes

-- Akash Verma (2.4k points)

### 11.3.30 English Grammar: GATE2016 EC-2: GA-1 [top](#)

<https://gateoverflow.in/108474>



✓ *taller*. comparative form of tall: more tall.

*Taller definition, having a relatively great height; of more than average stature: a tall woman; tall grass.*

Mr. X is **taller** than Mr. Y. So option C is correct.

5 votes

-- Akash Verma (2.4k points)

### 11.3.31 English Grammar: GATE2016 EC-3: GA-1 [top](#)

<https://gateoverflow.in/110820>



- The price of an apple is greater than an onion. -- Wrong as price of apple is compared not with price of onion but with onion
- The price of an apple is more than onion. -- Wrong, same as above
- The price of an apple is greater than that of an onion. -- Correct usage
- Apples are more costlier than onions. -- with "costlier" we do not need "more".

Correct Option: C.

6 votes

-- Arjun Suresh (328k points)

### 11.3.32 English Grammar: GATE2017 EC-2: GA-2 [top](#)

<https://gateoverflow.in/313515>



✓ Correct Answer: A. "It is **easier** to read this year's textbook **than** the last year's."

The word '**than**' is used to make comparison.

"easiest to" is incorrect construction and "most easy" cannot be used with "than".

2 votes

-- Naveen Kumar (9.9k points)

### 11.3.33 English Grammar: GATE2017 ME-1: GA-1 [top](#)

<https://gateoverflow.in/313663>



✓ Keenly: Intensely, deeply.

The sentence states 'one of my best' meaning out of many best friends.

So, the sentence should be 'He was one of my best friends and I felt his loss keenly.'

Correct answer is (D).

4 votes

-- Lakshman Patel (63.9k points)

### 11.3.34 English Grammar: GATE2017 ME-2: GA-1 [top](#)

<https://gateoverflow.in/313675>



✓ The correct sentence is "The ways in which this game can be played **are** potentially infinite."

Since, the subject here is 'The ways' which is plural so, 'are' is used

The words 'is being', 'are being' are used for 'passive present progressive' tense.

Reference: <https://ell.stackexchange.com/questions/10404/how-do-i-use-is-being>

Correct Answer: C

#### References



3 votes

-- Naveen Kumar (9.9k points)

**11.3.35 English Grammar: GATE2018 ME-1: GA-1** [top](#)<https://gateoverflow.in/313655>

- ✓ "Going by the **principle** that many hands make light work, the school **principal** involved all the students in the task."

**principle** means basic rules which needs to be followed,

**principal** means head of any institution.

So, A is correct choice.

1 votes

-- Naveen Kumar (9.9k points)

**11.3.36 English Grammar: GATE2019 CE-1: GA-1** [top](#)<https://gateoverflow.in/313442>

- ✓ "by quite a few students, so the hall was not very quiet."

- "a few" -- small number
- "few" -- almost zero
- "quite" -- fairly
- "quiet" -- silent

Correct Option: C

5 votes

-- Arjun Suresh (328k points)

**11.3.37 English Grammar: GATE2019 CE-1: GA-2** [top](#)<https://gateoverflow.in/313443>

- ✓ "in creating" is the correct usage.

Correct Option: A.

1 votes

-- Arjun Suresh (328k points)

**11.3.38 English Grammar: GATE2019 CE-1: GA-5** [top](#)<https://gateoverflow.in/313444>

- ✓ "me" - the object form of "I".

Correct option: B

#### References



3 votes

-- Arjun Suresh (328k points)

**11.3.39 English Grammar: GATE2019 EC: GA-1** [top](#)<https://gateoverflow.in/313543>

- ✓ **Answer B**

"the company" is singular, hence "uses"

"The strategies" is plural, hence "include"

6 votes

-- Shalini26 (449 points)

**11.3.40 English Grammar: GATE2019 IN: GA-1** [top](#)<https://gateoverflow.in/313550>

- ✓ Correct Answer: C "**to whom**"

While talking about living beings "which" and "that" are inappropriate.

"whom" makes the sentence incorrect while "to whom" makes it correct.

[More reading for who and whom](#)

#### References



5 votes

-- Arjun Suresh (328k points)

#### 11.3.41 English Grammar: GATE2020 Practice Test 2: General Aptitude-9 [top ↴](#)



Adding an "ing" to a verb does not make it a noun. In the sentence  
 "Walking in the park it began to rain"  
 "walking" is a verb and it misses a subject. It can be corrected as  
 "Me walking in the park it began to rain"

PS: We can start a sentence using a verb if it is a gerund (taking noun form) like "Walking is a nice exercise" <http://www.chompchomp.com/terms/gerundphrase.htm>

Options B, C and D are grammatically correct.

Correct Answer: Option A

#### References



1 votes

-- Arjun Suresh (328k points)

#### 11.4

#### Grammatical Sentence (6) [top ↴](#)



#### 11.4.1 Grammatical Sentence: GATE CSE 2012 | Question: 59 [top ↴](#)

<https://gateoverflow.in/2198>

Choose the grammatically **INCORRECT** sentence:

- A. They gave us the money back less the service charges of Three Hundred rupees.
- B. This country's expenditure is not less than that of Bangladesh.
- C. The committee initially asked for a funding of Fifty Lakh rupees, but later settled for a lesser sum.
- D. This country's expenditure on educational reforms is very less.

[gate2012-cse](#) [verbal-aptitude](#) [grammatical-sentence](#) [normal](#)

Answer

#### 11.4.2 Grammatical Sentence: GATE CSE 2013 | Question: 60 [top ↴](#)

<https://gateoverflow.in/1564>



Choose the grammatically **INCORRECT** sentence:

- A. He is of Asian origin.
- B. They belonged to Africa.
- C. She is an European.
- D. They migrated from India to Australia.

[gate2013-cse](#) [verbal-aptitude](#) [grammatical-sentence](#) [normal](#)

Answer

#### 11.4.3 Grammatical Sentence: GATE CSE 2015 Set 2 | Question: GA-10 [top ↴](#)

<https://gateoverflow.in/8041>



Out of the following 4 sentences, select the most suitable sentence with respect to grammar and usage:

- A. Since the report lacked needed information, it was of no use to them.
- B. The report was useless to them because there were no needed information in it.
- C. Since the report did not contain the needed information, it was not real useful to them.
- D. Since the report lacked needed information, it would not had been useful to them.

[gate2015-cse-set2](#) [verbal-aptitude](#) [normal](#) [english-grammar](#) [grammatical-sentence](#)

[Answer](#)**11.4.4 Grammatical Sentence: GATE CSE 2016 Set 1 | Question: GA01** [top](#)<https://gateoverflow.in/39608>

Out of the following four sentences, select the most suitable sentence with respect to grammar and usage.

- A. I will not leave the place until the minister does not meet me.
- B. I will not leave the place until the minister doesn't meet me.
- C. I will not leave the place until the minister meet me.
- D. I will not leave the place until the minister meets me.

[gate2016-cse-set1](#) [verbal-aptitude](#) [english-grammar](#) [easy](#) [grammatical-sentence](#)

[Answer](#)**11.4.5 Grammatical Sentence: GATE2012 AR: GA-3** [top](#)<https://gateoverflow.in/40224>

Choose the grammatically CORRECT sentence:

- A. He laid in bed till 8 o'clock in the morning.
- B. He layed in bed till 8 o'clock in the morning.
- C. He lain in bed till 8 o'clock in the morning.
- D. He lay in bed till 8 o'clock in the morning.

[gate2012-ar](#) [verbal-aptitude](#) [english-grammar](#) [easy](#) [grammatical-sentence](#)

[Answer](#)**11.4.6 Grammatical Sentence: GATE2013 EE: GA-4** [top](#)<https://gateoverflow.in/40291>

Choose the grammatically CORRECT sentence:

- A. Two and two add four.
- B. Two and two become four.
- C. Two and two are four.
- D. Two and two make four.

[gate2013-ee](#) [english-grammar](#) [verbal-aptitude](#) [grammatical-sentence](#)

[Answer](#)**Answers: Grammatical Sentence****11.4.1 Grammatical Sentence: GATE CSE 2012 | Question: 59** [top](#)<https://gateoverflow.in/2198>

✓ Answer is (D)

"is very less" should be "is much less" or "is very little"

16 votes

-- Kathleen Bankson (51.6k points)

**11.4.2 Grammatical Sentence: GATE CSE 2013 | Question: 60** [top](#)<https://gateoverflow.in/1564>

✓ C. She is a European

"The sound of a word's first letter determines which to use. If the word starts with a [vowel](#) sound, you should use an. If it starts with a [consonant](#) sound, you should use a."

The word "European" does not start with a vowel sound, it starts with the syllable "you". The "y"-sound is in this case a consonant (or at least a half-consonant), so the indefinite article is "a".

**References**

29 votes

-- Kathleen Bankson (51.6k points)

**11.4.3 Grammatical Sentence: GATE CSE 2015 Set 2 | Question: GA-10**

top ↴

☛ <https://gateoverflow.in/8041>

- ✓ Answer is (A)

Correct versions of other 3:

- B. The report was useless to them because there **was** no needed information in it.  
 C. Since the report did not contain the needed information, it was not **really** useful to them.  
 D. Since the report lacked needed information, it would not **have** been useful to them.

↳ 21 votes

-- Arjun Suresh (328k points)

**11.4.4 Grammatical Sentence: GATE CSE 2016 Set 1 | Question: GA01**

top ↴

☛ <https://gateoverflow.in/39608>

- ✓ Not is already embedded in until. So, A and B are incorrect. Also, the minister is a single person, and with a singular subject, singular verb follows(ending in 's'). **Thus, C is incorrect and D is the right answer.**

↳ 14 votes

-- Akash Verma (2.4k points)

**11.4.5 Grammatical Sentence: GATE2012 AR: GA-3**

top ↴

☛ <https://gateoverflow.in/40224>

- ✓ Answer should be "D"

Lay vs Lie Chart

Infinitive	Definition	Present	Past	Past Participle	Present Participle
to lay	to put or place something down	lay(s)	laid	laid	laying
to lie	to rest or recline	lie(s)	lay	lain	lying

Lay means **to put or set something down**,

Lie, on the other hand, is defined as, “**to be, to stay or to assume rest in a horizontal position**”

↳ 15 votes

-- Prateek kumar (6.7k points)

**11.4.6 Grammatical Sentence: GATE2013 EE: GA-4**

top ↴

☛ <https://gateoverflow.in/40291>

- ✓
- Two and two add four -- Correct form is "Two and two add to four"

Sentences **B** and **C** are wrong forms of the sentence "Two and two is equal to four". (Value is becoming equal)

- Two and two make four. -- is Correct. ["makes" is also correct usage here.](#)

Correct Answer: D

**References**

↳ 4 votes

-- Arjun Suresh (328k points)

**11.5****Meaning (35)**

top ↴

☛ <https://gateoverflow.in/2365>**11.5.1 Meaning: GATE CSE 2010 | Question: 57**

top ↴

Which of the following options is the closest in meaning to the word given below:

**Circuitous**

- A. cyclic
- B. indirect
- C. confusing
- D. crooked

[gate2010-cse](#)
[verbal-aptitude](#)
[meaning](#)
[normal](#)
[Answer](#)
**11.5.2 Meaning: GATE CSE 2011 | Question: 56**
top ↗
<https://gateoverflow.in/2165>


Which of the following options is the closest in the meaning to the word below:

**Inexplicable**

- A. Incomprehensible
- B. Indelible
- C. Inextricable
- D. Infallible

[gate2011-cse](#)
[verbal-aptitude](#)
[meaning](#)
[normal](#)
[Answer](#)
**11.5.3 Meaning: GATE CSE 2012 | Question: 58**
top ↗
<https://gateoverflow.in/2197>


Which one of the following options is the closest in meaning to the word given below?

**Mitigate**

- A. Diminish
- B. Divulge
- C. Dedicate
- D. Denote

[gate2012-cse](#)
[verbal-aptitude](#)
[meaning](#)
[easy](#)
[Answer](#)
**11.5.4 Meaning: GATE CSE 2013 | Question: 56**
top ↗
<https://gateoverflow.in/1559>


Which one of the following options is the closest in meaning to the word given below?

**Nadir**

- A. Highest
- B. Lowest
- C. Medium
- D. Integration

[gate2013-cse](#)
[verbal-aptitude](#)
[meaning](#)
[normal](#)
[Answer](#)
**11.5.5 Meaning: GATE CSE 2014 Set 1 | Question: GA-1**
top ↗
<https://gateoverflow.in/56>


Which of the following options is the closest in meaning to the phrase in bold in the sentence below?

It is fascinating to see life forms \*\*cope with\*\* varied environmental conditions.

- A. Adopt to
- B. Adapt to
- C. Adept in
- D. Accept with

[verbal-aptitude](#)
[gate2014-cse-set1](#)
[meaning](#)
[easy](#)
[Answer](#)
**11.5.6 Meaning: GATE CSE 2014 Set 1 | Question: GA-3**
top ↗
<https://gateoverflow.in/772>


In a press meet on the recent scam, the minister said, "The buck stops here". What did the minister convey by the statement?

- A. He wants all the money
- B. He will return the money
- C. He will assume final responsibility
- D. He will resist all enquiries

[gate2014-cse-set1](#) [verbal-aptitude](#) [normal](#) [meaning](#)

Answer 

#### 11.5.7 Meaning: GATE CSE 2014 Set 2 | Question: GA-3 [top](#)

<https://gateoverflow.in/1940>



Match the columns.

Column 1	Column 2
1. eradicate	P. misrepresent
2. distort	Q. soak completely
3. saturate	R. use
4. utilize	S. destroy utterly

- A. 1:S, 2:P, 3:Q, 4:R
- B. 1:P, 2:Q, 3:R, 4:S
- C. 1:Q, 2:R, 3:S, 4:P
- D. 1:S, 2:P, 3:R, 4:Q

[gate2014-cse-set2](#) [verbal-aptitude](#) [meaning](#) [normal](#)

Answer 

#### 11.5.8 Meaning: GATE CSE 2015 Set 1 | Question: GA-2 [top](#)

<https://gateoverflow.in/8003>



Which of the following options is the closest in meaning of the sentence below?

She enjoyed herself immensely at the party.

- A. She had a terrible time at the party
- B. She had a horrible time at the party
- C. She had a terrific time at the party
- D. She had a terrifying time at the party

[gate2015-cse-set1](#) [verbal-aptitude](#) [easy](#) [meaning](#)

Answer 

#### 11.5.9 Meaning: GATE CSE 2015 Set 1 | Question: GA-7 [top](#)

<https://gateoverflow.in/8011>



Select the alternative meaning of the underlined part of the sentence.

The chain snatchers took to their heels when the police party arrived.

- A. Took shelter in a thick jungle
- B. Open indiscriminate fire
- C. Took to flight
- D. Unconditionally surrendered

[gate2015-cse-set1](#) [verbal-aptitude](#) [meaning](#) [easy](#)

Answer 

#### 11.5.10 Meaning: GATE CSE 2015 Set 2 | Question: GA-2 [top](#)

<https://gateoverflow.in/8029>



Choose the statement where underlined word is used correctly.

- A. The industrialist had a personnel jet.
- B. I write my experience in my personnel diary.
- C. All personnel are being given the day off.
- D. Being religious is a personnel aspect.

[gate2015-cse-set2](#) [verbal-aptitude](#) [meaning](#) [normal](#)

Answer 

### 11.5.11 Meaning: GATE CSE 2016 Set 1 | Question: GA02 [top](#)

<https://gateoverflow.in/39607>



A rewording of something written or spoken is a \_\_\_\_\_.

- A. paraphrase
- B. paradox
- C. paradigm
- D. paraffin

[gate2016-cse-set1](#) [verbal-aptitude](#) [meaning](#) [normal](#)

Answer 

### 11.5.12 Meaning: GATE CSE 2016 Set 2 | Question: GA-02 [top](#)

<https://gateoverflow.in/39531>



Nobody knows how the Indian cricket team is going to cope with the difficult and seamer-friendly wickets in Australia.  
Choose the option which is closest in meaning to the underlined phrase in the above sentence.

- A. Put up with.
- B. Put in with.
- C. Put down to.
- D. Put up against.

[gate2016-cse-set2](#) [verbal-aptitude](#) [meaning](#) [normal](#)

Answer 

### 11.5.13 Meaning: GATE CSE 2016 Set 2 | Question: GA-03 [top](#)

<https://gateoverflow.in/39530>



Find the odd one in the following group of words.

mock, deride, praise, jeer

- A. Mock
- B. Deride
- C. Praise
- D. Jeer

[gate2016-cse-set2](#) [verbal-aptitude](#) [meaning](#) [easy](#)

Answer 

### 11.5.14 Meaning: GATE CSE 2017 Set 2 | Question: GA-1 [top](#)

<https://gateoverflow.in/118415>



Choose the option with words that are not synonyms.

- A. aversion, dislike
- B. luminous, radiant
- C. plunder, loot
- D. yielding, resistant

[gate2017-cse-set2](#) [verbal-aptitude](#) [meaning](#)

Answer 

### 11.5.15 Meaning: GATE CSE 2020 | Question: GA-2 [top](#)

<https://gateoverflow.in/333239>



His knowledge of the subject was excellent but his classroom performance was \_\_\_\_\_.

- A. extremely poor
- B. good
- C. desirable
- D. praiseworthy

[gate2020-cse](#) [verbal-aptitude](#) [english-grammar](#) [meaning](#)

Answer 

### 11.5.16 Meaning: GATE2010 MN: GA-1 [top](#)

▪ <https://gateoverflow.in/312009>



Which of the following options is the closest in meaning to the word below :

#### Exhort

- A. urge
- B. condemn
- C. restrain
- D. scold

[general-aptitude](#) [verbal-aptitude](#) [gate2010-mn](#) [meaning](#)

Answer 

### 11.5.17 Meaning: GATE2010 TF: GA-1 [top](#)

▪ <https://gateoverflow.in/312020>



Which of the following options is the closest in meaning to the word below :

#### Ephemeral

- A. effeminate
- B. ghostlike
- C. soft
- D. short-lived

[general-aptitude](#) [verbal-aptitude](#) [gate2010-tf](#) [meaning](#)

Answer 

### 11.5.18 Meaning: GATE2012 AR: GA-1 [top](#)

▪ <https://gateoverflow.in/40222>



Which one of the following options is the closest in meaning to the word given below?

#### Pacify

- A. Excite
- B. Soothe
- C. Deplete
- D. Tire

[gate2012-ar](#) [verbal-aptitude](#) [meaning](#)

Answer 

### 11.5.19 Meaning: GATE2012 CY: GA-3 [top](#)

▪ <https://gateoverflow.in/40234>



Which one of the following options is the closest in meaning to the word given below?

#### Latitude

- A. Eligibility
- B. Freedom
- C. Coercion
- D. Meticulousness

[gate2012-cy](#) [verbal-aptitude](#) [meaning](#)

Answer 

### 11.5.20 Meaning: GATE2014 EC-4: GA-1 [top](#)

▪ <https://gateoverflow.in/41463>



Which of the following options is the closest in meaning to the word underlined in the sentence below?

In a democracy, everybody has the freedom to disagree with the government.

- A. Dissent

- B. Descent
- C. Decent
- D. Decadent

gate2014-ec-4 verbal-aptitude meaning normal

Answer 

#### 11.5.21 Meaning: GATE2014 EC-4: GA-2

 <https://gateoverflow.in/41464>



After the discussion, Tom said to me, 'Please revert!'. He expects me to \_\_\_\_\_.

- A. Retract
- B. Get back to him
- C. Move in reverse
- D. Retreat

gate2014-ec-4 verbal-aptitude meaning easy

Answer 

#### 11.5.22 Meaning: GATE2014 EC-4: GA-3

 <https://gateoverflow.in/41465>



While receiving the award, the scientist said, "I feel vindicated". Which of the following is closest in meaning to the word 'vindicated'?

- A. Punished
- B. Substantiated
- C. Appreciated
- D. Chastened

gate2014-ec-4 verbal-aptitude meaning normal

Answer 

#### 11.5.23 Meaning: GATE2015 CE-2: GA-2

 <https://gateoverflow.in/40177>



Choose the statement where underlined word is used correctly.

- A. The minister insured the victims that everything would be all right.
- B. He ensured that the company will not have to bear any loss.
- C. The actor got himself ensured against any accident.
- D. The teacher insured students of good results.

gate2015-ce-2 general-aptitude verbal-aptitude meaning

Answer 

#### 11.5.24 Meaning: GATE2015 CE-2: GA-3

 <https://gateoverflow.in/40178>



Which word is not a synonym for the word **vernacular**?

- A. regional
- B. indigenous
- C. indigent
- D. colloquial

gate2015-ce-2 general-aptitude verbal-aptitude meaning

Answer 

#### 11.5.25 Meaning: GATE2015 CE-2: GA-6

 <https://gateoverflow.in/40181>



The word similar in meaning to 'dreary' is

- A. cheerful

- B. dreamy
- C. hard
- D. dismal

[gate2015-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [meaning](#)

Answer 

#### 11.5.26 Meaning: GATE2015 EC-2: GA- 2 [top](#)

<https://gateoverflow.in/39503>



Choose the word most similar in meaning to the given word:  
Awkward

- A. Inept
- B. Graceful
- C. Suitable
- D. Dreadful

[gate2015](#) [gate2015-ec-2](#) [verbal-aptitude](#) [meaning](#)

Answer 

#### 11.5.27 Meaning: GATE2015 EC-3: GA- 2 [top](#)

<https://gateoverflow.in/39515>



Choose the most suitable one word substitute for the following expression:  
Connotation of a road or way

- A. Pertinacious
- B. Viaticum
- C. Clandestine
- D. Ravenous

[gate2015-ec-3](#) [gate2015](#) [meaning](#)

Answer 

#### 11.5.28 Meaning: GATE2015 ME-3: GA-3 [top](#)

<https://gateoverflow.in/40168>



Choose the statement where underlined word is used correctly.

- A. When the teacher eludes to different authors, he is being elusive.
- B. When the thief keeps eluding the police, he is being elusive.
- C. Matters that are difficult to understand, identify or remember are allusive.
- D. Mirages can be allusive, but a better way to express them is illusory.

[gate2015-me-3](#) [verbal-aptitude](#) [meaning](#)

Answer 

#### 11.5.29 Meaning: GATE2016 EC-1: GA-2 [top](#)

<https://gateoverflow.in/108064>



The policeman asked the victim of a theft, "What did you \_\_\_?"

- A. Loose
- B. Lose
- C. Loss
- D. Louse

[gate2016-ec-1](#) [verbal-aptitude](#) [meaning](#)

Answer 

#### 11.5.30 Meaning: GATE2016 EC-3: GA-2 [top](#)

<https://gateoverflow.in/110821>



The Buddha said, "Holding on to anger is like grasping a hot coal with the intent of throwing it at someone else; you are the one who gets burnt." Select the word below which is closest in meaning to the word underlined above.

- A. Burning
- B. Igniting
- C. Clutching
- D. Flinging

[gate2016-ec-3](#) [meaning](#)

Answer 

### 11.5.31 Meaning: GATE2016 ME-2: GA-3 [top](#)

<https://gateoverflow.in/108259>



Choose the statement(s) where the underlined word is used correctly:

- i. A prone is a dried plum.
  - ii. He was lying prone on the floor.
  - iii. People who eat a lot of fat are prone to heart disease.
- A. (i) and (iii) only  
 B. (iii) only  
 C. (i) and (ii) only  
 D. (ii) and (iii) only

[gate2016-me-2](#) [meaning](#) [verbal-aptitude](#)

Answer 

### 11.5.32 Meaning: GATE2017 CE-2: GA-2 [top](#)

<https://gateoverflow.in/313421>



There was no doubt that their work was through.

Which of the words below is closest in meaning to the underlined word above?

- A. pretty
- B. complete
- C. sloppy
- D. haphazard

[gate2017-ce-2](#) [meaning](#) [verbal-aptitude](#)

Answer 

### 11.5.33 Meaning: GATE2017 EC-1: GA-6 [top](#)

<https://gateoverflow.in/313526>



"If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for all reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for impartial recording of these matters".

Here, the word 'antagonistic' is closest in meaning to,

- A. Impartial
- B. Argumentative
- C. Separated
- D. Hostile

[gate2017-ec-1](#) [verbal-aptitude](#) [meaning](#)

Answer 

### 11.5.34 Meaning: GATE2017 EC-2: GA-1 [top](#)

<https://gateoverflow.in/313514>



The ninth and the tenth of this month are Monday and Tuesday\_\_\_\_\_.

- A. figuratively
- B. retrospectively
- C. respectively
- D. rightfully

gate2017-ec-2 general-aptitude verbal-aptitude meaning

Answer 

### 11.5.35 Meaning: GATE2019 CE-1: GA-8 [top](#)

<https://gateoverflow.in/313447>



"The increasing interest in tribal characters might be a mere coincidence, but the timing is of interest. None of this, though, is to say that the tribal hero has arrived in Hindi cinema, or that the new crop of characters represents the acceptance of the tribal character in the industry. The films and characters are too few to be described as a pattern."

What does the word 'arrived' mean in the paragraph above?

- A. reached a terminus
- B. came to a conclusion
- C. attained a status
- D. went to a place

gate2019-ce-1 general-aptitude verbal-aptitude passage-reading meaning

Answer 

## Answers: Meaning

### 11.5.1 Meaning: GATE CSE 2010 | Question: 57 [top](#)

<https://gateoverflow.in/2365>



✓ B Indirect

Synonyms for circuitous

adj going around, indirect

 12 votes

-- Kathleen Bankson (51.6k points)

### 11.5.2 Meaning: GATE CSE 2011 | Question: 56 [top](#)

<https://gateoverflow.in/2165>



✓ Answer is (a)

**Inexplicable** - difficult or impossible to explain

**Incomprehensible** - difficult or impossible to understand or comprehend - Most appropriate

**Indelible** - impossible to remove, erase or wash away - Not appropriate

**Inextricable** - unavoidable , inescapable - Not appropriate

**Infallible** - completely dependable or trustworthy - irrelevant

 14 votes

-- Kalpana Bhargav (2.5k points)

### 11.5.3 Meaning: GATE CSE 2012 | Question: 58 [top](#)

<https://gateoverflow.in/2197>



✓ Mitigate means to reduce, to lessen etc. So, only "diminish" is close in meaning.

Correct Option: A

 6 votes

-- avadh (573 points)

### 11.5.4 Meaning: GATE CSE 2013 | Question: 56 [top](#)

<https://gateoverflow.in/1559>



✓ B, the lowest point

 10 votes

-- Kathleen Bankson (51.6k points)

### 11.5.5 Meaning: GATE CSE 2014 Set 1 | Question: GA-1 [top](#)

<https://gateoverflow.in/56>



✓ Answer is (B) Adapt to. Often seen in newspaper "Indian players could not adapt to foreign conditions".

Adopt - means legally take care of. Also means to take up and use as in "He adopted my point of view."

Adept in - means smart in. Example- "Sachin is adept in batting."

 17 votes

-- Arjun Suresh (328k points)

**11.5.6 Meaning: GATE CSE 2014 Set 1 | Question: GA-3**<https://gateoverflow.in/772>

- ✓ C. The buck stops here is a term meaning to put an end to something, not continue, stop it.

([idiomatic](#)) A statement that no [excuses](#) will be made, that the speaker is going to take [direct responsibility](#) for matters, rather than pass the responsibility to higher authorities.

**References**

19 votes

-- Kathleen Bankson (51.6k points)

**11.5.7 Meaning: GATE CSE 2014 Set 2 | Question: GA-3**<https://gateoverflow.in/1940>

- **eradicate** - destroy completely - The health department eradicated swine flu within a month.
- **distort** - give a misleading account - The policeman distorted the facts after taking bribe.
- **saturate** - cause something to become so soaked in water so that no more water can be absorbed - The saturation point of any oil decreases with temperature.
- **utilize** - make use of - He utilized the available resources and topped the exam.

So, correct option is A.

5 votes

-- Arjun Suresh (328k points)

**11.5.8 Meaning: GATE CSE 2015 Set 1 | Question: GA-2**<https://gateoverflow.in/8003>

- ✓ She enjoyed herself immensely at the party

means, she had a good time at the party.

- A. She had a terrible time at the party - means her time was bad at the party.
- B. She had a horrible time at the party - same as above; her time was bad at the party.
- C. She had a terrific time at the party - means she had a good time at the party.
- D. She had a terrifying time at the party - means she had a frightening (not good) time at the party.

So, correct option: C.

2 votes

-- Arjun Suresh (328k points)

**11.5.9 Meaning: GATE CSE 2015 Set 1 | Question: GA-7**<https://gateoverflow.in/8011>

- ✓ "take to heels" means "[to run away](#)" or "[to flee](#)" or "[भाग जाना](#)" which also have the same meaning as "take flight".

<https://idioms.thefreedictionary.com/take+to+heels>

Correct Option: C.

**References**

8 votes

-- ankitgupta.1729 (14.9k points)

**11.5.10 Meaning: GATE CSE 2015 Set 2 | Question: GA-2**<https://gateoverflow.in/8029>

- ✓ Answer: C

**Personnel:** People employed in an organization or engaged in an organized undertaking such as military service.

**Option A,B,D should use the word personal.**

9 votes

-- Rajarshi Sarkar (27.8k points)

**11.5.11 Meaning: GATE CSE 2016 Set 1 | Question: GA02** [top](#)<https://gateoverflow.in/39607>

- ✓ Answer is (A)paraphrase-express something (written or spoken) in a different way.

paradox: a statement that apparently contradicts itself and yet might be true

paradigm: a typical example or pattern of something

paraffin: a white or colorless, tasteless, odorless, water-insoluble, solid substance not easily acted upon by reagents

21 votes

-- Pooja Palod (24k points)

**11.5.12 Meaning: GATE CSE 2016 Set 2 | Question: GA-02** [top](#)<https://gateoverflow.in/39531>

- ✓ Answer is (A)

The closest meaning to cope with is put up with which means to tolerate. Cope with does not mean to place someone into competition with someone else.

12 votes

-- UK (1.2k points)

**11.5.13 Meaning: GATE CSE 2016 Set 2 | Question: GA-03** [top](#)<https://gateoverflow.in/39530>

- ✓ Ans C , praise. Rest all have same meaning.

11 votes

-- UK (1.2k points)

**11.5.14 Meaning: GATE CSE 2017 Set 2 | Question: GA-1** [top](#)<https://gateoverflow.in/118415>

- ✓ Yield means to give in and resistance means to not give in.  
Rest are all synonyms.

Hence, (D) is correct.

10 votes

-- Kloseup (477 points)

**11.5.15 Meaning: GATE CSE 2020 | Question: GA-2** [top](#)<https://gateoverflow.in/333239>

- ✓ A. Extremely poor

Conjunctions like although, however, but, though, in spite of, despite etc. create contrast between two parts of a sentence.

Here, the person has an excellent knowledge of subject but his performance was extremely poor.

positive

negative

4 votes

-- Ram Swaroop1 (4.6k points)

**11.5.16 Meaning: GATE2010 MN: GA-1** [top](#)<https://gateoverflow.in/312009>

- ✓ Exhort: to **strongly encourage** or **try to persuade** someone to do something

Similar words are **urging** or **persuading**

Option A should be the answer

#### References



3 votes

-- Akash Dinkar (27.9k points)

**11.5.17 Meaning: GATE2010 TF: GA-1** [top](#)<https://gateoverflow.in/312020>

- ✓ **Ephemeral** :- lasting for a very short time.

So **short – lived** is the most appropriate choice.

∴ Option D. **short – lived** is the correct answer.

2 votes

-- Satbir Singh (20.9k points)

**11.5.18 Meaning: GATE2012 AR: GA-1** top ↴<https://gateoverflow.in/40222>

- ✓ Answer is [B].

Pacify means to calm down.

A] Excite : to arouse

B] soothe : to calm down, to slow down

C] deplete : to evacuate.

D] tire : to annoy.

5 votes

-- Desert\_Warrior (6k points)

**11.5.19 Meaning: GATE2012 CY: GA-3** top ↴<https://gateoverflow.in/40234>

- ✓ **Latitude** means scope for freedom of action or thought.

Option B.

4 votes

-- Monanshi Jain (7k points)

**11.5.20 Meaning: GATE2014 EC-4: GA-1** top ↴<https://gateoverflow.in/41463>

- ✓ Ans will be (A) Dissent, which means disagree

- descent - going down
- decent - conforming to acceptable standard
- decadent - corrupt

5 votes

-- srestha (85k points)

**11.5.21 Meaning: GATE2014 EC-4: GA-2** top ↴<https://gateoverflow.in/41464>

- ✓ Revert means to get back..

Answer B) Get back to him

7 votes

-- Abhilash Panicker (7.6k points)

**11.5.22 Meaning: GATE2014 EC-4: GA-3** top ↴<https://gateoverflow.in/41465>

- ✓ **option B**

Vindicated means to free from allegation(unproved) and substantiate means prove the truth of.

6 votes

-- Prateek Banra (149 points)

**11.5.23 Meaning: GATE2015 CE-2: GA-2** top ↴<https://gateoverflow.in/40177>

- ✓ Ans **B**)

ensured: , make something certain in future

insured: , covered by some policy/ insurance

For everything other than B, the words have to be interchanged :)

3 votes

-- Ganesh K (329 points)

**11.5.24 Meaning: GATE2015 CE-2: GA-3** top ↴<https://gateoverflow.in/40178>

- ✓ **vernacular** means the language spoken by the ordinary people of a country or region

Option C is indigent which means poor or needy. For example, we do charity for indigent person. So, it is not a synonym for the word vernacular.

Option A also relates in some sense because it means relating to a region and same for colloquial means language used informally in a particular region and same thing for B also.

CORRECT ANSWER IS C.

3 votes

-- rajan (4.4k points)

**11.5.25 Meaning: GATE2015 CE-2: GA-6** top ↗[↗ https://gateoverflow.in/40181](https://gateoverflow.in/40181)

- ✓ **Dreary** means depressingly dull and bleak or repetitive or gloomy or upset.

Option A is wrong because cheerful means happy and options B and C are not related to depression or upset.

Option D which is dismal means mood of gloom or depression.

Correct Answer: D.

5 votes

-- rajan (4.4k points)

**11.5.26 Meaning: GATE2015 EC-2: GA- 2** top ↗[↗ https://gateoverflow.in/39503](https://gateoverflow.in/39503)

- ✓ Correct Option: A Inept

Awkward means unsuitable and is a synonym for inept.

Dreadful is not suitable here as it means horrible and is more negative than "awkward".

Graceful and suitable are positive words and hence not applicable.

Ref: <https://thesaurus.plus/related/awkward/inept>.

**References**

2 votes

-- Arjun Suresh (328k points)

**11.5.27 Meaning: GATE2015 EC-3: GA- 2** top ↗[↗ https://gateoverflow.in/39515](https://gateoverflow.in/39515)

- Denotation : defined meaning
- Connotation: feelings associated or inner meaning

1. Pertinacious -- persistent

2. **Viaticum -- travel allowance for a journey**

Word origin of 'viaticum': from Latin, from *viāticus* belonging to a journey, from *viāre* to travel, from *via* way

3. Clandestine -- kept secret

4. Ravenous -- extremely hungry

Option B is the answer.

Ref: <https://examples.yourdictionary.com/examples-of-connotative-words.html>

**References**

2 votes

-- Arjun Suresh (328k points)

**11.5.28 Meaning: GATE2015 ME-3: GA-3** top ↗[↗ https://gateoverflow.in/40168](https://gateoverflow.in/40168)

- ✓ Ans : [B] When the thief keeps eluding the police, he is being **elusive**.

elusive - Difficult to find, catch or achieve.

allusive - Using or containing suggestion rather than explicit mention.

The correct alternatives for the incorrect answers are :

- A. When the teacher **alludes** to different authors, he is being **allusive**.
- C. Matters that are difficult to understand, identify or remember are **elusive**.
- D. Mirages can be **elusive**, but a better way to express them is illusory.

10 votes

-- Sharath George M (141 points)

**11.5.29 Meaning: GATE2016 EC-1: GA-2** top ↗[↗ https://gateoverflow.in/108064](https://gateoverflow.in/108064)



1. Loose means not firmly or tightly hold .
2. Lose means something lost in past .
3. Loss is present form of lose.
4. Louse means spoil or ruin something.

so going through the meaning of this sentence only option B is correct , Lose .

8 votes

-- Bikram (58.3k points)

#### 11.5.30 Meaning: GATE2016 EC-3: GA-2 top ↴

☞ <https://gateoverflow.in/110821>



- ✓ Clutching is synonym to grasping.

Fling means to throw which is not meaning grasp. Burning and igniting are also different from "grasping".

Correct Option: C

2 votes

-- Arjun Suresh (328k points)

#### 11.5.31 Meaning: GATE2016 ME-2: GA-3 top ↴

☞ <https://gateoverflow.in/108259>



- ✓ prone means :

1. likely or liable to suffer from, which is option (iii)
2. lying flat, especially face downwards. which is option (ii)

And a *prune* is a dried plum of any cultivar. Prune means a plum preserved by drying and having a black, wrinkled appearance .So statement (i) is wrong.

Hence correct answer is option D.

2 votes

-- Bikram (58.3k points)

#### 11.5.32 Meaning: GATE2017 CE-2: GA-2 top ↴

☞ <https://gateoverflow.in/313421>



- ✓ The sentence shows the work is completed without a doubt.

- 'sloppy' means 'in a careless and unsystematic manner'
- the word 'haphazard' is used when something is done in unorganised or in random order.

so, these words can't replace 'through', here.

the word 'pretty' doesn't fit in this sentence.

so, Option "B." **Complete** is the correct choice.

3 votes

-- Naveen Kumar (9.9k points)

#### 11.5.33 Meaning: GATE2017 EC-1: GA-6 top ↴

☞ <https://gateoverflow.in/313526>



cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections

This shows that the two parts are **hostile** towards each other and is also the meaning of "antagonistic".

Correct Option: D.

1 votes

-- Arjun Suresh (328k points)

#### 11.5.34 Meaning: GATE2017 EC-2: GA-1 top ↴

☞ <https://gateoverflow.in/313514>



- ✓ Correct Answer: **C.** respectively

- 'respectively' is used when two or more items are used in a sentence, order-wise.
- 'retrospectively', generally, is a look back at events that took place.

- 'figuratively' is used to indicate a departure from a literal use of words, metaphorically.
- 'rightfully' is used in accordance with a legitimate right or claim to anything

2 votes

-- Naveen Kumar (9.9k points)

### 11.5.35 Meaning: GATE2019 CE-1: GA-8 [top](#)

<https://gateoverflow.in/313447>



- ✓ "None of this, though, is to say that the tribal hero has **arrived** in Hindi cinema"  
 "attained a status" is the best meaning for "arrived" here.  
 Correct option: C.

1 votes

-- Arjun Suresh (328k points)

## 11.6

### Most Appropriate Alternative (4) [top](#)

#### 11.6.1 Most Appropriate Alternative: GATE CSE 2012 | Question: 57 [top](#)

<https://gateoverflow.in/2195>



Choose the most appropriate alternative from the options given below to complete the following sentence:

**Despite several \_\_\_\_\_ the mission succeeded in its attempt to resolve the conflict.**

- attempts
- setbacks
- meetings
- delegations

[gate2012-cse](#) [verbal-aptitude](#) [easy](#) [most-appropriate-alternative](#)

Answer

#### 11.6.2 Most Appropriate Alternative: GATE2012 AE: GA-2 [top](#)

<https://gateoverflow.in/40213>



Choose the most appropriate alternative from the options given below to complete the following sentence:

**Food prices \_\_\_\_ again this month.**

- have raised
- have been raising
- have been rising
- have arose

[gate2012-ae](#) [verbal-aptitude](#) [most-appropriate-alternative](#)

Answer

#### 11.6.3 Most Appropriate Alternative: GATE2012 CY: GA-5 [top](#)

<https://gateoverflow.in/40236>



Choose the most appropriate alternative from the options given below to complete the following sentence:

**If the tired soldier wanted to lie down, he \_\_\_\_ the mattress out on the balcony.**

- should take
- shall take
- should have taken
- will have taken

[gate2012-cy](#) [most-appropriate-alternative](#) [english-grammar](#) [verbal-aptitude](#)

Answer

#### 11.6.4 Most Appropriate Alternative: GATE2015 EC-1: GA-3 [top](#)

<https://gateoverflow.in/39491>



Choose the word most similar in meaning to the given word:

Educe

- A. Exert
- B. Educate
- C. Extract
- D. Extend

[gate2015-ec-1](#) [meaning](#) [most-appropriate-alternative](#)

Answer 

### Answers: Most Appropriate Alternative

#### 11.6.1 Most Appropriate Alternative: GATE CSE 2012 | Question: 57 [top](#)

<https://gateoverflow.in/2195>



- ✓ Answer is (B) SETBACK: something that happens that delays or prevents a process from developing:

Ex: Sally had been recovering well from her operation, but yesterday she experienced/suffered a setback.

Ex: There has been a temporary/slight setback in our plans .

 6 votes

-- avadh (573 points)

#### 11.6.2 Most Appropriate Alternative: GATE2012 AE: GA-2 [top](#)

<https://gateoverflow.in/40213>



- ✓ Food price **have been rising** again this month.  
Answer C.

- A) wrong - have risen
- B) wrong
- D) wrong - have risen

 2 votes

-- Abhilash Panicker (7.6k points)

#### 11.6.3 Most Appropriate Alternative: GATE2012 CY: GA-5 [top](#)

<https://gateoverflow.in/40236>



- ✓ **Answer C:** If the tired soldier wanted to lie down, he should have taken the mattress out on the balcony.

 11 votes

-- Kathleen Bankson (51.6k points)

#### 11.6.4 Most Appropriate Alternative: GATE2015 EC-1: GA-3 [top](#)

<https://gateoverflow.in/39491>



- ✓ **Answer is C**

**Educe:** verb (used with object), educed, educating.

1. to draw forth or bring out, as something potential or latent; elicit; develop.
2. to infer or deduce.

<http://www.dictionary.com/browse/educre>

Most appropriate to this is **extract** like we extract the meaning of something (infer)

#### References



 3 votes

-- ஜானிட் (1.3k points)

### 11.7

### Most Appropriate Word (83) [top](#)

#### 11.7.1 Most Appropriate Word: GATE CSE 2010 | Question: 56 [top](#)

<https://gateoverflow.in/2364>



Choose the most appropriate word from the options given below to complete the following sentence:

**His rather casual remarks on politics \_\_\_\_\_ his lack of seriousness about the subject.**

- A. masked
- B. belied
- C. betrayed
- D. suppressed

gate2010-cse verbal-aptitude most-appropriate-word normal

Answer 

### 11.7.2 Most Appropriate Word: GATE CSE 2010 | Question: 58 top ↗

<https://gateoverflow.in/2366>



Choose the most appropriate word from the options given below to complete the following sentence:

**If we manage to \_\_\_\_\_ our natural resources, we would leave a better planet for our children.**

- A. uphold
- B. restrain
- C. cherish
- D. conserve

gate2010-cse verbal-aptitude most-appropriate-word easy

Answer 

### 11.7.3 Most Appropriate Word: GATE CSE 2011 | Question: 58 top ↗

<https://gateoverflow.in/2167>



Choose the most appropriate word(s) from the options given below to complete the following sentence.

**I contemplated \_\_\_\_\_ Singapore for my vacation but decided against it.**

- A. to visit
- B. having to visit
- C. visiting
- D. for a visit

gate2011-cse verbal-aptitude most-appropriate-word easy

Answer 

### 11.7.4 Most Appropriate Word: GATE CSE 2011 | Question: 59 top ↗

<https://gateoverflow.in/2169>



Choose the most appropriate word from the options given below to complete the following sentence.

**If you are trying to make a strong impression on your audience, you cannot do so by being understated, tentative or \_\_\_\_\_.**

- A. hyperbolic
- B. restrained
- C. argumentative
- D. indifferent

gate2011-cse verbal-aptitude most-appropriate-word normal

Answer 

### 11.7.5 Most Appropriate Word: GATE CSE 2012 | Question: 60 top ↗

<https://gateoverflow.in/2200>



Choose the most appropriate alternative from the options given below to complete the following sentence:

**Suresh's dog is the one \_\_\_\_\_ was hurt in the stampede.**

- A. that
- B. which
- C. who
- D. whom

gate2012-cse verbal-aptitude most-appropriate-word normal

Answer 

### 11.7.6 Most Appropriate Word: GATE CSE 2014 Set 1 | Question: GA-2 top ↗

<https://gateoverflow.in/771>



Choose the most appropriate word from the options given below to complete the following sentence.

He could not understand the judges awarding her the first prize, because he thought that her performance was quite \_\_\_\_\_.

- A. superb
- B. medium
- C. mediocre
- D. exhilarating

[gate2014-cse-set1](#) [verbal-aptitude](#) [most-appropriate-word](#) [easy](#)

Answer 

#### 11.7.7 Most Appropriate Word: GATE CSE 2014 Set 2 | Question: GA-1 [top](#)

<https://gateoverflow.in/1938>



Choose the most appropriate phrase from the options given below to complete the following sentence.

India is a post-colonial country because

- A. it was a former British colony
- B. Indian Information Technology professionals have colonized the world
- C. India does not follow any colonial practices
- D. India has helped other countries gain freedom

[gate2014-cse-set2](#) [verbal-aptitude](#) [most-appropriate-word](#) [easy](#)

Answer 

#### 11.7.8 Most Appropriate Word: GATE CSE 2015 Set 2 | Question: GA-4 [top](#)

<https://gateoverflow.in/8032>



A generic term that includes various items of clothing such as a skirt, a pair of trousers and a shirt is

- A. fabric
- B. textile
- C. fiber
- D. apparel

[gate2015-cse-set2](#) [verbal-aptitude](#) [easy](#) [most-appropriate-word](#)

Answer 

#### 11.7.9 Most Appropriate Word: GATE CSE 2015 Set 3 | Question: GA-3 [top](#)

<https://gateoverflow.in/8301>



Extreme focus on syllabus and studying for tests has become such a dominant concern of Indian student that they close their minds to anything \_\_\_\_\_ to the requirements of the exam.

- A. related
- B. extraneous
- C. outside
- D. useful

[gate2015-cse-set3](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)

Answer 

#### 11.7.10 Most Appropriate Word: GATE CSE 2018 | Question: GA-1 [top](#)

<https://gateoverflow.in/204062>



"From where are they bringing their books? \_\_\_\_\_ bringing \_\_\_\_\_ books from \_\_\_\_\_"

The words that best fill the blanks in the above sentence are

- A. Their, they're, there
- B. They're, their, there
- C. There, their, they're
- D. They're, there,there

[gate2018-cse](#) [verbal-aptitude](#) [most-appropriate-word](#) [easy](#)

Answer 

**11.7.11 Most Appropriate Word: GATE CSE 2018 | Question: GA-2** [top](#)[www.gateoverflow.in/204063](https://gateoverflow.in/204063)

A \_\_\_\_\_ investigation can sometimes yield new facts, but typically organized ones are more successful.

The word that best fills the blank in the above sentence is

- A. meandering
- B. timely
- C. consistent
- D. systematic

[gate2018-cse](#) [verbal-aptitude](#) [most-appropriate-word](#) [normal](#)

Answer 

**11.7.12 Most Appropriate Word: GATE CSE 2019 | Question: GA-1** [top](#)[www.gateoverflow.in/302872](https://gateoverflow.in/302872)

The expenditure on the project \_\_\_\_\_ as follows: equipment Rs. 20 lakhs, salaries Rs.12 lakhs, and contingency Rs.3 lakhs.

- A. break down
- B. break
- C. breaks down
- D. breaks

[gate2019-cse](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.13 Most Appropriate Word: GATE CSE 2019 | Question: GA-5** [top](#)[www.gateoverflow.in/302868](https://gateoverflow.in/302868)

A court is to a judge as \_\_\_\_\_ is to a teacher

- A. a student
- B. a punishment
- C. a syllabus
- D. a school

[gate2019-cse](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.14 Most Appropriate Word: GATE Chemical 2020 | GA Question: 1** [top](#)[www.gateoverflow.in/359826](https://gateoverflow.in/359826)

Rajiv Gandhi Khel Ratna Award was conferred \_\_\_\_\_ Mary Kom, a six-time world champion in boxing, recently in a ceremony \_\_\_\_\_ the Rashtrapati Bhawan (the President's official residence) in New Delhi.

- A. with, at
- B. on, in
- C. on, at
- D. to, at

[gate2020-ch](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.15 Most Appropriate Word: GATE Chemical 2020 | GA Question: 2** [top](#)[www.gateoverflow.in/359824](https://gateoverflow.in/359824)

Despite a string of poor performances, the chances of *K. L. Rahul*'s selection in the team are \_\_\_\_\_

- A. slim
- B. bright
- C. obvious
- D. uncertain

[gate2020-ch](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.16 Most Appropriate Word: GATE Civil 2020 Set 1 | GA Question: 1** top ↴<https://gateoverflow.in/359868>

It is a common criticism that most of the academicians live in their \_\_\_\_\_, so, they are not aware of their real life challenges.

- A. homes
- B. ivory towers
- C. glass palaces
- D. big flats

[gate2020-ce-1](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer

**11.7.17 Most Appropriate Word: GATE Civil 2020 Set 1 | GA Question: 2** top ↴<https://gateoverflow.in/359866>

His hunger for reading is insatiable. He reads indiscriminately. He is most certainly a/an \_\_\_\_\_ reader.

- A. all-round
- B. precocious
- C. voracious
- D. wise

[gate2020-ce-1](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer

**11.7.18 Most Appropriate Word: GATE Civil 2020 Set 2 | GA Question: 2** top ↴<https://gateoverflow.in/359844>

Select the most appropriate word that can replace the underlined word without changing the meaning of the sentence:

Now-a-days, most children have a tendency to bewilder the legitimate concerns of their parents.

- A. disparage
- B. applaud
- C. reduce
- D. begrudge

[gate2020-ce-2](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer

**11.7.19 Most Appropriate Word: GATE ECE 2020 | GA Question: 1** top ↴<https://gateoverflow.in/359783>

The untimely loss of life is a cause of serious global concern as thousands of people get killed \_\_\_\_\_ accidents every year while many other die \_\_\_\_\_ diseases like cardio vascular disease, cancer, etc.

- A. in, of
- B. from, of
- C. during, from
- D. from, from

[gate2020-ec](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer

**11.7.20 Most Appropriate Word: GATE Electrical 2020 | GA Question: 2** top ↴<https://gateoverflow.in/359730>

People were prohibited \_\_\_\_\_ their vehicles near the entrance of the main administrative building.

- A. to park
- B. from parking
- C. parking
- D. to have parked

[gate2020-ee](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer

**11.7.21 Most Appropriate Word: GATE Electrical 2020 | GA Question: 4** top ↗<https://gateoverflow.in/359726>

Stock markets \_\_\_\_\_ at the news of the coup.

- A. poised
- B. plunged
- C. plugged
- D. probed

[gate2020-ee](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.22 Most Appropriate Word: GATE Mechanical 2020 Set 1 | GA Question: 1** top ↗<https://gateoverflow.in/359536>

He is known for his unscrupulous ways. He always sheds \_\_\_\_\_ tears to deceive people.

- A. fox's
- B. crocodile's
- C. crocodile
- D. fox

[gateme-2020-set1](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.23 Most Appropriate Word: GATE2010 MN: GA-3** top ↗<https://gateoverflow.in/312011>

Choose the most appropriate word from the options given below to complete the following sentence :

The committee wrote a \_\_\_\_\_ report, extolling only the strengths of the proposal .

- A. reasonable
- B. supportive
- C. biased
- D. fragmented

[general-aptitude](#) [verbal-aptitude](#) [gate2010-mn](#) [most-appropriate-word](#)

Answer 

**11.7.24 Most Appropriate Word: GATE2010 MN: GA-4** top ↗<https://gateoverflow.in/312012>

Choose the most appropriate word from the options given below to complete the following sentence :

If the country has to achieve real prosperity, it is \_\_\_\_\_ that the fruits of progress reach all, and in equal measure .

- A. inevitable
- B. contingent
- C. oblivious
- D. imperative

[general-aptitude](#) [verbal-aptitude](#) [gate2010-mn](#) [most-appropriate-word](#)

Answer 

**11.7.25 Most Appropriate Word: GATE2010 TF: GA-3** top ↗<https://gateoverflow.in/312022>

Choose the most appropriate word from the options given below to complete the following sentence:

The two child norm with \_\_\_\_\_ for the violators will have significant implications for our demographic profile .

- A. disincentives
- B. incitements
- C. restrictions
- D. restraints

[general-aptitude](#) [verbal-aptitude](#) [gate2010-tf](#) [most-appropriate-word](#)

**Answer****11.7.26 Most Appropriate Word: GATE2010 TF: GA-4**<https://gateoverflow.in/312023>

Choose the most appropriate word from the options given below to complete the following sentence :

There is no fixed relation between food and famine ; famines can occur with or without a substantial \_\_\_\_\_ in food output.

- A. aberration
- B. weakening
- C. decline
- D. deterioration

[general-aptitude](#) [verbal-aptitude](#) [gate2010-tf](#) [most-appropriate-word](#)
**Answer****11.7.27 Most Appropriate Word: GATE2011 AG: GA-1**<https://gateoverflow.in/312112>

Choose the most appropriate word from the options given below to complete the following sentence:

Under ethical guidelines recently adopted by the India Medical Association, human genes are to be manipulated only to correct diseases for which \_\_\_\_\_ treatments are unsatisfactory.

- A. similar
- B. most
- C. uncommon
- D. available

[general-aptitude](#) [verbal-aptitude](#) [gate2011-ag](#) [most-appropriate-word](#)
**Answer****11.7.28 Most Appropriate Word: GATE2011 AG: GA-3**<https://gateoverflow.in/312114>

Choose the most appropriate word from the options given below to complete the following sentence:

**It was her view that the country's problem had been \_\_\_\_\_ by foreign technocrats, so that to invite them to come back would be counter-productive.**

- A. identified
- B. ascertained
- C. exacerbated
- D. analysed

[general-aptitude](#) [verbal-aptitude](#) [gate2011-ag](#) [most-appropriate-word](#)
**Answer****11.7.29 Most Appropriate Word: GATE2011 GG: GA-1**<https://gateoverflow.in/40202>

Choose the most appropriate word or phrase from the options given below to complete the following sentence.

**The environmentalists hope \_\_\_\_\_ the lake to its pristine condition.**

- A. in restoring
- B. in the restoration of
- C. to restore
- D. restoring

[gate2011-gg](#) [verbal-aptitude](#) [most-appropriate-word](#)
**Answer**

**11.7.30 Most Appropriate Word: GATE2011 GG: GA-3** top ↗<https://gateoverflow.in/40204>

Choose the most appropriate word from the options given below to complete the following sentence.

**Despite the mixture's \_\_\_\_\_ nature, we found that by lowering its temperature in the laboratory we could dramatically reduce its tendency to vaporize.**

- A. acerbic
- B. resilient
- C. volatile
- D. heterogeneous

[gate2011-gg](#) [verbal-aptitude](#) [most-appropriate-word](#) [normal](#)

Answer 

**11.7.31 Most Appropriate Word: GATE2011 GG: GA-5** top ↗<https://gateoverflow.in/40206>

Choose the most appropriate words from the options given below to complete the following sentence.

**Because she had a reputation for \_\_\_\_\_ we were surprised and pleased when she greeted us so \_\_\_\_\_.**

- A. insolence ..... irately
- B. insouciance ..... curtly
- C. graciousness ..... amiably
- D. querulousness ..... affably

[gate2011-gg](#) [most-appropriate-word](#) [verbal-aptitude](#)

Answer 

**11.7.32 Most Appropriate Word: GATE2011 MN: GA-57** top ↗<https://gateoverflow.in/31522>

Choose the most appropriate word(s) from the options given below to complete the following sentence.

**We lost confidence in him because he never \_\_\_\_\_ the grandiose promises he had made.**

- A. delivered
- B. delivered on
- C. forgot
- D. reneged on

[gate2011-mn](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.33 Most Appropriate Word: GATE2011 MN: GA-58** top ↗<https://gateoverflow.in/31529>

Choose the word or phrase that best completes the sentence below.

\_\_\_\_\_ in the frozen wastes of Arctic takes special equipment.

- A. To survive
- B. Surviving
- C. Survival
- D. That survival

[verbal-aptitude](#) [gate2011-mn](#) [most-appropriate-word](#)

Answer 

**11.7.34 Most Appropriate Word: GATE2011 MN: GA-60** top ↗<https://gateoverflow.in/31533>

Choose the most appropriate word from the options given below to complete the following sentence.

The \_\_\_\_\_ of evidence was on the side of the plaintiff since all but one witness testified that his story was correct.

- A. paucity
- B. propensity
- C. preponderance
- D. accuracy

[verbal-aptitude](#) [gate2011-mm](#) [most-appropriate-word](#)

Answer 

### 11.7.35 Most Appropriate Word: GATE2012 AE: GA-3 top ↗

► <https://gateoverflow.in/40214>



Choose the most appropriate alternative from the options given below to complete the following sentence:

**The administrators went on to implement yet another unreasonable measure, arguing that the measures were already \_\_\_ and one more would hardly make a difference.**

- A. reflective
- B. utopian
- C. luxuriant
- D. unpopular

[gate2012-ae](#) [most-appropriate-word](#) [verbal-aptitude](#)

Answer 

### 11.7.36 Most Appropriate Word: GATE2012 AE: GA-4 top ↗

► <https://gateoverflow.in/40215>



Choose the most appropriate alternative from the options given below to complete the following sentence:

**To those of us who had always thought him timid, his \_\_\_ came as a surprise.**

- A. intrepidity
- B. inevitability
- C. inability
- D. inertness

[gate2012-ae](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

### 11.7.37 Most Appropriate Word: GATE2012 AR: GA-2 top ↗

► <https://gateoverflow.in/40223>



Choose the most appropriate pair of words from the options given below to complete the following sentence:

The high level of \_\_\_ of the questions in the test was \_\_\_ by an increase in the period of time allotted for answering them.

- A. difficulty, compensated
- B. exactitude, magnified
- C. aptitude, decreased
- D. attitude, mitigated

[gate2012-ar](#) [most-appropriate-word](#) [verbal-aptitude](#) [normal](#)

Answer 

### 11.7.38 Most Appropriate Word: GATE2012 CY: GA-4 top ↗

► <https://gateoverflow.in/40235>



Choose the most appropriate word from the options given below to complete the following sentence:

**Given the seriousness of the situation that he had to face, his \_\_\_ was impressive .**

- A. beggary
- B. nomenclature
- C. jealousy
- D. nonchalance

[gate2012-cy](#) [most-appropriate-word](#)

Answer 

**11.7.39 Most Appropriate Word: GATE2013 CE: GA-4** top ↗<https://gateoverflow.in/40271>

Friendship, no matter how \_\_\_\_\_ it is, has its limitations.

- A. cordial
- B. intimate
- C. secret
- D. pleasant

[gate2013-ce](#) [most-appropriate-word](#) [verbal-aptitude](#)

Answer 

**11.7.40 Most Appropriate Word: GATE2013 EE: GA-3** top ↗<https://gateoverflow.in/40290>

Complete the sentence:

Dare \_\_\_\_\_ mistakes.

- A. commit
- B. to commit
- C. committed
- D. committing

[gate2013-ee](#) [most-appropriate-word](#) [easy](#) [verbal-aptitude](#)

Answer 

**11.7.41 Most Appropriate Word: GATE2014 AE: GA-2** top ↗<https://gateoverflow.in/40301>

Choose the most appropriate word from the options given below to complete the following sentence.

One of his biggest \_\_\_\_\_ was his ability to forgive.

- A. vice
- B. virtues
- C. choices
- D. strength

[gate2014-ae](#) [most-appropriate-word](#)

Answer 

**11.7.42 Most Appropriate Word: GATE2014 AG: GA-1** top ↗<https://gateoverflow.in/41660>

Choose the most appropriate word from the options given below to complete the following sentence. A person suffering from Alzheimer's disease \_\_\_\_\_ short-term memory loss.

- A. Experienced
- B. Has experienced
- C. Is experiencing
- D. Experiences

[gate2014-ag](#) [verbal-aptitude](#) [most-appropriate-word](#) [normal](#)

Answer 

**11.7.43 Most Appropriate Word: GATE2014 AG: GA-2** top ↗<https://gateoverflow.in/41665>

Choose the most appropriate word from the options given below to complete the following sentence. \_\_\_\_\_ is the key to their happiness; they are satisfied with what they have.

- A. Contentment
- B. Ambition
- C. Perseverance
- D. Hunger

gate2014-ag verbal-aptitude most-appropriate-word easy

Answer 

#### 11.7.44 Most Appropriate Word: GATE2014 EC-1: GA-3 [top](#)

<https://gateoverflow.in/41492>



Choose the most appropriate word from the options given below to complete the following sentence.

Many ancient cultures attributed disease to supernatural causes. However, modern science has largely helped \_\_\_\_\_ such notions.

- A. Impel
- B. Dispel
- C. Propel
- D. Repel

gate2014-ec-1 most-appropriate-word verbal-aptitude

Answer 

#### 11.7.45 Most Appropriate Word: GATE2014 EC-2: GA-1 [top](#)

<https://gateoverflow.in/41507>



Choose the most appropriate word from the options given below to complete the following sentence.

Communication and interpersonal skills are \_\_\_\_\_ important in their own ways.

- A. Each
- B. Both
- C. All
- D. Either

gate2014-ec-2 verbal-aptitude most-appropriate-word easy

Answer 

#### 11.7.46 Most Appropriate Word: GATE2014 EC-2: GA-3 [top](#)

<https://gateoverflow.in/41510>



Choose the most appropriate pair of words from the options given below to complete the following sentence.

She could not \_\_\_\_\_ the thought of \_\_\_\_\_ the election to her bitter rival.

- A. Bear, loosing
- B. Bare, loosing
- C. Bear, losing
- D. Bare, losing

gate2014-ec-2 most-appropriate-word

Answer 

#### 11.7.47 Most Appropriate Word: GATE2014 EC-3: GA-2 [top](#)

<https://gateoverflow.in/41141>



The value of one U.S. dollar is 65 Indian Rupees today, compared to 60 last year. The Indian Rupee has \_\_\_\_\_.

- A. Depressed
- B. Depreciated
- C. Appreciated
- D. Stabilized

gate2014-ec-3 most-appropriate-word verbal-aptitude

Answer 

#### 11.7.48 Most Appropriate Word: GATE2015 CE-2: GA-1 [top](#)

<https://gateoverflow.in/40176>



Choose the most appropriate word from the options given below to complete the following sentence.

The official answered \_\_\_\_\_ that the complaints of the citizen would be looked into.

- A. respectably

- B. respectfully
- C. reputably
- D. respectively

[gate2015-ce-2](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.49 Most Appropriate Word: GATE2015 EC-1: GA-1 [top](#)

<https://gateoverflow.in/39489>



Choose the most appropriate word from the options given below to complete the following sentence.

The principal presented the chief guest with a \_\_\_\_\_, as token of appreciation.

- A. momento
- B. memento
- C. momentum
- D. moment

[gate2015-ec-1](#) [most-appropriate-word](#)

Answer 

#### 11.7.50 Most Appropriate Word: GATE2015 EC-1: GA-2 [top](#)

<https://gateoverflow.in/39490>



Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence:

Frogs \_\_\_\_\_.

- A. croak
- B. roar
- C. hiss
- D. patter

[gate2015-ec-1](#) [most-appropriate-word](#)

Answer 

#### 11.7.51 Most Appropriate Word: GATE2015 EC-2: GA- 1 [top](#)

<https://gateoverflow.in/38935>



Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence:

Dhoni, as well as the other team members of Indian team, \_\_\_\_\_ present on the occasion.

- A. were
- B. was
- C. has
- D. have

[gate2015-ec-2](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.52 Most Appropriate Word: GATE2015 EC-3: GA-3 [top](#)

<https://gateoverflow.in/39516>



Choose the correct verb to fill in the blank below:

Let us \_\_\_\_\_.

- A. introvert
- B. alternate
- C. atheist
- D. altruist

[gate2015-ec-3](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.53 Most Appropriate Word: GATE2015 ME-3: GA-1** top ↗<https://gateoverflow.in/40166>

Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence:  
Apparent lifelessness \_\_\_\_\_ dormant life.

- A. harbours
- B. leads to
- C. supports
- D. affects

[gate2015-me-3](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.54 Most Appropriate Word: GATE2015 ME-3: GA-2** top ↗<https://gateoverflow.in/40167>

Fill in the blank with the correct idiom/phrase.

That boy from the town was a \_\_\_\_\_ in the sleepy village.

- A. dog out of herd
- B. sheep from the heap
- C. fish out of water
- D. bird from the flock

[gate2015-me-3](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.55 Most Appropriate Word: GATE2016 CE-2: GA-3** top ↗<https://gateoverflow.in/110881>

Choose the most appropriate set of words from the options given below to complete the following sentence.

\_\_\_\_\_, \_\_\_\_\_ is a will, \_\_\_\_\_ is a way.

- A. Wear, there, their
- B. Were, their, there
- C. Where, there, there
- D. Where, their, their

[gate2016-ce-2](#) [most-appropriate-word](#) [verbal-aptitude](#)

Answer 

**11.7.56 Most Appropriate Word: GATE2016 EC-1: GA-3** top ↗<https://gateoverflow.in/108069>

Despite the new medicine's \_\_\_\_\_ in treating diabetes, it is not \_\_\_\_\_ widely.

- A. effectiveness --- prescribed
- B. availability --- used
- C. prescription --- available
- D. acceptance --- proscribed

[gate2016-ec-1](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.57 Most Appropriate Word: GATE2016 EC-2: GA-2** top ↗<https://gateoverflow.in/108478>

The students \_\_\_\_\_ the teacher on teachers' day for twenty years of dedicated teaching.

- A. Facilitated
- B. Felicitated
- C. Fantasized
- D. Facillitated

[gate2016-ec-2](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.58 Most Appropriate Word: GATE2016 ME-2: GA-1** top ↗<https://gateoverflow.in/108240>

The volume of a sphere of diameter 1 unit is \_\_\_\_\_ than the volume of a cube of side 1 unit.

- A. Least
- B. Less
- C. Lesser
- D. Low

[gate2016-me-2](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.59 Most Appropriate Word: GATE2016 ME-2: GA-2** top ↗<https://gateoverflow.in/108249>

The unruly crowd demanded that the accused be \_\_\_\_\_ without trial.

- A. Hanged
- B. Hanging
- C. Hankering
- D. Hung

[gate2016-me-2](#) [most-appropriate-word](#) [verbal-aptitude](#)

Answer 

**11.7.60 Most Appropriate Word: GATE2017 CE-1: GA-2** top ↗<https://gateoverflow.in/313488>

\_\_\_\_\_ with someone else's email account is now a very serious offence.

- A. Involving
- B. Assisting
- C. Tampering
- D. Incubating

[gate2017-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.61 Most Appropriate Word: GATE2018 CE-1: GA-1** top ↗<https://gateoverflow.in/313276>

"The driver applied the \_\_\_\_\_ as soon as she approached the hotel where she wanted to take a \_\_\_\_\_"

- A. brake, break
- B. break, brake
- C. brake, brake
- D. break, break

[gate2018-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.62 Most Appropriate Word: GATE2018 CE-1: GA-2** top ↗<https://gateoverflow.in/313278>

"It is no surprise that every society has had codes of behavior; however, the nature of these codes is often \_\_\_\_\_."

The word that best fills the blank in the above sentence is

- A. unpredictable
- B. simple
- C. expected
- D. strict

[gate2018-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.63 Most Appropriate Word: GATE2018 CE-2: GA-1** top ↴<https://gateoverflow.in/313395>

"His face \_\_\_\_\_ with joy when the solution of the puzzle was \_\_\_\_\_ to him."

The words that best fill the blanks in the above sentence are

- A. shone, shown
- B. shone, shone
- C. shown, shone
- D. shown, shown

[gate2018-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.64 Most Appropriate Word: GATE2018 CE-2: GA-2** top ↴<https://gateoverflow.in/313396>

"Although it does contain some pioneering ideas, one would hardly characterize the work as \_\_\_\_\_."

- A. innovative
- B. simple
- C. dull
- D. boring

[gate2018-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

**11.7.65 Most Appropriate Word: GATE2018 CH: GA-1** top ↴<https://gateoverflow.in/205087>

"When she fell down the \_\_\_\_\_, she received many \_\_\_\_\_ but little help."

The words that best fill the blanks in the above sentence are

- A. stairs, stares
- B. stairs, stairs
- C. stares, stairs
- D. stares, stares

[gate2018-ch](#) [general-aptitude](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)

Answer 

**11.7.66 Most Appropriate Word: GATE2018 CH: GA-2** top ↴<https://gateoverflow.in/205088>

"In spite of being warned repeatedly, he failed to correct his \_\_\_\_\_ behaviour."

The word that best fills the blank in the above sentence is

- A. rational
- B. reasonable
- C. errant
- D. good

[gate2018-ch](#) [general-aptitude](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)

Answer 

**11.7.67 Most Appropriate Word: GATE2018 EC: GA-1** top ↴<https://gateoverflow.in/205205>

"By giving him the last \_\_\_\_\_ of the cake, you will ensure lasting \_\_\_\_\_ in our house today."

The words that best fill the blanks in the above sentence are

- A. peas, piece
- B. piece, peace
- C. peace, piece
- D. peace, peas

[gate2018-ec](#) [general-aptitude](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)

**Answer****11.7.68 Most Appropriate Word: GATE2018 EC: GA-2** top ↗<https://gateoverflow.in/205206>

"Even though there is a vast scope for its \_\_\_\_\_, tourism has remained a/an \_\_\_\_\_ area."  
 The words that best fill the blanks in the above sentence are

- A. improvement, neglected
- B. rejection, approved
- C. fame, glum
- D. interest, disinterested

[gate2018-ec](#) [general-aptitude](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)
**Answer****11.7.69 Most Appropriate Word: GATE2018 EE: GA-1** top ↗<https://gateoverflow.in/205097>

"Since you have gone off the \_\_\_\_\_, the \_\_\_\_\_ sand is likely to damage the car."  
 The words that best fill the blanks in the above sentence are

- A. course, coarse
- B. course, course
- C. coarse, course
- D. coarse, coarse

[gate2018-ee](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)
**Answer****11.7.70 Most Appropriate Word: GATE2018 EE: GA-2** top ↗<https://gateoverflow.in/205098>

"A common misconception among writers is that sentence structure mirrors thought; the more \_\_\_\_\_ the structure, the more complicated the ideas."

The word that best fills the blank in the above sentence is

- A. detailed
- B. simple
- C. clear
- D. convoluted

[gate2018-ee](#) [general-aptitude](#) [verbal-aptitude](#) [normal](#) [most-appropriate-word](#)
**Answer****11.7.71 Most Appropriate Word: GATE2018 ME-1: GA-2** top ↗<https://gateoverflow.in/313656>

"Her \_\_\_\_\_ should not be confused with miserliness; she is ever willing to assist those in need."

The word that best fills the blank in the above sentence is

- A. cleanliness
- B. punctuality
- C. frugality
- D. greatness

[gate2018-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)
**Answer****11.7.72 Most Appropriate Word: GATE2018 ME-2: GA-1** top ↗<https://gateoverflow.in/313634>

"The dress \_\_\_\_\_ her so well that they all immediately \_\_\_\_\_ her on her appearance."

The words that best fill the blanks in the above sentence are

- A. complemented, complemented
- B. complimented, complemented
- C. complimented, complimented

- D. complemented, complimented

[gate2018-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.73 Most Appropriate Word: GATE2018 ME-2: GA-2 [top](#)

<https://gateoverflow.in/313641>



"The judge's standing in the legal community, though shaken by false allegations of wrongdoing, remained \_\_\_\_\_."

The word that best fills the blank in the above sentence is

- A. undiminished
- B. damaged
- C. illegal
- D. uncertain

[gate2018-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.74 Most Appropriate Word: GATE2019 CE-2: GA-1 [top](#)

<https://gateoverflow.in/313377>



Daytime temperature in Delhi can \_\_\_\_\_  $40^{\circ}C$ .

- A. get
- B. stand
- C. reach
- D. peak

[gate2019-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.75 Most Appropriate Word: GATE2019 EC: GA-5 [top](#)

<https://gateoverflow.in/313541>



When he did not come home, she \_\_\_\_\_ him lying dead on the roadside somewhere.

- A. concluded
- B. looked
- C. notice
- D. pictured

[gate2019-ec](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.76 Most Appropriate Word: GATE2019 EE: GA-1 [top](#)

<https://gateoverflow.in/313568>



I am not sure if the bus that has been booked will be able to \_\_\_\_\_ all the students.

- A. sit
- B. deteriorate
- C. fill
- D. accommodate

[gate2019-ee](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

#### 11.7.77 Most Appropriate Word: GATE2019 EE: GA-5 [top](#)

<https://gateoverflow.in/313744>



Newspapers are a constant source of delight and recreation for me. The \_\_\_\_\_ trouble is that I read \_\_\_\_\_ many of them.

- A. even, quite
- B. even, too
- C. only, quite

D. only, too

[gate2019-ee](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

### 11.7.78 Most Appropriate Word: GATE2019 ME-1: GA-1 [top](#)

<https://gateoverflow.in/313602>



John Thomas, an \_\_\_\_\_ writer, passed away in 2018.

- A. imminent
- B. prominent
- C. eminent
- D. dominant

[gate2019-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

### 11.7.79 Most Appropriate Word: GATE2019 ME-1: GA-5 [top](#)

<https://gateoverflow.in/313604>



The minister avoided any mention of the issue of women's reservation in the private sector. He was accused of \_\_\_\_\_ the issue.

- A. collaring
- B. skirting
- C. tying
- D. belting

[gate2019-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

### 11.7.80 Most Appropriate Word: GATE2019 ME-2: GA-2 [top](#)

<https://gateoverflow.in/313586>



A final examination is the \_\_\_\_\_ of a series of evaluations that a student has to go through

- A. culmination
- B. consultation
- C. desperation
- D. insinuation

[gate2019-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

### 11.7.81 Most Appropriate Word: GATE2019 ME-2: GA-5 [top](#)

<https://gateoverflow.in/313590>



Are there enough seats here? There are \_\_\_\_\_ people here than I expected

- A. many
- B. most
- C. least
- D. more

[gate2019-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [most-appropriate-word](#)

Answer 

### 11.7.82 Most Appropriate Word: GATE2020 Practice Test 2: General Aptitude-7 [top](#)

<https://gateoverflow.in/314534>



Pick the word which fills the blank suitably

The messages went \_\_\_\_\_ until a decision was made.

- A. back and forth
- B. deliberated
- C. discussed

D. back

gate2020-practise-2 most-appropriate-word

Answer 

### 11.7.83 Most Appropriate Word: GATE2020 Practice Test 2: General Aptitude-8 top ↗ ↗ https://gateoverflow.in/314533



Pick the word which does not fill the blank in the following sentence

His \_\_\_\_\_ made the new comer nervous.

- A. jibe
- B. gibe
- C. taunt
- D. scoff

gate2020-practise-2 most-appropriate-word verbal-aptitude

Answer 

## Answers: Most Appropriate Word

### 11.7.1 Most Appropriate Word: GATE CSE 2010 | Question: 56 top ↗

↗ https://gateoverflow.in/2364



- ✓ answer is option (c)
- (a) Masked : Hide under a false appearance - **opposite**
- (b) Belied : Be in contradiction with - **not appropriate**
- (c) Betrayed : Reveal unintentionally - **most appropriate**
- (d) Suppressed: To put down by force or authority - **irrelevant**

 17 votes

-- Kalpana Bhargav (2.5k points)

### 11.7.2 Most Appropriate Word: GATE CSE 2010 | Question: 58 top ↗

↗ https://gateoverflow.in/2366



- ✓ answer is (d)

Uphold : cause to remain - **Not appropriate**

Restrain : keep under control - **Not appropriate**

Cherish : be fond of - **Not related**

Conserve : keep in safety and protect from harm , decay, loss or destruction - **most appropriate**

 9 votes

-- Kalpana Bhargav (2.5k points)

### 11.7.3 Most Appropriate Word: GATE CSE 2011 | Question: 58 top ↗

↗ https://gateoverflow.in/2167



- ✓ Answer "Visiting"
- some Verbs are Followed by Gerunds, not infinitives
- e.g.,

- I recommend leaving while we can.
- I have quit smoking
- Did I mention reading that novel last summer?
- He avoided talking to her.

Some verb can be followed by either an infinitive or a gerund, but there will be a difference in meaning.

e.g.,

- I stopped smoking - means something quite different, for instance,
- I stopped to smoke - the infinitive form will usually describe a potential action.

<http://grammar.ccc.commnet.edu/grammar/gerunds.htm>

## References



12 votes

-- Prateek kumar (6.7k points)

### 11.7.4 Most Appropriate Word: GATE CSE 2011 | Question: 59 [top](#)

<https://gateoverflow.in/2169>



- ✓ restrained -showing careful self-control

synonyms: - sober, quite, calm, steady

7 votes

-- Prateek kumar (6.7k points)

### 11.7.5 Most Appropriate Word: GATE CSE 2012 | Question: 60 [top](#)

<https://gateoverflow.in/2200>



- ✓ A. that

Who and whom are people, not dogs.

Regarding that and which...

Restrictive Clause—That

A [restrictive clause](#) is just part of a sentence that you can't get rid of because it specifically restricts some other part of the sentence. Here's an example:

- Gems that sparkle often elicit forgiveness.

The words *that sparkle* restrict the kind of gems you're talking about. Without them, the meaning of the sentence would change. Without them, you'd be saying that all gems elicit forgiveness, not just the gems that sparkle. (And note that you don't need [commas](#) around the words *that sparkle*.)

Nonrestrictive Clause—Which

A [nonrestrictive clause](#) is something that can be left off without changing the meaning of the sentence. You can think of a nonrestrictive clause as simply additional information. Here's an example:

- Diamonds, which are expensive, often elicit forgiveness.

## References



30 votes

-- Kathleen Bankson (51.6k points)



### 11.7.6 Most Appropriate Word: GATE CSE 2014 Set 1 | Question: GA-2 [top](#)

<https://gateoverflow.in/771>

- ✓ C. Mediocre meaning not very good, not up to par, average. Her performance was average and not worthy of 1st prize.

11 votes

-- Kathleen Bankson (51.6k points)



### 11.7.7 Most Appropriate Word: GATE CSE 2014 Set 2 | Question: GA-1 [top](#)

<https://gateoverflow.in/1938>



- ✓ **Explanation:** A country is called postcolonial if it came into existence after the colonies of the British and the Europeans were abolished and the countries then under their rule were declared independent.

India was under the British colonial rule till 1947, i.e. it was a former British colony and thus is called a postcolonial country.

**So, A is the correct option.**

3 votes

-- vardhamana venkatachalam (569 points)



### 11.7.8 Most Appropriate Word: GATE CSE 2015 Set 2 | Question: GA-4 [top](#)

<https://gateoverflow.in/8032>



- ✓ It is 'D' apparel.

A. Fabric - cloth or material used for making the clothes.

B. Textile - it is a synonym to fabric.

- C. Fiber - a leather-like material made by compressing layers of paper or cloth.  
 D. Apparel - refers to clothing in general.

10 votes

-- Anoop Sonkar (4.1k points)

### 11.7.9 Most Appropriate Word: GATE CSE 2015 Set 3 | Question: GA-3 [top](#)



- Answer is B. extraneous

To use outside it must be in the form "outside of".

11 votes

-- naresh1845 (1.1k points)

### 11.7.10 Most Appropriate Word: GATE CSE 2018 | Question: GA-1 [top](#)



- They're for pointing group

Their for pointing people

There for place

B is answer

11 votes

-- Prashant Singh (47.2k points)

### 11.7.11 Most Appropriate Word: GATE CSE 2018 | Question: GA-2 [top](#)



- The correct word is **meandering**. It means '*proceeding in a convoluted or undirected fashion*'.  
 All other options are similar to the word organized.

16 votes

-- Rakesh Kumar (2.4k points)

### 11.7.12 Most Appropriate Word: GATE CSE 2019 | Question: GA-1 [top](#)



- **Break down** means to separate something into smaller parts.  
 → The **subject-word agreement** states that

Singular nouns go with singular verbs while plural nouns go with plural verbs.

→ **Expenditure** is singular noun and its plural form is **expenditures**.

The expenditure (**singular noun**) in the project breaks (**singular verb used in the phrase**) down as follows

→ The above statement satisfies the subject verb agreement and hence, the correct option is **C**

17 votes

-- NabilSayyad (761 points)

### 11.7.13 Most Appropriate Word: GATE CSE 2019 | Question: GA-5 [top](#)



- D. School**

A court is a place where the judge works, school is a place where a teacher works.

20 votes

-- great\_gater (165 points)

### 11.7.14 Most Appropriate Word: GATE Chemical 2020 | GA Question: 1 [top](#)



- Conferred is **followed by on/upon**

ceremony **at** the Rashtrapati Bhavan is correct. “at” is used when a specific location is given. Otherwise “in” can be used like “ceremony in New Delhi”.

Correct Option: C

**References**

1 votes

-- Arjun Suresh (328k points)

### 11.7.15 Most Appropriate Word: GATE Chemical 2020 | GA Question: 2 top ↴

<https://gateoverflow.in/359824>



- ✓ Despite a string of **poor performances**,

- poor performance should reduce chances of selection. But “despite” being used, chances of selection must be “high”.

Correct choice B. bright

1 votes

-- Arjun Suresh (328k points)

### 11.7.16 Most Appropriate Word: GATE Civil 2020 Set 1 | GA Question: 1 top ↴

<https://gateoverflow.in/359868>



- ✓ Living in **ivory towers** is a metamorphic term used to denote living in own world and cut off from the rest of world.

Correct option: B

**References**

1 votes

-- Arjun Suresh (328k points)

### 11.7.17 Most Appropriate Word: GATE Civil 2020 Set 1 | GA Question: 2 top ↴

<https://gateoverflow.in/359866>



- ✓ The given sentences imply that he has **great enthusiasm** for reading. So, “voracious” is the most appropriate word here.

**Voracious:** engaging in an activity with great eagerness or enthusiasm.

Correct option: C

**Precocious:** having developed certain abilities or inclinations at an earlier age than is usual or expected.

1 votes

-- Arjun Suresh (328k points)

### 11.7.18 Most Appropriate Word: GATE Civil 2020 Set 2 | GA Question: 2 top ↴

<https://gateoverflow.in/359844>



- ✓
- disparage:** regard or represent as being of little worth
  - applaud:** show approval or praise by clapping
  - reduce**
  - begrudge:** envy (someone) the possession or enjoyment of (something)

Option A is the only suitable option.

1 votes

-- Arjun Suresh (328k points)

### 11.7.19 Most Appropriate Word: GATE ECE 2020 | GA Question: 1 top ↴

<https://gateoverflow.in/359783>



- ✓ option A – **in, of**

die **of** diseases and die **from** diseases both are correct but in case of accidents you can only use **in** i.e. killed **in** accidents

2 votes

-- Madhav kumar (1.5k points)

**11.7.20 Most Appropriate Word: GATE Electrical 2020 | GA Question: 2** top ↴<https://gateoverflow.in/359730>

- ✓ “prohibited” means “banned” or “stopped” and should be followed by “from”.

Correct option: B.

1 votes

-- Arjun Suresh (328k points)

**11.7.21 Most Appropriate Word: GATE Electrical 2020 | GA Question: 4** top ↴<https://gateoverflow.in/359726>

- ✓ Ans B.

**poised** – having a composed and self-assured manner. Having self-confidence.

Eg. economic times | Aug 12, 2020, Are domestic stocks **poised** for a fall from the cliff?

thepienews, India “poised” to be largest student source market.

**plunged** – fall suddenly and uncontrollably. to move or fall suddenly forward, down, or into something

CNBC | AUG 12, 2020, UK enters recession after GDP **plunged** by a record 20.4% in the second quarter.

Hindustan Times | Aug 12, 2020, 1 dead as SUV **plunges into** gorge in Uttarakhand, monsoon mayhem blights state.

**plugged** – block or fill in (a hole or cavity)

Times of India | Aug 9, 2020, Government: Gaps in data will be **plugged**.

**probed** – physically explore or examine (something) with the hands or an instrument.

Business Standard | Aug 9, 2020, Expert who **probed** Mangalore crash lists likely reasons for Kozhikode mishap.

#### References



3 votes

-- Vijay Purohit (2.8k points)

**11.7.22 Most Appropriate Word: GATE Mechanical 2020 Set 1 | GA Question: 1** top ↴<https://gateoverflow.in/359536>

- ✓ Crocodile tears (or superficial sympathy) is a false, insincere display of emotion such as a hypocrite crying fake tears of grief.

So, the correct answer is (C).

1 votes

-- Lakshman Patel (63.9k points)

**11.7.23 Most Appropriate Word: GATE2010 MN: GA-3** top ↴<https://gateoverflow.in/312011>

- ✓ Extol: to **praise** something or someone very much

From the sentence it is clear that the report is not reasonable but **biased**.

Option C should be answer

#### References



1 votes

-- Akash Dinkar (27.9k points)

**11.7.24 Most Appropriate Word: GATE2010 MN: GA-4** top ↴<https://gateoverflow.in/312012>

- ✓ **inevitable**: certain to happen and unable to be avoided or prevented

**contingent**: a group of people representing an organization or country, or a part of a military force

**oblivious**: not conscious of something, especially what is happening around you

**imperative**: extremely important or urgent

option **D** should be answer

3 votes

-- Akash Dinkar (27.9k points)

**11.7.25 Most Appropriate Word: GATE2010 TF: GA-3** top ↗<https://gateoverflow.in/312022>

- ✓ disincentives.

Basically disincentives means some sort of punishment for the people who will not follow the 2 child norm.

1 votes

-- Arkaprava Paul (1.9k points)

**11.7.26 Most Appropriate Word: GATE2010 TF: GA-4** top ↗<https://gateoverflow.in/312023>

- ✓ famine is acute shortage of food and as per the sentence we require a word meaning "reduction in food output."

"aberration" means sharp change -- not necessarily a reduction.

"weakening" and "deterioration" must be followed by "of" than "in".

"decline" perfectly fits here.

Correct Option: C.

0 votes

-- Arjun Suresh (328k points)

**11.7.27 Most Appropriate Word: GATE2011 AG: GA-1** top ↗<https://gateoverflow.in/312112>

- ✓ (D) Available is the correct option.

Alternatively, we can say,

"human genes are to be manipulated only to correct diseases for which the satisfactory treatments are not **available**."

Only **Available** makes sense here.

2 votes

-- Satbir Singh (20.9k points)

**11.7.28 Most Appropriate Word: GATE2011 AG: GA-3** top ↗<https://gateoverflow.in/312114>

- ✓ "so that to invite them to come back would be **counter-productive**"

This means that foreign technocrats were harmful to the country. So, only suitable option is exacerbate - meaning aggravate.

Correct Option: C.

4 votes

-- Arkaprava Paul (1.9k points)

**11.7.29 Most Appropriate Word: GATE2011 GG: GA-1** top ↗<https://gateoverflow.in/40202>

- ✓ The verb "**HOPE**" is always followed by (verb + infinity not verb +ing)

e.g., *She hopes to go to university next year*

Correct Option: C

2 votes

-- Prateek kumar (6.7k points)

**11.7.30 Most Appropriate Word: GATE2011 GG: GA-3** top ↗<https://gateoverflow.in/40204>

- ✓ **Despite** the mixture's \_\_\_\_\_ nature, we found that by lowering its temperature in the laboratory we could dramatically **reduce its tendency to vaporize**

This means that the nature of the mixture must be prone to easy evaporation.

- A. acerbic - means acidic; does not mean it evaporates easily.
- B. resilient - means can be stretched easily; again does not say anything about evaporation.
- C. volatile - means easily evaporated at room temperature; best option here.
- D. heterogeneous - means composed of different components; again not telling anything about evaporation.

Correct option: C. volatile.

2 votes

-- Arjun Suresh (328k points)

**11.7.31 Most Appropriate Word: GATE2011 GG: GA-5** top ↗<https://gateoverflow.in/40206>

- ✓ Part 2 must be a positive response which leads them surprised and amazed. So, options A & B are eliminated.  
(irate means angry and curtly means abrupt)

Also, part 1 must be negative.

So, only option D matches.

Amiably & Affably are synonyms to each other.

Querulous:- impatient, moody, tempered, ill-natured etc

**Correct Option: "D"**

4 votes

-- Prateek kumar (6.7k points)

**11.7.32 Most Appropriate Word: GATE2011 MN: GA-57** top ↗<https://gateoverflow.in/31522>

- ✓ **Answer B**

**(B) Delivered on:** is most appropriate. It means to do something promised.

**(A) Delivered:** this is not correct because it means promise was not made which contradicts the later part of the sentence.

**(C) forgot:** Does not fit properly

**(D) reneged on:** This does not seem appropriate, as if he never goes back on a promise then we should not lose confidence!

6 votes

-- Akash Kanase (36k points)

**11.7.33 Most Appropriate Word: GATE2011 MN: GA-58** top ↗<https://gateoverflow.in/31529>

- ✓ \_\_\_\_\_ in the frozen wastes of Arctic takes special equipment.

What is taking (requiring) "special equipment"?

It is "survival" (noun form)

If we use "To survive" (infinitive form) we need to modify the sentence as

- To survive in the frozen wastes of Arctic, it takes special equipment.

"Surviving" is also not correct because we are not having a noun here.

**PS: "Although a gerund phrase can function as the subject of a sentence, adding an "ing" to a verb does not make it a noun."**

References:

- <https://www.grammarin.com/the-gerund-as-subject>
- <https://www.utdallas.edu/studentsuccess/files/GerundsandInfinitivePhrases.pdf>

Correct Answer: C "survival".

References



9 votes

-- Arjun Suresh (328k points)

**11.7.34 Most Appropriate Word: GATE2011 MN: GA-60** top ↗<https://gateoverflow.in/31533>

- ✓

- paucity - scarcity
- propensity - tendency
- preponderance - the quality or fact of being greater in number, quantity, or importance.
- accuracy - correctness

- plaintiff means a person who brings a case against another in a court of law.

"\_\_\_\_\_ of evidence was on the side of the plaintiff since all but one witness testified that his story was correct."

So, here it means that the "plaintiff" brought a case to the court and all but one witness supported him and so he has "plenty

of evidence" in support.

Correct option: C

8 votes

-- Akash Kanase (36k points)

#### 11.7.35 Most Appropriate Word: GATE2012 AE: GA-3 top ↗

<https://gateoverflow.in/40214>



✓ "yet another unreasonable measure" and "measures were already" means that the new measure is surely unreasonable. "unpopular" is the most suitable word here.

"reflective" and "luxuriant" are not negative words and hence cannot fit here. "utopian" is far more negative than "unreasonable" and hence unsuitable.

Correct Option: D.

2 votes

-- Arjun Suresh (328k points)

#### 11.7.36 Most Appropriate Word: GATE2012 AE: GA-4 top ↗

<https://gateoverflow.in/40215>



✓ (A)

Explanation : Timid means fearful and Intrepid means fearless which is the most suitable contrast.

5 votes

-- Sourav Mishra (सौरव मिश्रा) (1.1k points)

#### 11.7.37 Most Appropriate Word: GATE2012 AR: GA-2 top ↗

<https://gateoverflow.in/40223>



✓ difficulty of the questions was compensated by an increase in time

This makes sense as with more time one can expect to solve more difficult questions.

- "exactitude" means high level of correction and it won't be magnified by an increase in time
- "aptitude" of the questions also does not decrease with an increase in time.
- "attitude" of the question does not make sense.

Correct Option: A

1 votes

-- Arjun Suresh (328k points)

#### 11.7.38 Most Appropriate Word: GATE2012 CY: GA-4 top ↗

<https://gateoverflow.in/40235>



✓ Beggary - means poverty which is not suiting here

Nomenclature - is choosing names for things which also seems wrong

Jealousy - Wrong

So, the Correct Option is D

Nonchalance - means casualness or the state of being relaxed.

6 votes

-- saif ahmed (3.2k points)

#### 11.7.39 Most Appropriate Word: GATE2013 CE: GA-4 top ↗

<https://gateoverflow.in/40271>



✓ B. Intimate

Statement says about limitations of friendship and our required word follows "no matter how" meaning it should be something which increases the friendship bond.

5 votes

-- vamsi2376 (2.8k points)

#### 11.7.40 Most Appropriate Word: GATE2013 EE: GA-3 top ↗

<https://gateoverflow.in/40290>



✓ Dare means "have the courage to" and "to" is implied here.

Option A commit.

10 votes

-- Sreyas S (1.6k points)

#### 11.7.41 Most Appropriate Word: GATE2014 AE: GA-2 top ↗

<https://gateoverflow.in/40301>



✓ (B) Virtues

Virtues is related to moral standards while strength is related to physical ability.

4 votes

-- Monanshi Jain (7k points)

#### 11.7.42 Most Appropriate Word: GATE2014 AG: GA-1 [top](#)

<https://gateoverflow.in/41660>



- ✓ D. experiences.

Reason: We should generally use simple present tense for describing FACTUAL information.

5 votes

-- ashishkr73 (1.81 points)

#### 11.7.43 Most Appropriate Word: GATE2014 AG: GA-2 [top](#)

<https://gateoverflow.in/41665>



- ✓ Ans : A

contentment means → A state of happiness and satisfaction.

11 votes

-- Marylyn Joseph (1.81 points)

#### 11.7.44 Most Appropriate Word: GATE2014 EC-1: GA-3 [top](#)

<https://gateoverflow.in/41492>



- ✓ Propel :- motivate,stimulate,to push forward

Dispel :- do away,banish,discard,delete

repel: - to push or thrust away

Impel: – urged; persuaded

option "B"

3 votes

-- Prateek kumar (6.7k points)

#### 11.7.45 Most Appropriate Word: GATE2014 EC-2: GA-1 [top](#)

<https://gateoverflow.in/41507>



- ✓ The given statement means that one should have both communication and interpersonal skills.

- "both" is the apt word here.
- "Each" does not go with "are"
- "All" is not used with just 2 things
- "Either" does not go with important.

Correct Answer: B. Both.

1 votes

-- Arjun Suresh (328k points)

#### 11.7.46 Most Appropriate Word: GATE2014 EC-2: GA-3 [top](#)

<https://gateoverflow.in/41510>



- ✓ Ans : Option C

bear means to carry (*in this context*)

losing OR loosing ?

loose is opposite of tight. Hence losing

6 votes

-- Desert\_Warrior (6k points)

#### 11.7.47 Most Appropriate Word: GATE2014 EC-3: GA-2 [top](#)

<https://gateoverflow.in/41141>



- ✓ Ans: B) **Depreciated** meaning diminish in value over a period of time.

2 votes

-- biranchi (1k points)

#### 11.7.48 Most Appropriate Word: GATE2015 CE-2: GA-1 [top](#)

<https://gateoverflow.in/40176>



- ✓ answer should be B ie respectfully

3 votes

-- Pooja Palod (24k points)

**11.7.49 Most Appropriate Word: GATE2015 EC-1: GA-1** top ↴<https://gateoverflow.in/39489>

- ✓ I think the ans is memento. :) option B) nd it is correct.. there is no such word as momento ,memento is spelled as "momento "

2 votes

-- Ritaban Basu (519 points)

**11.7.50 Most Appropriate Word: GATE2015 EC-1: GA-2** top ↴<https://gateoverflow.in/39490>

- ✓ Ans : [A] Frogs croak

here are the links: experience it... :)

<https://youtu.be/GUcfvd0X9rg>[https://youtu.be/p7\\_kJXNytNw](https://youtu.be/p7_kJXNytNw)

Also more info :

Lion roarcat hissmice patter**References**

3 votes

-- Desert\_Warrior (6k points)

**11.7.51 Most Appropriate Word: GATE2015 EC-2: GA- 1** top ↴<https://gateoverflow.in/38935>

- ✓ Words joined to a singular subject by WITH, AS WELL AS, takes a singular verb. So it will be WAS.

Correct Option: B

8 votes

-- Shalini (133 points)

**11.7.52 Most Appropriate Word: GATE2015 EC-3: GA-3** top ↴<https://gateoverflow.in/39516>

- ✓ Let us is followed by a verb.

But introvert, atheist and altruist are all nouns.

Hence, the correct answer is alternate which is a verb.

1 votes

-- Jeet (15.3k points)

**11.7.53 Most Appropriate Word: GATE2015 ME-3: GA-1** top ↴<https://gateoverflow.in/40166>

- ✓ It should be A.

Apparent lifelessness harbours dormant life. What seems to be lifeless because of lack of movements might be alive, probably simply sleeping.

3 votes

-- Vishal Goel (1.6k points)

**11.7.54 Most Appropriate Word: GATE2015 ME-3: GA-2** top ↴<https://gateoverflow.in/40167>

- ✓ Ans : That boy from the town was a fish out of water in the sleepy village.

- dog out of herd : no meaning for this idiom
- sheep from the heap : no meaning for this idiom
- fish out of water** : someone who is uncomfortable in a particular situation
- bird from the flock : no meaning for this idiom

4 votes

-- Desert\_Warrior (6k points)

**11.7.55 Most Appropriate Word: GATE2016 CE-2: GA-3** [top ↴](#)<https://gateoverflow.in/110881>

- ✓ Options A and B clearly wrong as **Wear** and **Were** cannot start the given statement.

Between options C and D, **Their** means belongs to some people but meaning of the given sentence says it should be **There** means to that position.

That makes option C correct.

Where there is a will there is a way means If one really wants to do something, he always find a way to do it.

6 votes

-- Bikram (58.3k points)

**11.7.56 Most Appropriate Word: GATE2016 EC-1: GA-3** [top ↴](#)<https://gateoverflow.in/108069>

- ✓ Despite the new medicine's **effectiveness** in treating diabetes, it is not **prescribed** widely.  
option A

4 votes

-- Shobhit (13.5k points)

**11.7.57 Most Appropriate Word: GATE2016 EC-2: GA-2** [top ↴](#)<https://gateoverflow.in/108478>

- ✓
- Facilitated:** to make easier or less difficult; help forward (an action, a process, etc.)
  - Felicitated:** to compliment upon a happy event; congratulate.
  - Fantasized:** to create in one's fancy, daydreams, or the like; imagine
  - Facillitated:** incorrect word

So only suitable option is B.

6 votes

-- ചന്ദ്രമേരൻ (1.3k points)

**11.7.58 Most Appropriate Word: GATE2016 ME-2: GA-1** [top ↴](#)<https://gateoverflow.in/108240>

- ✓ 'Lesser' and 'than' both are comparative words and using them together is grammatical error. Either say 'Sphere is lesser in volume than Cube for same diameter and edge length' or say 'Sphere is less than.....'!

9 votes

-- Rupendra Choudhary (11.3k points)

**11.7.59 Most Appropriate Word: GATE2016 ME-2: GA-2** [top ↴](#)<https://gateoverflow.in/108249>

- ✓ The unruly crowd demanded that the accused be **hanged** without trial.

The past and past participle form of the word "hang" is "hung" except when the word is used to denote a person being tied in a rope around neck until death.

Correct option A.

3 votes

-- Shobhit (13.5k points)

**11.7.60 Most Appropriate Word: GATE2017 CE-1: GA-2** [top ↴](#)<https://gateoverflow.in/313488>

- ✓ **Tampering** with someone else's email account is now a very serious offence.

Tampering here means doing 'unauthorised alterations'

2 votes

-- Naveen Kumar (9.9k points)

**11.7.61 Most Appropriate Word: GATE2018 CE-1: GA-1** [top ↴](#)<https://gateoverflow.in/313276>

- ✓
- Brake is a device which is used for stopping or moving a vehicle.
  - Break refers to a pause in work or during an activity.

So, the correct answer is (A).

1 votes

-- Lakshman Patel (63.9k points)

**11.7.62 Most Appropriate Word: GATE2018 CE-1: GA-2** [top](#)<https://gateoverflow.in/313278>

- ✓ In this sentence, one part contradicts what is stated in the former part of the sentence. The keyword is 'no surprise' so the right and cogent word is 'unpredictable' because of the contrasting word 'however'.

So, the correct answer is (A).

2 votes

-- Lakshman Patel (63.9k points)

**11.7.63 Most Appropriate Word: GATE2018 CE-2: GA-1** [top](#)<https://gateoverflow.in/313395>

- 'shone' - past participle of shine.
- 'shown' - past participle of show.

"His face **shone** with joy when the solution of the puzzle was **shown** to him."

Correct Answer: A

2 votes

-- Naveen Kumar (9.9k points)

**11.7.64 Most Appropriate Word: GATE2018 CE-2: GA-2** [top](#)<https://gateoverflow.in/313396>

- ✓ "it does contain some pioneering ideas, one would **hardly**"

"contain some pioneering ideas" means the work can be "innovative" but the usage of "hardly" means the work is "not exactly innovative".

Options B, C and D are not suitable because they are all negative usage and with "hardly" - a negative word, they becomes positive which is wrong with the given sentence.

Option A is correct.

0 votes

-- Arjun Suresh (328k points)

**11.7.65 Most Appropriate Word: GATE2018 CH: GA-1** [top](#)<https://gateoverflow.in/205087>

- ✓ stairs: **a series of steps or flights of steps for passing from one level to another.**

stares: **look fixedly or vacantly at someone or something with one's eyes wide open.**

It is option A.

1 votes

-- Akash Dinkar (27.9k points)

**11.7.66 Most Appropriate Word: GATE2018 CH: GA-2** [top](#)<https://gateoverflow.in/205088>

- ✓ In spite of being warned  $\implies$  he was warned for ...

Warning is given for bad behaviour. Only suitable option is "errant". Other three options are positive words.

Correct Option: C

0 votes

-- Arjun Suresh (328k points)

**11.7.67 Most Appropriate Word: GATE2018 EC: GA-1** [top](#)<https://gateoverflow.in/205205>

- ✓ By giving him the last **piece** (means part) of the cake, you will ensure lasting **peace** (state of calmness) in our house today.

**Option (B)**

5 votes

-- Sukanya Das (9.9k points)

**11.7.68 Most Appropriate Word: GATE2018 EC: GA-2** [top](#)<https://gateoverflow.in/205206>

- ✓ Even though there is a vast scope for its **improvement**, tourism has remained a **neglected** area.

Meaning: Tourism can be improved; but it has been neglected.

**Option (A)**

4 votes

-- Sukanya Das (9.9k points)

**11.7.69 Most Appropriate Word: GATE2018 EE: GA-1** [top](#)<https://gateoverflow.in/205097>

- ✓ The adjective *coarse* means *rough*, common, inferior, crude, or vulgar.
- The noun *course* can mean several things, including *path*, *playing field*,
- So, option A course = place coarse= rough sand

1 vote

-- Ram Swaroop1 (4.6k points)

**11.7.70 Most Appropriate Word: GATE2018 EE: GA-2** [top](#)<https://gateoverflow.in/205098>

- ✓ D) convoluted :complicated/extremely complex and difficult to follow

1 vote

-- reena kandari (7.1k points)

**11.7.71 Most Appropriate Word: GATE2018 ME-1: GA-2** [top](#)<https://gateoverflow.in/313656>

- ✓ C. frugality

frugality means "economical with money", & the word 'miserliness' is related to 'meanness' or 'excessive desire to save money'.

so, the word 'frugality' best fills the above sentence.

1 vote

-- Naveen Kumar (9.9k points)

**11.7.72 Most Appropriate Word: GATE2018 ME-2: GA-1** [top](#)<https://gateoverflow.in/313634>

- ✓
  - complement: contribute extra
  - compliment: praise

So, correct answer: D.

0 votes

-- Arjun Suresh (328k points)

**11.7.73 Most Appropriate Word: GATE2018 ME-2: GA-2** [top](#)<https://gateoverflow.in/313641>

- ✓ "though shaken by false **allegations**"

means the word must be a positive one. Only "undiminished" is a positive one.

Correct Option: A

0 votes

-- Arjun Suresh (328k points)

**11.7.74 Most Appropriate Word: GATE2019 CE-2: GA-1** [top](#)<https://gateoverflow.in/313377>

- ✓ Ans C. reach

Other words can be used as follows:

- Daytime temperature in Delhi can **get to** 40°C
- Daytime temperature in Delhi can **stand at** 40°C
- Daytime temperature in Delhi can **peak to** 40°C

2 votes

-- Resmi Arjun (619 points)

**11.7.75 Most Appropriate Word: GATE2019 EC: GA-5** [top](#)<https://gateoverflow.in/313541>

- ✓ The given sentence is pointing to some kind of imagination, hence the most appropriate word is 'pictured'.

Hence, the correct option is (D).

1 vote

-- Lakshman Patel (63.9k points)

**11.7.76 Most Appropriate Word: GATE2019 EE: GA-1** [top](#)<https://gateoverflow.in/313568>

- ✓ 'sit' is inappropriate as bus is not sitting the students and this is different from saying if the bus will have enough

seats for all the students.

'deteriorate' means becoming progressively worse and is clearly unsuitable here.

'fill' is also inappropriate here as the bus is not filling the students but rather students are filling the bus.

'accommodate' means to provide sufficient space and is the apt word here.

Correct Answer: D.

0 votes

-- Arjun Suresh (328k points)



#### 11.7.77 Most Appropriate Word: GATE2019 EE: GA-5 [top](#)

<https://gateoverflow.in/313744>

##### ✓ Answer D

"even" does not fill the first gap. "quite many" is wrong construction and it should be "quite a lot". So, here, the correct grammatical construction will be:

The only trouble is that I read too many of them.

2 votes

-- Shalini26 (449 points)



#### 11.7.78 Most Appropriate Word: GATE2019 ME-1: GA-1 [top](#)

<https://gateoverflow.in/313602>

##### ✓

- imminent means about to happen
- prominent means important
- eminent means one who is famous and respected within a particular sphere; distinguished or renowned.
- dominant means having power and influence

So, (C) is the correct choice.

2 votes

-- Lakshman Patel (63.9k points)



#### 11.7.79 Most Appropriate Word: GATE2019 ME-1: GA-5 [top](#)

<https://gateoverflow.in/313604>

##### ✓

- He was accused of skirting. Skirt as a verb means to avoid discussing a subject or problem, usually because there are difficulties that you do not want to deal with.
- Skirting means to avoid (something) especially because it is difficult or will cause problems.

So, the correct answer is (B).

2 votes

-- Lakshman Patel (63.9k points)



#### 11.7.80 Most Appropriate Word: GATE2019 ME-2: GA-2 [top](#)

<https://gateoverflow.in/313586>

##### ✓ A. Culmination

Culmination is defined by a concluding action.

1 votes

-- Mukunda Madhava Nath (259 points)



#### 11.7.81 Most Appropriate Word: GATE2019 ME-2: GA-5 [top](#)

<https://gateoverflow.in/313590>

##### ✓ Answer (D)

There are **more** people here than I expected.

most and least are clearly inappropriate. "There are **many** people here" is correct but "than I expected" cannot go with it.

1 votes

-- Shalini26 (449 points)



#### 11.7.82 Most Appropriate Word: GATE2020 Practice Test 2: General Aptitude-7 [top](#)

<https://gateoverflow.in/314534>

Answer: A

back and forth

3 votes

-- Sathuri Bharath Kumar Goud (539 points)

**11.7.83 Most Appropriate Word: GATE2020 Practice Test 2: General Aptitude-8** [top ↴](#) <https://gateoverflow.in/314533>

I always thought the "Jibe" meant a happy or sound presence, whereas "Gibe" refers to being negative or always criticising.

0 votes

-- Sherrinford (237 points)

**11.8****Noun Verb Adjective (2)** [top ↴](#)**11.8.1 Noun Verb Adjective: GATE2014 EC-3: GA-3** [top ↴](#)

<https://gateoverflow.in/41142>



'Advice' is \_\_\_\_\_.

- A. A verb
- B. A noun
- C. An adjective
- D. Both a verb and a noun

[gate2014-ec-3](#) [verbal-aptitude](#) [noun-verb-adjective](#)

Answer

**11.8.2 Noun Verb Adjective: GATE2015 EC-2: GA- 3** [top ↴](#)

<https://gateoverflow.in/39504>



What is the adverb for the given word below?

Misogynous

- A. Misogynousness
- B. Misogynity
- C. Misogynously
- D. Misogynous

[gate2015-ec-2](#) [verbal-aptitude](#) [noun-verb-adjective](#)

Answer

**Answers: Noun Verb Adjective****11.8.1 Noun Verb Adjective: GATE2014 EC-3: GA-3** [top ↴](#)

<https://gateoverflow.in/41142>



- ✓ **Advise [verb] :- give advice to ,offer an opinion or suggestion**

eg. I advised him rent was due

I would advise you to go to the hospital immediately

- Advice [noun] :- a proposal for appropriate cause of action**

eg plz gives us some advice about better planning for preparation for GATE

His advice made me think twice about how to handle different subject parallelly

Correct Answer: *B*

8 votes

-- Prateek kumar (6.7k points)

**11.8.2 Noun Verb Adjective: GATE2015 EC-2: GA- 3** [top ↴](#)

<https://gateoverflow.in/39504>



- ✓ Misogynous is an adjective and it describes a person who dislikes women.

Its adverb form: Misogynously

Noun form: Misogynism

4 votes

-- Arjun Suresh (328k points)

**11.9****Opposite (6)** [top ↴](#)**11.9.1 Opposite: GATE CSE 2011 | Question: 60** [top ↴](#)

<https://gateoverflow.in/2170>



Choose the word from the options given below that is most nearly opposite in the meaning to the given word

**Amalgamate**

- A. merge
- B. split
- C. collect
- D. separate

[gate2011-cse](#) [verbal-aptitude](#) [opposite](#) [normal](#)

Answer 

### 11.9.2 Opposite: GATE CSE 2014 Set 3 | Question: GA-3 top ↴

☞ <https://gateoverflow.in/2026>



Choose the word that is opposite in meaning to the word “coherent”.

- A. sticky
- B. well-connected
- C. rambling
- D. friendly

[gate2014-cse-set3](#) [verbal-aptitude](#) [opposite](#) [easy](#)

Answer 

### 11.9.3 Opposite: GATE2011 AG: GA-2 top ↴

☞ <https://gateoverflow.in/312113>



Choose the word from the questions given below that is most nearly opposite in meaning to the given word:

#### Frequency

- A. periodicity
- B. rarity
- C. gradualness
- D. persistency

[general-aptitude](#) [verbal-aptitude](#) [gate2011-ag](#) [opposite](#)

Answer 

### 11.9.4 Opposite: GATE2011 GG: GA-2 top ↴

☞ <https://gateoverflow.in/40203>



Choose the word from the options given below that is most nearly opposite in meaning to the given word:

#### Polemical

- A. imitative
- B. conciliatory
- C. truthful
- D. ideological

[gate2011-gg](#) [verbal-aptitude](#) [opposite](#)

Answer 

### 11.9.5 Opposite: GATE2011 MN: GA-56 top ↴

☞ <https://gateoverflow.in/31519>



Choose the word from the options given below that is most nearly opposite in meaning to the given word:

#### Deference

- A. aversion
- B. resignation
- C. suspicion
- D. contempt

[verbal-aptitude](#) [gate2011-mn](#) [opposite](#)

Answer 

**11.9.6 Opposite: GATE2020 Practice Test 2: General Aptitude-10** [top ↴](#)<https://gateoverflow.in/314531>

Pick the word which is opposite in meaning to the following word.

praise:

- A. condemn
- B. commend
- C. contemn
- D. condon

[gate2020-practise-2](#) [opposite](#) [verbal-aptitude](#)

Answer

**Answers: Opposite****11.9.1 Opposite: GATE CSE 2011 | Question: 60** [top ↴](#)<https://gateoverflow.in/2170>

- ✓ (D) separate

[http://ref:https://www.google.co.in/search?q=Amalgamate&rlz=1C1GIWA\\_enIN597IN597&oq=Amalgamate&aqs=chrome..69i57&sourceid=chrome&es\\_sm=93&ie=UTF-8](http://ref:https://www.google.co.in/search?q=Amalgamate&rlz=1C1GIWA_enIN597IN597&oq=Amalgamate&aqs=chrome..69i57&sourceid=chrome&es_sm=93&ie=UTF-8)

**References**

9 votes

-- Kathleen Bankson (51.6k points)

**11.9.2 Opposite: GATE CSE 2014 Set 3 | Question: GA-3** [top ↴](#)<https://gateoverflow.in/2026>

- ✓ C) Rambling

**Coherent** = Logical and clear,  
**Rambling** = Confused,

8 votes

-- Srinath Jayachandran (2.9k points)

**11.9.3 Opposite: GATE2011 AG: GA-2** [top ↴](#)<https://gateoverflow.in/312113>

- ✓ **Frequency** : Number of times an event occurs. It is a related term of **frequent** which means to **occur commonly** or regularly.

- A. **periodicity**: It comes from periodic which means the tendency to repeat at regular intervals.
- B. **rarity**: Anything which has almost no chance of occurrence.i.e. **not occurring commonly**.
- C. **gradualness**: It comes from gradual which means occurring or developing slowly or by small increments.
- D. **persistency**: It comes from the word persistent which means to keep doing a course of action in spite of difficulty or opposition.

So, **rarity** is most nearly opposite in meaning to the given word **frequency**.

∴ *Option B is the correct answer.*

2 votes

-- Satbir Singh (20.9k points)

**11.9.4 Opposite: GATE2011 GG: GA-2** [top ↴](#)<https://gateoverflow.in/40203>

- ✓ Polemical means a strong verbal or written attack on someone or something.

Conciliatory means making someone less angry or hostile, hence the most suitable antonym for Polemical.

Correct Option: B.

6 votes

-- Sourav Mishra (सौरव मिश्रा) (1.1k points)

**11.9.5 Opposite: GATE2011 MN: GA-56** top ↗<https://gateoverflow.in/31519>

- ✓ Answer: D. Contempt

Deference → polite submission and respect.

- A. aversion → Plain Dislike
- B. resignation → Act of resigning
- C. suspicion → a feeling or thought that something is possible, likely, or true.
- D. contempt → the feeling that a person or a thing is worthless or beneath consideration.

"Pam stared at the girl with total contempt" synonyms: scorn, disdain, disrespect, depreciation, disparagement, denigration, opprobrium, odium, obloquy, scornfulness;

More derision, mockery, ridicule; disgust, loathing, detestation, abhorrence, hatred; archaic contumely

"she was showing little but contempt for him"

antonyms: respect

3 votes

-- Akash Kanase (36k points)

**11.9.6 Opposite: GATE2020 Practice Test 2: General Aptitude-10** top ↗<https://gateoverflow.in/314531>

Option: A

Opposite word to Praise: Condemn (to criticize)

2 votes

-- Sathuri Bharath Kumar Goud (539 points)

**11.10****Passage Reading (45)** top ↗**11.10.1 Passage Reading: GATE CSE 2010 | Question: 63** top ↗<https://gateoverflow.in/2371>

**Modern warfare has changed from large scale clashes of armies to suppression of civilian populations. Chemical agents that do their work silently appear to be suited to such warfare; and regrettably, there exist people in military establishments who think that chemical agents are useful tools for their cause.**

Which of the following statements best sums up the meaning of the above passage:

- A. Modern warfare has resulted in civil strife.
- B. Chemical agents are useful in modern warfare.
- C. Use of chemical agents in warfare would be undesirable.
- D. People in military establishments like to use chemical agents in war.

[gate2010-cse](#) [verbal-aptitude](#) [passage-reading](#) [normal](#)

Answer

**11.10.2 Passage Reading: GATE CSE 2011 | Question: 61** top ↗<https://gateoverflow.in/2171>

**Few school curricula include a unit on how to deal with bereavement and grief, and yet all students at some point in their lives suffer from losses through death and parting.**

Based on the above passage which topic would not be included in a unit on bereavement?

- A. how to write a letter of condolence
- B. what emotional stages are passed through in the healing process
- C. what the leading causes of death are
- D. how to give support to a grieving friend

[gate2011-cse](#) [verbal-aptitude](#) [passage-reading](#) [normal](#)

Answer

**11.10.3 Passage Reading: GATE CSE 2013 | Question: 63** top ↗<https://gateoverflow.in/1567>

After several defeats in wars, Robert Bruce went in exile and wanted to commit suicide. Just before committing suicide, he came across a spider attempting tirelessly to have its net. Time and again, the spider failed but that did not

deter it to refrain from making attempts. Such attempts by the spider made Bruce curious. Thus, Bruce started observing the near-impossible goal of the spider to have the net. Ultimately, the spider succeeded in having its net despite several failures. Such act of the spider encouraged Bruce not to commit suicide. And then, Bruce went back again and won many a battle, and the rest is history.

Which one of the following assertions is best supported by the above information?

- A. Failure is the pillar of success.
- B. Honesty is the best policy.
- C. Life begins and ends with adventures.
- D. No adversity justifies giving up hope.

[gate2013-cse](#) [verbal-aptitude](#) [passage-reading](#) [normal](#)

Answer 

#### 11.10.4 Passage Reading: GATE CSE 2014 Set 1 | Question: GA-6 [top](#)

<https://gateoverflow.in/774>



The Palghat Gap (or Palakkad Gap) , a region about 30 km wide in the southern part of the Western Ghats in India, is lower than the hilly terrain to its north and south. The exact reasons for the formation of this gap are not clear. It results in the neighbouring regions of Tamil Nadu getting more rainfall from the South West monsoon and the neighbouring regions of Kerala having higher summer temperatures.

What can be inferred from this passage?

Select one:

- A. The Palghat gap is caused by high rainfall and high temperatures in southern Tamil Nadu and Kerala
- B. The regions in Tamil Nadu and Kerala that are near the Palghat Gap are low-lying
- C. The low terrain of the Palghat Gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala
- D. Higher summer temperatures result in higher rainfall near the Palghat Gap area

[gate2014-cse-set1](#) [verbal-aptitude](#) [passage-reading](#) [normal](#)

Answer 

#### 11.10.5 Passage Reading: GATE CSE 2014 Set 2 | Question: GA-6 [top](#)

<https://gateoverflow.in/1943>



The old city of Koenigsberg, which had a German majority population before World War 2, is now called Kaliningrad. After the events of the war, Kaliningrad is now a Russian territory and has a predominantly Russian population. It is bordered by the Baltic Sea on the north and the countries of Poland to the south and west and Lithuania to the east respectively. Which of the statements below can be inferred from this passage?

- A. Kaliningrad was historically Russian in its ethnic make up
- B. Kaliningrad is a part of Russia despite it not being contiguous with the rest of Russia
- C. Koenigsberg was renamed Kaliningrad, as that was its original Russian name
- D. Poland and Lithuania are on the route from Kaliningrad to the rest of Russia

[gate2014-cse-set2](#) [verbal-aptitude](#) [passage-reading](#) [normal](#)

Answer 

#### 11.10.6 Passage Reading: GATE CSE 2014 Set 2 | Question: GA-7 [top](#)

<https://gateoverflow.in/1944>



Number of people diagnosed with dengue fever (contracted from the bite of a mosquito) in North India is twice the number diagnosed last year. Municipal authorities have concluded that measures to control the mosquito population have failed in this region.

Which one of the following statements, if true, does not contradict this conclusion?

- A. A high proportion of the affected population has returned from neighbouring countries where dengue is prevalent
- B. More cases of dengue are now reported because of an increase in the Municipal Office's administrative efficiency
- C. Many more cases of dengue are being diagnosed this year since the introduction of a new and effective diagnostic test
- D. The number of people with malarial fever (also contracted from mosquito bites) has increased this year

gate2014-cse-set2 verbal-aptitude passage-reading normal

Answer 

### 11.10.7 Passage Reading: GATE CSE 2014 Set 3 | Question: GA-6 top ↗

<https://gateoverflow.in/2029>



A dance programme is scheduled for 10.00 a.m. Some students are participating in the programme and they need to come an hour earlier than the start of the event. These students should be accompanied by a parent. Other students and parents should come in time for the programme. The instruction you think that is appropriate for this is

- A. Students should come at 9.00 a.m. and parents should come at 10.00 a.m.
- B. Participating students should come at 9.00 a.m. accompanied by a parent, and other parents and students should come by 10.00 a.m.
- C. Students who are not participating should come by 10.00 a.m. and they should not bring their parents. Participating students should come at 9.00 a.m.
- D. Participating students should come before 9.00 a.m. Parents who accompany them should come at 9.00 a.m. All others should come at 10.00 a.m.

gate2014-cse-set3 verbal-aptitude passage-reading easy

Answer 

### 11.10.8 Passage Reading: GATE CSE 2014 Set 3 | Question: GA-7 top ↗

<https://gateoverflow.in/2031>



By the beginning of the 20<sup>th</sup> century, several hypotheses were being proposed, suggesting a paradigm shift in our understanding of the universe. However, the clinching evidence was provided by experimental measurements of the position of a star which was directly behind our sun.

Which of the following inference(s) may be drawn from the above passage?

- i. Our understanding of the universe changes based on the positions of stars
  - ii. Paradigm shifts usually occur at the beginning of centuries
  - iii. Stars are important objects in the universe
  - iv. Experimental evidence was important in confirming this paradigm shift
- A. i, ii and iv
  - B. iii only
  - C. i and iv
  - D. iv only

gate2014-cse-set3 verbal-aptitude passage-reading easy

Answer 

### 11.10.9 Passage Reading: GATE CSE 2015 Set 3 | Question: GA-9 top ↗

<https://gateoverflow.in/8388>



Most experts feel that in spite of possessing all the technical skills required to be a batsman of the highest order, he is unlikely to be so due to lack of requisite temperament. He was guilty of throwing away his wicket several times after working hard to lay a strong foundation. His critics pointed out that until he addressed his problem, success at the highest level will continue to elude him.

Which of the statement(s) below is/are logically valid and can be inferred from the above passage?

- i. He was already a successful batsman at the highest level.
  - ii. He was to improve his temperament in order to become a great batsman.
  - iii. He failed to make many of his good starts count.
  - iv. Improving his technical skills will guarantee success.
- A. iii and iv
  - B. ii and iii
  - C. i, ii and iii
  - D. ii only

gate2015-cse-set3 verbal-aptitude normal passage-reading

Answer 

**11.10.10 Passage Reading: GATE CSE 2016 Set 2 | Question: GA-07** [top](#)<https://gateoverflow.in/39533>

Computers were invented for performing only high-end useful computations. However, it is no understatement that they have taken over our world today. The internet, for example, is ubiquitous. Many believe that the internet itself is an unintended consequence of the original invention. With the advent of mobile computing on our phones, a whole new dimension is now enabled. One is left wondering if all these developments are good or, more importantly, required.

Which of the statement(s) below is/are logically valid and can be inferred from the above paragraph?

- (i) The author believes that computers are not good for us.
- (ii) Mobile computers and the internet are both intended inventions.
- A. (i) only
- B. (ii) only
- C. Both (i) and (ii)
- D. Neither (i) nor (ii)

[gate2016-cse-set2](#) [verbal-aptitude](#) [passage-reading](#) [normal](#)

Answer

**11.10.11 Passage Reading: GATE CSE 2017 Set 1 | Question: GA-6** [top](#)<https://gateoverflow.in/118409>

"The hold of the nationalist imagination on our colonial past is such that anything inadequately or improperly nationalist is just not history."

Which of the following statements best reflects the author's opinion?

- A. Nationalists are highly imaginative.
- B. History is viewed through the filter of nationalism.
- C. Our colonial past never happened.
- D. Nationalism has to be both adequately and properly imagined.

[gate2017-cse-set1](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)

Answer

**11.10.12 Passage Reading: GATE2010 MN: GA-6** [top](#)<https://gateoverflow.in/312015>

The ban on smoking in designated public places can save a large number of people from the well-known effects of environmental tobacco smoke. Passive smoking seriously impairs respiratory health. The ban rightly seeks to protect non-smokers from its ill effects.

Which of the following statements best sums up the meaning of the above passage:

- A. Effects of environmental tobacco are well known.
- B. The ban on smoking in public places protects the non-smokers.
- C. Passive smoking is bad for health.
- D. The ban on smoking in public places excludes passive smoking.

[passage-reading](#) [verbal-aptitude](#) [gate2010-mn](#)

Answer

**11.10.13 Passage Reading: GATE2010 TF: GA-6** [top](#)<https://gateoverflow.in/312025>

It has taken fifty-six long and frustrating, years to turn bronze, into gold for India's Olympics aspirations . Beijing 2008 marks a defining moment in India's Olympic history. From Delhi to Beijing is a long journey but one that our Olympians have undertaken with courage.

Which of the following statement best sums up the meaning of the above passage :

- A. India's participation in Olympics has been frustrating.
- B. Beijing Olympics was a landmark in India's Olympic history.
- C. Our Olympians have undertaken a long journey to Beijing.
- D. India's bronze medal turned into gold at Beijing.

[general-aptitude](#) [verbal-aptitude](#) [gate2010-tf](#) [passage-reading](#)

Answer 

#### 11.10.14 Passage Reading: GATE2011 AG: GA-10 [top](#)

<https://gateoverflow.in/312132>



**The horse has played a little known but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serums to fight with diphtheria and tetanus were developed this way.**

It can be inferred from the passage, that horses were

- A. given immunity to diseases
- B. generally quite immune to diseases
- C. given medicines to fight toxins
- D. given diphtheria and tetanus serums

[general-aptitude](#) [verbal-aptitude](#) [gate2011-ag](#) [passage-reading](#)

Answer 

#### 11.10.15 Passage Reading: GATE2011 GG: GA-10 [top](#)

<https://gateoverflow.in/40211>



**In order to develop to full potential, a baby needs to be physically able to respond to the environment.**

It can be inferred from the passage that

- A. Full physical potential is needed in order for a baby to be able to respond to the environment.
- B. It is necessary for a baby to be able to physically respond to the environment for it to develop its full potential.
- C. Response to the environment of physically able babies needs to be developed to its full potential.
- D. A physically able baby needs to develop its full potential in order to respond to its environment.

[gate2011-gg](#) [logical-reasoning](#) [passage-reading](#)

Answer 

#### 11.10.16 Passage Reading: GATE2011 MN: GA-65 [top](#)

<https://gateoverflow.in/31545>



**Nimbus clouds are dark and ragged, stratus clouds appear dull in colour and cover the entire sky. Cirrus clouds are thin and delicate, whereas cumulus clouds look like cotton balls.**

It can be inferred from the passage that

- A. A cumulus cloud on the ground is called fog
- B. It is easy to predict the weather by studying clouds
- C. Clouds are generally of very different shapes, sizes and mass
- D. There are four basic cloud types: stratus, nimbus, cumulus and cirrus

[gate2011-mn](#) [verbal-aptitude](#) [passage-reading](#)

Answer 

#### 11.10.17 Passage Reading: GATE2012 AE: GA-10 [top](#)

<https://gateoverflow.in/40221>



**In the early nineteenth century, theories of social evolution were inspired less by Biology than by the conviction of social scientists that there was a growing improvement in social institutions. Progress was taken for granted and social scientists attempted to discover its laws and phases.**

Which one of the following inferences may be drawn with the greatest accuracy from the above passage?  
Social scientists

- A. did not question that progress was a fact.
- B. did not approve of Biology.
- C. framed the laws of progress.
- D. emphasized Biology over Social Sciences.

[gate2012-ae](#)
[verbal-aptitude](#)
[passage-reading](#)
**Answer**

### 11.10.18 Passage Reading: GATE2012 AR: GA-10 [top](#)

<https://gateoverflow.in/40231>

**The documents expose the cynicism of the government officials – and yet as the media website reflects, not a single newspaper has reported on their existence.**

Which one of the following inferences may be drawn with the greatest accuracy from the above passage?

- A. Nobody other than the government officials knew about the existence of the documents.
- B. Newspapers did report about the documents but nobody cared.
- C. Media reports did not show the existence of the documents.
- D. The documents reveal the attitude of the government officials.

[gate2012-ar](#)
[verbal-aptitude](#)
[passage-reading](#)
**Answer**

### 11.10.19 Passage Reading: GATE2012 CY: GA-6 [top](#)

<https://gateoverflow.in/40237>

**One of the legacies of the Roman legions was discipline. In the legions, military law prevailed and discipline was brutal. Discipline on the battlefield kept units obedient, intact and fighting, even when the odds and conditions were against them.**

Which one of the following statements best sums up the meaning of the above passage?

- A. Thorough regimentation was the main reason for the efficiency of the Roman legions even in adverse circumstances.
- B. The legions were treated inhumanly as if the men were animals.
- C. Discipline was the armies' inheritance from their seniors.
- D. The harsh discipline to which the legions were subjected to led to the odds and conditions being against them.

[gate2012-cy](#)
[verbal-aptitude](#)
[passage-reading](#)
**Answer**

### 11.10.20 Passage Reading: GATE2014 AE: GA-3 [top](#)

<https://gateoverflow.in/40302>

Rajan was not happy that Sajan decided to do the project on his own. On observing his unhappiness, Sajan explained to Rajan that he preferred to work independently.

Which one of the statements below is logically valid and can be inferred from the above sentences?

- A. Rajan has decided to work only in a group.
- B. Rajan and Sajan were formed into a group against their wishes.
- C. Sajan had decided to give in to Rajan's request to work with him.
- D. Rajan had believed that Sajan and he would be working together.

[gate2014-ae](#)
[passage-reading](#)
[logical-reasoning](#)
**Answer**

### 11.10.21 Passage Reading: GATE2014 AG: GA-7 [top](#)

<https://gateoverflow.in/41671>

Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis. From “BIG DATA” Viktor Mayer-Schonberger and Kenneth Cukier. The main point of the paragraph is:

- A. The twenty-first century is a digital world
- B. Big data is obsessed with exactness
- C. Exactitude is not critical in dealing with big data

- D. Sparse data leads to a bias in the analysis

gate2014-ag verbal-aptitude passage-reading normal

Answer 

#### 11.10.22 Passage Reading: GATE2014 EC-1: GA-7 top ↗

<https://gateoverflow.in/41496>



For submitting tax returns, all resident males with annual income below Rs 10 lakh should fill up Form *P* and all resident females with income below Rs 8 lakh should fill up Form *Q*. All people with incomes above Rs 10 lakh should fill up Form *R*, except non residents with income above Rs 15 lakhs, who should fill up Form *S*. All others should fill Form *T*. An example of a person who should fill Form *T* is

- A. A resident male with annual income Rs 9 lakh
- B. A resident female with annual income Rs 9 lakh
- C. A non-resident male with annual income Rs 16 lakh
- D. A non-resident female with annual income Rs 16 lakh

gate2014-ec-1 verbal-aptitude passage-reading normal

Answer 

#### 11.10.23 Passage Reading: GATE2015 EC-1: GA-7 top ↗

<https://gateoverflow.in/39495>



Read the following paragraph and choose the correct statement.

Climate change has reduced human security and threatened human well being. An ignored reality of human progress is that human security largely depends upon environmental security. But on the contrary, human progress seems contradictory to environmental security. To keep up both at the required level is a challenge to be addressed by one and all. One of the ways to curb the climate change may be suitable scientific innovations, while the other may be the Gandhian perspective on small scale progress with focus on sustainability.

- A. Human progress and security are positively associated with environmental security.
- B. Human progress is contradictory to environmental security.
- C. Human security is contradictory to environmental security.
- D. Human progress depends upon environmental security

gate2015-ec-1 general-aptitude verbal-aptitude passage-reading

Answer 

#### 11.10.24 Passage Reading: GATE2015 EC-3: GA-10 top ↗

<https://gateoverflow.in/39523>



Ms. *X* will be in Bagdogra from 01/05/2014 to 20/05/2014 and from 22/05/2014 to 31/05/2014. On the morning of 21/05/2014, she will reach Kochi via Mumbai.

Which one of the statements below is logically valid and can be inferred from the above sentences?

- A. Ms. *X* will be in Kochi for one day, only in May.
- B. Ms. *X* will be in Kochi for only one day in May.
- C. Ms. *X* will be only in Kochi for one day in May.
- D. Only Ms. *X* will be in Kochi for one day in May.

gate2015-ec-3 verbal-aptitude passage-reading

Answer 

#### 11.10.25 Passage Reading: GATE2016 CE-2: GA-7 top ↗

<https://gateoverflow.in/110913>



Today, we consider Ashoka as a great ruler because of the copious evidence he left behind in the form of stone carved edicts. Historians tend to correlate greatness of a king at his time with the availability of evidence today. Which of the following can be logically inferred from the above sentences?

- A. Emperors who do not leave significant sculpted evidence are completely forgotten.
- B. Ashoka produced stone carved edicts to ensure that later historians will respect him.
- C. Statues of kings are a reminder of their greatness.
- D. A king's greatness, as we know him today, is interpreted by historians.

[gate2016-ce-2](#)
[passage-reading](#)
[verbal-aptitude](#)
[Answer](#)
**11.10.26 Passage Reading: GATE2016 EC-2: GA-7**
top ↗
<https://gateoverflow.in/108717>


Social science disciplines were in existence in an amorphous form until the colonial period when they were institutionalized. In varying degrees, they were intended to further the colonial interest. In the time of globalization and the economic rise of postcolonial countries like India, conventional ways of Knowledge production have become obsolete.

Which of the following can be logically inferred from the above statements?

- (i) Social science disciplines have become obsolete.
  - (ii) Social science disciplines had a pre-colonial origin.
  - (iii) Social science disciplines always promote colonialism.
  - (iv) Social science must maintain disciplinary boundaries.
- A. (ii) only  
 B. (i) and (iii) only.  
 C. (ii) and (iv) only.  
 D. (iii) and (iv) only.

[gate2016-ec-2](#)
[logical-reasoning](#)
[passage-reading](#)
[Answer](#)
**11.10.27 Passage Reading: GATE2016 EC-3: GA-7**
top ↗
<https://gateoverflow.in/110844>


The overwhelming number of people infected with rabies in India has been flagged by the World Health Organization as a source of concern. It is estimated that inoculating 70% of pets and stray dogs against rabies can lead to a significant reduction in the number of people infected with rabies.

Which of the following can be logically inferred from the above sentences?

- A. The number of people in India infected with rabies is high.
- B. The number of people in other parts of the world who are infected with rabies is low.
- C. Rabies can be eradicated in India by vaccinating 70% of stray dogs.
- D. Stray dogs are the main source of rabies worldwide.

[gate2016-ec-3](#)
[verbal-aptitude](#)
[passage-reading](#)
[Answer](#)
**11.10.28 Passage Reading: GATE2017 CE-1: GA-6**
top ↗
<https://gateoverflow.in/313486>


The old concert hall was demolished because of fears that the foundation would be affected by the construction of the new metro line in the area. Modern technology for underground metro construction tried to mitigate the impact of pressurized air pockets created by the excavation of large amounts of soil. But even with these safeguards, it was feared the soil below the concert hall would not be stable.

From this, one can infer that

- A. the foundations of old buildings create pressurized air pockets underground, which are difficult to handle during metro construction.
- B. metro construction has to be done carefully considering its impact on the foundations of existing buildings.
- C. old buildings in an area from an impossible hurdle to metro construction in that area.
- D. pressurized air can be used to excavate large amount of soil from underground areas.

[gate2017-ce-1](#)
[general-aptitude](#)
[verbal-aptitude](#)
[passage-reading](#)
[Answer](#)
**11.10.29 Passage Reading: GATE2017 CE-2: GA-6**
top ↗
<https://gateoverflow.in/313422>


Bhaichung was observing the pattern of people entering and leaving a car service centre. There was a single window where customers were being served. He saw that people inevitably came out of the centre in the order that they went

in. However, the time they spent inside seemed to vary a lot: some people came out in a matter of minutes while for others it took much longer.

From this, what can conclude?

- The centre operators on a first-come-first-served basis, but with variable service times, depending on specific customer needs.
- Customers were served in an arbitrary order, since they took varying amounts of time for service completion in the centre.
- Since some people came out within a few minutes of entering the centre, the system is likely to operate on a last-come-first-served basis.
- Entering the centre early ensured that one would have shorter service times and most people attempted to do this.

[gate2017-ce-2](#) [verbal-aptitude](#) [passage-reading](#)

Answer 

#### 11.10.30 Passage Reading: GATE2017 CE-2: GA-7 [top](#)

<https://gateoverflow.in/313423>



A map shows the elevations of Darjeeling, Gangtok, Kalimpong, Pelling, and Siliguri. Kalimpong is at a lower elevation than Gangtok, Pelling is at a lower elevation than Gangtok. Pelling is at a higher elevation than Siliguri. Darjeeling is at a higher elevation than Gangtok.

Which of the following statement can be inferred from the paragraph above?

- Pelling is at a higher elevation than Kalimpong
  - Kalimpong is at a lower elevation than Darjeeling
  - Kalimpong is at a higher elevation than Siliguri
  - Siliguri is at a lower elevation than Gangtok
- Only ii
  - Only ii and iii
  - Only ii and iv
  - Only iii and iv

[gate2017-ce-2](#) [verbal-aptitude](#) [passage-reading](#) [logical-reasoning](#)

Answer 

#### 11.10.31 Passage Reading: GATE2017 EC-2: GA-6 [top](#)

<https://gateoverflow.in/313516>



"If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for all reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for impartial recording of these matters".

Which of the following statements best reflects the author's opinion?

- An intimate association does not allow for the necessary perspective.
- Matters are recorded with an impartial perspective.
- An intimate association offers an impartial perspective.
- Actors are typically associated with the impartial recording of matters.

[gate2017-ec-2](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)

Answer 

#### 11.10.32 Passage Reading: GATE2017 ME-1: GA-6 [top](#)

<https://gateoverflow.in/313667>



"Here, throughout the early 1820s, Stuart continued to fight his losing battle to allow his sepoys to wear their caste-marks and their own choice of facial hair on parade, being again reprimanded by the commander-in-chief. His retort that 'A stronger instance than this of European prejudice with relation to this country has never come under my observations' had no effect on his superiors."

According to this paragraph, which of the statements below is most accurate?

- Stuart's commander-in-chief was moved by this demonstration of his prejudice.
- The Europeans were accommodating of the sepoy's desire to wear their caste-marks.

- C. Stuart's 'losing-battle' refers to his inability to succeed in enabling sepoys to wear caste-marks.  
 D. The commander-in-chief was exempt from the Europeans prejudice that dictated how the sepoys were to dress.

gate2017-me-1 general-aptitude verbal-aptitude passage-reading easy

Answer 

#### 11.10.33 Passage Reading: GATE2017 ME-2: GA-6

<https://gateoverflow.in/313678>



"If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters."

Which of the following is closest in meaning to 'cleaving'?

- A. deteriorating  
 B. arguing  
 C. departing  
 D. splitting

gate2017-me-2 general-aptitude verbal-aptitude passage-reading

Answer 

#### 11.10.34 Passage Reading: GATE2018 EC: GA-10

<https://gateoverflow.in/205214>



A coastal region with unparalleled beauty is home to many species of animals. It is dotted with coral reefs and unspoilt white sandy beaches. It has remained inaccessible to tourists due to poor connectivity and lack of accommodation. A company has spotted the opportunity and is planning to develop a luxury resort with helicopter service to the nearest major city airport. Environmentalists are upset that this would lead to the region becoming crowded and polluted like any other major beach resorts.

Which one of the following statements can be logically inferred from the information given in the above paragraph?

- A. The culture and tradition of the local people will be influenced by the tourists.  
 B. The region will become crowded and polluted due to tourism.  
 C. The coral reefs are on the decline and could soon vanish.  
 D. Helicopter connectivity would lead to an increase in tourists coming to the region.

gate2018-ec general-aptitude verbal-aptitude normal passage-reading

Answer 

#### 11.10.35 Passage Reading: GATE2018 EC: GA-8

<https://gateoverflow.in/205212>



The Cricket Board has long recognized John's potential as a leader of the team. However, his on-field temper has always been a matter of concern for them since his junior days. While this aggression has filled stadia with die-hard fans, it has taken a toll on his own batting. Until recently, it appeared that he found it difficult to convert his aggression into big scores. Over the past three seasons though, that picture of John has been replaced by a cerebral, calculative and successful batsman-captain. After many years, it appears that the team has finally found a complete captain.

Which of the following statements can be logically inferred from the above paragraph?

- Even as a junior cricketer, John was considered a good captain.
  - Finding a complete captain is a challenge.
  - Fans and the Cricket Board have differing views on what they want in a captain.
  - Over the past three seasons, John has accumulated big scores.
- A. (i), (ii) and (iii) only  
 B. (iii) and (iv) only  
 C. (ii) and (iv) only  
 D. (i), (ii), (iii) and (iv)

gate2018-ec general-aptitude verbal-aptitude normal passage-reading

**Answer****11.10.36 Passage Reading: GATE2019 CE-1: GA-6** top ↗<https://gateoverflow.in/313445>

The new cotton technology, Bollgard\_II, with herbicide-tolerant traits has developed into a thriving business in India. However, the commercial use of this technology is not legal in India. Notwithstanding that, reports indicate that the herbicide tolerant Bt cotton had been purchased by farmers at an average of Rs 200 more than the control price of ordinary cotton, and planted in 15% of the cotton growing area in the 2017 Kharif season.

Which one of the following statements can be inferred from the given passage?

- A. Farmers want to access the new technology if India benefits from it
- B. Farmers want to access the new technology even if it is not legal
- C. Farmers want to access the new technology for experimental purposes
- D. Farmers want to access the new technology by paying high price

[gate2019-ce-1](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)**Answer****11.10.37 Passage Reading: GATE2019 CE-2: GA-10** top ↗<https://gateoverflow.in/313375>

"Popular Hindi fiction, despite - or perhaps because of - its wide reach, often does not appear in our cinema. As ideals that viewers are meant to look up to rather identify with, Hindi film protagonists usually read books of aspirational value: textbook, English books, or high-value literature."

Which one of the following CANNOT be inferred from the paragraph above?

- A. Though popular Hindi fiction has wide reach, it often does not appear in the movies
- B. Protagonists in Hindi movies, being ideals for viewers, read only books of aspirational value
- C. Textbooks, English books or high literature have aspirational value, but not popular Hindi fiction
- D. People do not look up to writers of textbook, English books or high-value literature

[gate2019-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)**Answer****11.10.38 Passage Reading: GATE2019 CE-2: GA-8** top ↗<https://gateoverflow.in/313381>

*The Newspaper* reports that over 500 hectares of tribal land spread across 28 tribal settlements in Mohinitampuram forest division have already been "alienated". A top forest official said, "First the tribals are duped out of their land holdings. Second, the families thus rendered landless are often forced to encroach further into the forests".

On the basis of the information available in the paragraph, \_\_\_\_\_ is /are responsible for duping the tribals.

- A. forest officials
- B. landless families
- C. *The Newspaper*
- D. it can not be inferred who

[gate2019-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)**Answer****11.10.39 Passage Reading: GATE2019 EC: GA-8** top ↗<https://gateoverflow.in/313540>

"Indian history was written by British historians-extremely well documented and researched, but not always impartial. History had to serve its purpose: Everything was made subservient to the glory of the Union Jack. Latter-day Indian scholars presented a contrary picture."

From the text above, we can infer that:

India history written by British historians \_\_\_\_\_

- A. was well documented and not researched but was always biased
- B. was not well documented and researched and was always biased
- C. was well documented and researched but was sometimes biased
- D. was not well documented and researched and was sometimes biased

[gate2019-ec](#) [general-aptitude](#) [verbal-aptitude](#) [easy](#) [passage-reading](#)
[Answer](#)

#### 11.10.40 Passage Reading: GATE2019 EE: GA-8 [top](#)

<https://gateoverflow.in/313747>



An award-winning study by a group of researchers suggests that men are as prone to buying on impulse as women but women feel more guilty about shopping.

Which one of the following statements can be inferred from the given text?

- A. Some men and women indulge in buying on impulse
- B. All men and women indulge in buying on impulse
- C. Few men and women indulge in buying on impulse
- D. Many men and women indulge in buying on impulse

[gate2019-ee](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)
[Answer](#)

#### 11.10.41 Passage Reading: GATE2019 IN: GA-10 [top](#)

<https://gateoverflow.in/313555>



"I read somewhere that in ancient times the prestige of a kingdom depended upon the number of taxes that it was able to levy on its people. It was very much like the prestige of a head-hunter in his own community."

Based on the paragraph above, the prestige of a head-hunter depended upon \_\_\_\_\_

- A. the prestige of the kingdom
- B. the prestige of the heads
- C. the number of taxes he could levy
- D. the number of heads he could gather

[gate2019-in](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)
[Answer](#)

#### 11.10.42 Passage Reading: GATE2019 IN: GA-8 [top](#)

<https://gateoverflow.in/313554>



The nomenclature of Hindustani music has changed over the centuries. Since the medieval period, *dhrupad* styles were identified as *baanis*. Terms like *gayaki* and *baaj* were used to refer to vocal and instrumental styles, respectively. With the institutionalization of music education, the term *gharana* became acceptable. *Gharana* originally referred to hereditary musicians from a particular lineage, including disciples and grand disciples.

Which one of the following pairings is NOT correct?

- A. *dhrupad, baani*
- B. *gayaki, vocal*
- C. *baaj, institution*
- D. *gharana, lineage*

[gate2019-in](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)
[Answer](#)

#### 11.10.43 Passage Reading: GATE2019 ME-1: GA-8 [top](#)

<https://gateoverflow.in/313606>



Congo was named by Europeans, Congo's dictator Mobuto later changed the name of the country and the river to Zaire with the objective of Africanising names of persons and spaces. However, the name Zaire was a Portuguese alteration of *Nzadi o Nzere*, a local African term meaning 'River that swallows Rivers'. Zaire was the Portuguese name for the Congo river in the 16th and 17th centuries.

Which one of the following statements can be inferred from the paragraph above?

- A. Mobuto was not entirely successful in Africanising the name of his country
- B. The term *Nzadi o Nzere* was of Portuguese origin
- C. Mobuto's desire to Africanise names was prevented by the Portuguese
- D. As a dictator Mobuto ordered the Portuguese to alter the name of the river to Zaire

[gate2019-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)

**Answer****11.10.44 Passage Reading: GATE2019 ME-2: GA-10** [top](#)<https://gateoverflow.in/313594>

*X* is an online media provider. By offering unlimited and exclusive online content at attractive prices for a loyalty membership, *X* is almost forcing its customers towards its loyalty membership. If its royalty membership continues to grow at its current rate, within the next eight years more households will be watching *X* than cable television.

Which one of the following statements can be inferred from the above paragraph?

- A. Most households that subscribe to *X*'s loyalty membership discontinue watching cable television
- B. Non-members prefer to watch cable television
- C. Cable television operators don't subscribe to *X*'s loyalty members
- D. The *X* is cancelling accounts of non-members

[gate2019-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)**Answer****11.10.45 Passage Reading: GATE2019 ME-2: GA-8** [top](#)<https://gateoverflow.in/313592>

While teaching a creative writing class in India, I was surprised at receiving stories from the students that were all set in distant places: in the American West with cowboys and in Manhattan penthouses with clinking ice cubes. This was, till an eminent Caribbean writer gave the writers in the once-colonised countries the confidence to see the shabby lives around them as worthy being "told".

The writer of this passage is surprised by the creative writing assignments of his students, because \_\_\_\_\_

- A. Some of the students had written stories set in foreign places
- B. None of the students had written stories set in India
- C. None of the students had written about ice cubes and cowboys
- D. Some of the students had written about ice cubes and cowboys

[gate2019-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#)**Answer****Answers: Passage Reading****11.10.1 Passage Reading: GATE CSE 2010 | Question: 63** [top](#)<https://gateoverflow.in/2371>

- ✓ D. People in military establishments like to use chemical agents in war.

[11 votes](#)

-- Kathleen Bankson (51.6k points)

**11.10.2 Passage Reading: GATE CSE 2011 | Question: 61** [top](#)<https://gateoverflow.in/2171>

- ✓ Based on the passage, the unit on bereavement must include topics which can help one overcome losses from death and parting. So, options (A), (B) and (D) are suitable topics but (C) is not helping here.

Option: C

[1 votes](#)

-- Arjun Suresh (328k points)

**11.10.3 Passage Reading: GATE CSE 2013 | Question: 63** [top](#)<https://gateoverflow.in/1567>

- ✓ D is my answer. He gave up hope and wanted to commit suicide until he saw the spider in his struggles so no struggle or difficulty is worth giving up hope. Continue on!

[18 votes](#)

-- Kathleen Bankson (51.6k points)

**11.10.4 Passage Reading: GATE CSE 2014 Set 1 | Question: GA-6** [top](#)<https://gateoverflow.in/774>

- ✓ The answer is C. The primary statement is about the Palghat Gap being low lying which is mentioned in the first sentence. The second part mentions the results of that causing lots of rain and unusual temperatures in the other areas. (Tamil Nadu and Kerala)

[11 votes](#)

-- Kathleen Bankson (51.6k points)

11.10.5 Passage Reading: GATE CSE 2014 Set 2 | Question: GA-6 [top](#)<https://gateoverflow.in/1943>

option A)

**!** The old city of Koenigsberg, which had a German majority population before World War 2, is now called Kaliningrad

This line clearly shows that Kaliningrad was historically German

**option C)** Don't just assume anything. No where it is mentioned why was the past name changed and what is the significance of the new name or its origin.

**option D)** Again no information about path which is b/w Russia and this kaliningrad. Why only this path why can't be Baltic sea?

**option B)** It is clearly mentioned that this Kaliningrad is surrounded by different countries like Lithuania and Poland so that means it is apart from rest of Russia.

Only option B can be inferred.

3 votes

-- Rupendra Choudhary (11.3k points)

11.10.6 Passage Reading: GATE CSE 2014 Set 2 | Question: GA-7 [top](#)<https://gateoverflow.in/1944>

D is closer to possibility and doesn't atleast contradict directly with any information.

A. The reason is provided for increase in dengue. It straightaway contradicts the given para.

B. Municipal Office's administrative efficiency has definitely not increased. To increase administrative efficiency is to improve the capability of institution to produce more desirable results. Apparently, it's not the case here. Contradiction

C. "new and effective diagnostic test (to detect dengue). It is clearly mentioned that the reason behind the increase in dengue cases is failure of control measures adopted by Municipal Authorities to control mosquito population (and not any flawed diagnostic test).

D. It doesn't contradict directly with any of the information given in paragraph. In fact there is a high probability this might happen as malaria and dengue both are caused by mosquitoes. And from that fact that mosquito population control measures has failed, we can say malaria might increase. (If it was mentioned that dengue increased because mosquitoes carrying dengue viruses has increased, then it would not be appropriate to conclude increase in malaria)

8 votes

-- Gaurav (4.8k points)

11.10.7 Passage Reading: GATE CSE 2014 Set 3 | Question: GA-6 [top](#)<https://gateoverflow.in/2029>

- A. Students should come at 9.00 a.m. and parents should come at 10.00 a.m. - Not correct as only participating are asked to come at 9.00 a.m.
- B. Participating students should come at 9.00 a.m. accompanied by a parent, and other parents and students should come by 10.00 a.m. - This is correct
- C. Students who are not participating should come by 10.00 a.m. and they should not bring their parents. Participating students should come at 9.00 a.m. - Not correct as it is not told that non participating students should not bring their parents.
- D. Participating students should come before 9.00 a.m. Parents who accompany them should come at 9.00 a.m. All others should come at 10.00 a.m. - Not correct as participating students need to come by 9.00 a.m. accompanied by their parents; there is no need for them to reach earlier than their parents.

Correct Answer: B.

3 votes

-- Arjun Suresh (328k points)

11.10.8 Passage Reading: GATE CSE 2014 Set 3 | Question: GA-7 [top](#)<https://gateoverflow.in/2031>

A paradigm shift means, a fundamental change in approach or underlying assumptions.

And a change in paradigm happens only when we have an experimented evidence. It is crucial to have an evidence.

In this para the evidence was provided by the experimental measurements of the position of a star which was directly behind our sun.

**Option D) suits well for the given para.**

8 votes

-- Srinath Jayachandran (2.9k points)

**11.10.9 Passage Reading: GATE CSE 2015 Set 3 | Question: GA-9** [top](#) <https://gateoverflow.in/8388>



- ✓ "possessing all the technical skills" - iv is false

"throwing away his wicket several time after working hard to lay a strong foundation" - iii is true

"he is unlikely to be so due to lack of requisite temperament" - ii is true

"success at the highest level will continue to elude him" - i is false

So, B.

14 votes

-- Arjun Suresh (328k points)

**11.10.10 Passage Reading: GATE CSE 2016 Set 2 | Question: GA-07** [top](#) <https://gateoverflow.in/39533>



- ✓ "Many believes that the internet itself is unintended consequence of the original invention. So (ii) statement does not follow from the passage."

The author has no where said that the computers are bad, authoring is talking about the way computers are being used today and the author questions this way. So, (i) statement does not follow.

Hence, option (d) is the answer.

14 votes

-- Ashish Deshmukh (1.3k points)

**11.10.11 Passage Reading: GATE CSE 2017 Set 1 | Question: GA-6** [top](#) <https://gateoverflow.in/118409>



- ✓ It says that we try to overlook facts of history which is not in favour of our nationalism interest.

So, B. history is viewed through nationalism.

11 votes

-- Aboveallplayer (12.5k points)

**11.10.12 Passage Reading: GATE2010 MN: GA-6** [top](#)

<https://gateoverflow.in/312015>



- ✓ "The **ban on smoking** in designated public places can save a large number of people from the well-known effects of environmental tobacco smoke. Passive smoking seriously impairs respiratory health. **The ban rightly seeks** to protect non-smokers from its ill effects."

Throughout the passage the main talk is about "ban". Though options A and C are mentioned in the passage, the main meaning of the passage is given by option B -- "The ban on smoking in public places protects the non-smokers."

Correct Option: B.

3 votes

-- Arjun Suresh (328k points)

**11.10.13 Passage Reading: GATE2010 TF: GA-6** [top](#)

<https://gateoverflow.in/312025>



- ✓ All the four options are true but the core of the passage is that "India won gold in Beijing Olympics for first time. The below sentence clearly highlights this.

"It has taken **fifty-six long and frustrating, years to turn bronze, into gold** for India's Olympics aspirations."

So, correct answer: D.

2 votes

-- Arjun Suresh (328k points)

**11.10.14 Passage Reading: GATE2011 AG: GA-10** [top](#)

<https://gateoverflow.in/312132>



- ✓ Horses were injected with toxins of diseases **until their blood built up immunities**

Immunity for diseases can be artificially given (take the case of smallpox).

So the answer is (A)

4 votes

-- Anand Vijayan (723 points)

**11.10.15 Passage Reading: GATE2011 GG: GA-10** top ↴<https://gateoverflow.in/40211>

- ✓ In order to develop to full potential, a baby needs to be physically able to respond to the environment.

- Full physical potential is needed in order for a baby to be able to respond to the environment. - this is the converse of the given statement; may or may not be true.
- It is necessary for a baby to be able to physically respond to the environment for it to develop its full potential. - same meaning as given statement.
- Response to the environment of physically able babies needs to be developed to its full potential. -- the given statement only says about responding to the environment; does not say that this response must be done with full potential. Full potential in the given statement is for the baby; not the response.
- A physically able baby needs to develop its full potential in order to respond to its environment. - this is same as option A; may or may not be TRUE.

Correct option: B.

1 votes

-- Arjun Suresh (328k points)

**11.10.16 Passage Reading: GATE2011 MN: GA-65** top ↴<https://gateoverflow.in/31545>

- ✓ Option A is wrong because nowhere 'fog' is referenced to any type of cloud in paragraph.

Option B is wrong because it is easy to predict whether from cloud but it is not referenced from given paragraph.

Option C is wrong because paragraph talks about the colour of all clouds but size of only '**stratus**' cloud. So, whether size of all clouds are same or different, we can not conclude.

But one thing is sure that all clouds are different type because at least we can differentiate them based on their colours .

**So, we are left with option(D). D is correct because the passage talks about 4 cloud types.**

2 votes

-- Shashank Kumar (2.2k points)

**11.10.17 Passage Reading: GATE2012 AE: GA-10** top ↴<https://gateoverflow.in/40221>

- did not question that progress was a fact. -- TRUE. "**Progress was taken for granted**" implies this.
- did not approve of Biology. -- FALSE. "**were inspired less by Biology**" does not mean that Biology was disapproved, it just means that Biology had less significance.
- framed the laws of progress.-- FALSE "**attempted to discover its laws**" shows that they only attempted and success is not mentioned.
- emphasized Biology over Social Sciences. -- FALSE. "**less by Biology than by the conviction of social scientists**" shows that it was the other way around.

Correct Option: A.

1 votes

-- Arjun Suresh (328k points)

**11.10.18 Passage Reading: GATE2012 AR: GA-10** top ↴<https://gateoverflow.in/40231>

- ✓ answer must be D according to me because if i check options A is wrong bcz in the passage they did not mention who knows or who does not know about the existence of document so A will be wrong. B totally irrelevant from passage and C is wrong bcz after reading the passage you got an idea media is waiting once they got the information about existence of document then they will expose them .. then remaining is **D which is related to passage so D will be answer according to me**

6 votes

-- rajan (4.4k points)

**11.10.19 Passage Reading: GATE2012 CY: GA-6** top ↴<https://gateoverflow.in/40237>

- ✓ The whole passage says about discipline and the line "Discipline on the battlefield kept units obedient, intact and fighting, even when the odds and conditions were against them" means Option A best sums up the meaning of the passage.

Option C can be inferred from the first sentence, but is not the main objective of the passage.

Options B and D cannot be inferred from the given passage.

Correct Option: A.

1 2 votes

-- Arjun Suresh (328k points)

#### 11.10.20 Passage Reading: GATE2014 AE: GA-3 [top](#)

<https://gateoverflow.in/40302>



- ✓ option A discarded: Sajan preferred to work independently
- option B discarded: No expectation so no unhappiness
- option C discarded: Sajan preferred to work independently
- option D **correct**: unhappy as he believed to be working together

1 4 votes

-- Prince Kumar (291 points)

#### 11.10.21 Passage Reading: GATE2014 AG: GA-7 [top](#)

<https://gateoverflow.in/41671>



- ✓ The paragraph is talking about the 'Things that must have to take care in todays "BIG DATA" world where we have to deal with enormous amount of data.'

In first line it is telling that we must have to reconsider our choices about "Exactitude" in this BIG DATA world. Now whether we have to neglect exactitude or put more weightage to it , is not clear at that level so read more.

In second line it is telling that in today's world when we're well connected thorough INTERNET, the way we handled data in past won't work now as now data is not that sparse. Now we're dealing with Big Data so we can't deal it with that conventional manner.

Now, here we come to the point. He said that in our past time when we were information deprived, we had to took care about exactitude. When data was sparse (means NOT BIG DATA) so we can suppose when we have limited information we must have to be very careful about every single piece of information. But in todays world when we're information affluent, we must not have to be that careful about Exactitude as even if we avoid some information it won't be a case that this act can cause bias in our analysis.

**So, we can see that option C matched with all this conclusions.**

1 5 votes

-- Rupendra Choudhary (11.3k points)

#### 11.10.22 Passage Reading: GATE2014 EC-1: GA-7 [top](#)

<https://gateoverflow.in/41496>



- ✓
- A. A resident male with annual income Rs 9 lakh - form *P*
- B. A resident female with annual income Rs 9 lakh - form *T*
- C. A non-resident male with annual income Rs 16 lakh - form *S*
- D. A non-resident female with annual income Rs 16 lakh - form *S*

So, correct option: B.

1 1 votes

-- Arjun Suresh (328k points)

#### 11.10.23 Passage Reading: GATE2015 EC-1: GA-7 [top](#)

<https://gateoverflow.in/39495>



- ✓
- human security largely depends upon environmental security. But on the contrary, human progress seems contradictory to environmental security

From the passage its clear that only B option is correct.

1 3 votes

-- Anurag Semwal (6.6k points)

#### 11.10.24 Passage Reading: GATE2015 EC-3: GA-10 [top](#)

<https://gateoverflow.in/39523>



- ✓
- 1. Ms. *X* will be in Kochi for one day, only in May.  
Means *X* will be in Kochi for one day and this happens only in May. The given passage does not say anything about what happens in other months.
- 2. Ms. *X* will be in Kochi for only one day in May.  
This is true, as *X* is in Kochi on May 21 and in all other days of MAY she is in Bagdogra.
- 3. Ms. *X* will be only in Kochi for one day in May.

False as she is also in Mumbai for one day in May.

4. Only Ms. X will be in Kochi for one day in May.

False as the passage does not say about other people not in Kochi for a day.

Correct Answer: B.

2 votes

-- Arjun Suresh (328k points)

#### 11.10.25 Passage Reading: GATE2016 CE-2: GA-7 [top](#)



- ✓ Correct answer is 'D'.

A and C are completely out of context so we can first eliminate those. Confusion is b/w B and D.

The given paragraph no where talked about the true intentions of, why the great Ashoka left copious evidences in the form of stone carved edicts. So we can't consider ourselves like He did it so that he can be remembered. So option B is out.

It's clearly mentioned that historians predict the greatness of a king by the availability of evidences of his time. It also says Ashoka left behind stone carved edicts and today, we consider Ashoka as a great ruler. So in that way D is the correct answer.

PS :- key point for such kind of questions is, do not just suppose anything. Just like good listener, be here good reader and apply common sense without making any assumption.

5 votes

-- Rupendra Choudhary (11.3k points)

#### 11.10.26 Passage Reading: GATE2016 EC-2: GA-7 [top](#)



- ✓ Statement III is wrong as their is no mention in passage about promotion of colonialism **always**, only mention their interest to increase it further.

"conventional ways of Knowledge production have become obsolete." this line supports statement (i) . but option B is false due to statement III .

and Statement IV are false clearly, not related to the passage. That makes option C and D false.

"Social science disciplines were in existence in an amorphous form( means without any clear form ) until the colonial period " this statement directly say Social science disciplines had a pre-colonial origin. which makes option A correct.

so answer is option A , statement (ii) .

4 votes

-- Bikram (58.3k points)

#### 11.10.27 Passage Reading: GATE2016 EC-3: GA-7 [top](#)



- ✓ The number of people in India infected with rabies is high  
**option A**

5 votes

-- Shobhit (13.5k points)

#### 11.10.28 Passage Reading: GATE2017 CE-1: GA-6 [top](#)



- ✓ The passage states that pressurized air pockets are created underground due to the excavation of a large amount of soil. So, options (A) and (D) are incorrect.

"because of fears that the foundation would be affected by the construction of the new metro line". This was a fear and not a fact. So, option (C) is also incorrect.

Correct answer is (B).

2 votes

-- Lakshman Patel (63.9k points)

#### 11.10.29 Passage Reading: GATE2017 CE-2: GA-6 [top](#)



- ✓ "He saw that people inevitably **came out of the centre in the order that they went in**"

This means customers were serviced on FCFS basis. This rules out options B and C.

"However, the time they spent inside seemed to vary a lot"

This makes option A correct.

Option D in no way can be inferred from the given passage.

Correct Option: A.

1 votes

-- Arjun Suresh (328k points)

**11.10.30 Passage Reading: GATE2017 CE-2: GA-7** top ↗<https://gateoverflow.in/313423>

- ✓ Using fist letter to denote the cities, we can arrange them in the order of elevations as (, means order is not sure)

$$\{\{S < P\}, K\} < G < D$$

So, options (ii) and (iv) can be concluded whereas we are not sure about (i) and (iii).

Correct Option: C.

3 votes

-- Arjun Suresh (328k points)

**11.10.31 Passage Reading: GATE2017 EC-2: GA-6** top ↗<https://gateoverflow.in/313516>

- ✓ "I lived too near the seat of events, and was **too intimately associated with the actors**, to get the perspective **needed for impartial recording** of these matters"

This statement shows that option A is TRUE and B, C and D are FALSE.

Correct option: A.

2 votes

-- Arjun Suresh (328k points)

**11.10.32 Passage Reading: GATE2017 ME-1: GA-6** top ↗<https://gateoverflow.in/313667>

- ✓ "Stuart continued to fight his losing battle to allow his sepoys to wear their caste-marks"

This shows that Option (C) is TRUE.

Options (A) and (B) are contradictory to the given passage.

"A stronger instance than this of European prejudice" shows that the commander-in-chief was not exempt from the European prejudice. So, option (D) is also contradictory to the given passage.

Correct Option: C.

0 votes

-- Arjun Suresh (328k points)

**11.10.33 Passage Reading: GATE2017 ME-2: GA-6** top ↗<https://gateoverflow.in/313678>

- ✓ The trigger is the phrase "*cleaving of the subcontinent into two*". Clearly, the answer is **D**

1 votes

-- Mukunda Madhava Nath (259 points)

**11.10.34 Passage Reading: GATE2018 EC: GA-10** top ↗<https://gateoverflow.in/205214>

- ✓ **(A) The culture and tradition of the local people will be influenced by the tourists.**

There is no information about the culture and tradition of local people.

So, this option is discarded.

- (B) The region will become crowded and polluted due to tourism.**

This is already written in the paragraph itself.

So, this option is discarded.

- (C) The coral reefs are on the decline and could soon vanish.**

There is no information about declination of the coral reefs.

So, this option is discarded.

- (D) Helicopter connectivity would lead to an increase in tourists coming to the region.**

This option can be logically inferred from the above paragraph

So, this is the answer **D**)

5 votes

-- Sukanya Das (9.9k points)

**11.10.35 Passage Reading: GATE2018 EC: GA-8** top ↴<https://gateoverflow.in/205212>

- ✓ (i) Even as a junior cricketer, John was considered a good captain.

- There is no information whether John is a captain when he was in the junior team. Only his potential was known.

**(ii) Finding a complete captain is a challenge.**

- We can infer this statement by reading the below line

After many years, it appears that the team has finally found a complete captain.

**(iii) Fans and the Cricket Board have differing views on what they want in a captain.**

- We can't infer this statement by reading the above paragraph. The paragraph only says fans liked aggression but not on what fans and cricket board want in a captain.

**(iv) Over the past three seasons, John has accumulated big scores.**

- This can be inferred by reading the below line

Over the past three seasons though, that picture of John has been replaced by a cerebral, calculative and successful batsman-captain.

Hence, (ii) and (iv) only are correct.

Answer (C)

5 votes

-- Sukanya Das (9.9k points)

**11.10.36 Passage Reading: GATE2019 CE-1: GA-6** top ↴<https://gateoverflow.in/313445>

- Farmers want to access the new technology if India benefits from it -- there is nothing in the passage that says that farmers are doing anything specifically for India's benefit.
- Farmers want to access the new technology even if it is not legal -- this is true as the passage says that the new technology is not legal and that the farmers are using it.
- Farmers want to access the new technology for experimental purposes -- it is not clear whether the farmers are using the new technology for experimental purposes. It can also be inferred that some of the farmers are using the new technology while others are not.
- Farmers want to access the new technology by paying high price -- this also cannot be inferred. The passage only says that the price of new technology is higher and it can be that the farmers are "forced to" buy them at high price.

Correct Option: B.

2 votes

-- Arjun Suresh (328k points)

**11.10.37 Passage Reading: GATE2019 CE-2: GA-10** top ↴<https://gateoverflow.in/313375>

- Popular Hindi fiction, despite – or perhaps because of – its wide reach, often does not appear in our cinema. -- makes option A true
- As ideals that viewers are meant to look up to rather identify with, Hindi film protagonists usually read books of aspirational value: -- can infer option B but "usually" does not imply "only".
- Hindi film protagonists usually read books of aspirational value: textbook, English books, or high-value literature -- makes option C true
- As ideals that viewers are meant to **look up to** rather identify with, Hindi film protagonists usually read books of aspirational value: textbook, English books, or high-value literature -- this is contradictory to option D.

So, options D and B cannot be inferred.

Official answer: D, B

1 votes

-- Arjun Suresh (328k points)

**11.10.38 Passage Reading: GATE2019 CE-2: GA-8** [top](#)<https://gateoverflow.in/313381>

- ✓ Ans D. The paragraph only says that tribals are duped but does not mention who duped them.

[1 votes](#)

-- Resmi Arjun (619 points)

**11.10.39 Passage Reading: GATE2019 EC: GA-8** [top](#)<https://gateoverflow.in/313540>

- ✓ It is given at the starting of the paragraph that the Indian history written by British historians was extremely well documented and researched and later it is intended to say that it was sometimes biased. The sentence 'but not always impartial' implies that it was sometimes biased.

So, the correct answer is (C).

[1 votes](#)

-- Lakshman Patel (63.9k points)

**11.10.40 Passage Reading: GATE2019 EE: GA-8** [top](#)<https://gateoverflow.in/313747>

- ✓ "men are as prone to buying on impulse as women"

This means there are "Some men" and "some women" who buy on impulse.

So, option A is true.

Option B is false as the passage does not say all men and women buy on impulse.

Option C is false as "Few" means almost none and "prone to buying" means the number is not so insignificant.

Option D can be debated as correct as the meaning of "many" can be ambiguous. Still option A is a safer pick.

Correct Answer: Option A.

[0 votes](#)

-- Arjun Suresh (328k points)

**11.10.41 Passage Reading: GATE2019 IN: GA-10** [top](#)<https://gateoverflow.in/313555>

- ✓ The analogy is between kingdom and head-hunter. Like kingdom collects taxes, head-hunter gather heads.

So, Option D.

[1 votes](#)

-- Arjun Suresh (328k points)

**11.10.42 Passage Reading: GATE2019 IN: GA-8** [top](#)<https://gateoverflow.in/313554>

- ✓ **dhrupad** styles were identified as **baanis** - Option A is correct

**gayaki** and **baaj** were used to refer to **vocal** - Option B is correct

**Gharana** originally referred to hereditary musicians from a **particular lineage** Option D is correct.

So, only Option C is not correct.

[1 votes](#)

-- Arjun Suresh (328k points)

**11.10.43 Passage Reading: GATE2019 ME-1: GA-8** [top](#)<https://gateoverflow.in/313606>

- ✓ As the paragraph states, dictator Mobuto wanted to Africanise the name of Congo but could not succeed as the new name given to the country was a Portuguese alteration. So, option (A) is correct.

Option (B) is wrong as the term *Nzadi o Nzere* is a local African term as per the passage.

There is no detail about any confrontation between Mobuto and Portuguese in the passage. So, options C and D are wrong.

Correct answer is (A).

[2 votes](#)

-- Lakshman Patel (63.9k points)

**11.10.44 Passage Reading: GATE2019 ME-2: GA-10** [top](#)<https://gateoverflow.in/313594>

- ✓ Answer (A)

Implied by the last sentence that states that more households will be watching X than cable television. This means more households that subscribe to X's loyalty membership will discontinue watching cable television.

4 votes

-- Shalini26 (449 points)

#### 11.10.45 Passage Reading: GATE2019 ME-2: GA-8 [top](#)

<https://gateoverflow.in/313592>



- ✓ "While teaching a creative writing class **in India**, I was **surprised** at receiving stories from the students that **were all** set in distant places"

This means the teacher got no story set in India.

Correct Answer: Option B.

0 votes

-- Arjun Suresh (328k points)

### 11.11

#### Phrasal Verbs (2) [top](#)

##### 11.11.1 Phrasal Verbs: GATE2016 CE-2: GA-2 [top](#)

<https://gateoverflow.in/110873>



He turned a deaf ear to my request.

What does the underlined phrasal verb mean?

- A. Ignored
- B. Appreciated
- C. Twisted
- D. Returned

[gate2016-ce-2](#) [general-aptitude](#) [english-grammar](#) [phrasal-verbs](#)

Answer

##### 11.11.2 Phrasal Verbs: GATE2016 EC-2: GA-3 [top](#)

<https://gateoverflow.in/108481>



After India's cricket world cup victory in 1985, Shrotria who was playing both tennis and cricket till then, decided to concentrate only on cricket. And the rest is history.

What does the underlined phrase mean in this context?

- A. History will rest in peace
- B. Rest is recorded in history books
- C. Rest is well known
- D. Rest is archaic

[gate2016-ec-2](#) [verbal-aptitude](#) [phrasal-verbs](#)

Answer

#### Answers: Phrasal Verbs

##### 11.11.1 Phrasal Verbs: GATE2016 CE-2: GA-2 [top](#)

<https://gateoverflow.in/110873>



- ✓ turned a deaf ear to → to ignore what someone says

∴ The answer will be **Option A)** *ignored*

2 votes

-- Subarna Das (11.3k points)

##### 11.11.2 Phrasal Verbs: GATE2016 EC-2: GA-3 [top](#)

<https://gateoverflow.in/108481>



- ✓ Ans: (C) rest is well known

The phrasal verb "rest is history" means that the later part of the story is well known.

4 votes

-- Arnabi Bej (5.8k points)

### 11.12

#### Phrase Meaning (2) [top](#)

**11.12.1 Phrase Meaning: GATE Mechanical 2020 Set 1 | GA Question: 4** top ↴<https://gateoverflow.in/359530>

I do not think you know the case well enough to have opinions. Having said that, I agree with your other point.

What does the phrase “having said that” mean in the given text?

- A. as opposed to what I have said
- B. despite what I have said
- C. in addition to what I have said
- D. contrary to what I have said

[gateme-2020-set1](#) [verbal-aptitude](#) [phrase-meaning](#)

Answer 

**11.12.2 Phrase Meaning: GATE Mechanical 2020 Set 2 | GA Question: 1** top ↴<https://gateoverflow.in/359557>

While I agree \_\_\_\_\_ his proposal this time, I do not often agree \_\_\_\_\_ him.

- A. to, with
- B. with, to
- C. with, with
- D. to, to

[gateme-2020-set2](#) [verbal-aptitude](#) [english-grammar](#) [phrase-meaning](#)

Answer 

**Answers: Phrase Meaning****11.12.1 Phrase Meaning: GATE Mechanical 2020 Set 1 | GA Question: 4** top ↴<https://gateoverflow.in/359530>

- ✓ I do not think you know the case well enough to have opinions.
  - So, I'm not expected to agree to your opinions.

Having said that, I agree with your other point.

- So, “having said that” is “not contradicting” but “adding something extra” which is “not in agreement” with the previous statement. “despite what I have said” is the correct meaning.

Correct Answer: B.

 1 votes

-- Arjun Suresh (328k points)

**11.12.2 Phrase Meaning: GATE Mechanical 2020 Set 2 | GA Question: 1** top ↴<https://gateoverflow.in/359557>

- ✓ “agree with” is used for referring to agreeing with a **person**

“agree to” is used for referring to agreeing with a **non-person**

Correct option: A.

 1 votes

-- Arjun Suresh (328k points)

**11.13****Prepositions (5)** top ↴**11.13.1 Prepositions: GATE Civil 2020 Set 2 | GA Question: 1** top ↴<https://gateoverflow.in/359846>

Rescue teams deployed \_\_\_\_\_ disaster hit areas combat \_\_\_\_\_ a lot of difficulties to save the people.

- A. with, at
- B. in, with
- C. with, with
- D. to, to

[gate2020-ce-2](#) [verbal-aptitude](#) [prepositions](#)

Answer 

**11.13.2 Prepositions: GATE2019 CE-2: GA-2** [top ↗](#)<https://gateoverflow.in/313378>

The growth rate of ABC Motors in 2017 was the same \_\_\_\_\_ XYZ Motors in 2016.

- A. as off
- B. as those of
- C. as that off
- D. as that of

[gate2019-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [prepositions](#) [most-appropriate-word](#)

Answer 

**11.13.3 Prepositions: GATE2019 CE-2: GA-5** [top ↗](#)<https://gateoverflow.in/313379>

Hema Das was \_\_\_\_\_ only Indian athlete to win \_\_\_\_\_ gold for India.

- A. the , many
- B. the, a
- C. an, a
- D. an , the

[gate2019-ce-2](#) [general-aptitude](#) [verbal-aptitude](#) [english-grammar](#) [prepositions](#)

Answer 

**11.13.4 Prepositions: GATE2019 EC: GA-2** [top ↗](#)<https://gateoverflow.in/313542>

The boat arrived \_\_\_\_\_ dawn.

- A. in
- B. at
- C. on
- D. under

[gate2019-ec](#) [general-aptitude](#) [verbal-aptitude](#) [prepositions](#)

Answer 

**11.13.5 Prepositions: GATE2019 EE: GA-2** [top ↗](#)<https://gateoverflow.in/313571>

The passengers were angry \_\_\_\_\_ the airline staff about the delay.

- A. on
- B. about
- C. with
- D. towards

[gate2019-ee](#) [general-aptitude](#) [verbal-aptitude](#) [prepositions](#)

Answer 

**Answers: Prepositions****11.13.1 Prepositions: GATE Civil 2020 Set 2 | GA Question: 1** [top ↗](#)<https://gateoverflow.in/359846>

- ✓ “deployed” means to “spread out” and deployed **in** disaster hit areas is the correct usage.  
“combat” means “fight” and combat **with** is the right usage.  
Correct option: B

 1 votes

-- Arjun Suresh (328k points)

**11.13.2 Prepositions: GATE2019 CE-2: GA-2** [top ↗](#)<https://gateoverflow.in/313378>

- ✓ Ans D. As that of - compare two inanimate things

 2 votes

-- Resmi Arjun (619 points)

**11.13.3 Prepositions: GATE2019 CE-2: GA-5** top ↗<https://gateoverflow.in/313379>

- ✓ Ans B. The - to provide emphasis. A - since the next word is gold ('a' gold means one gold out of many possible).

1 vote

-- Resmi Arjun (619 points)

**11.13.4 Prepositions: GATE2019 EC: GA-2** top ↗<https://gateoverflow.in/313542>

- ✓ As the sentence is intended to specify a particular time instance of the arrival of the boat, 'at' is the most appropriate option. We also use 'at' to specify places like 'at the market'.

Correct option is (B).

1 vote

-- Lakshman Patel (63.9k points)

**11.13.5 Prepositions: GATE2019 EE: GA-2** top ↗<https://gateoverflow.in/313571>

- ✓ "Angry with" is used if anger is aimed at someone.

"Angry at" is used if anger is aimed at some situation.

Ref: <https://english.stackexchange.com/questions/43671/angry-with-vs-angry-at-vs-angry-on>

Correct Answer: C

**References**

2 votes

-- Arjun Suresh (328k points)

**11.14****Sentence Ordering (1)** top ↗**11.14.1 Sentence Ordering: GATE2015 EC-3: GA-7** top ↗<https://gateoverflow.in/39520>

In the following question, the first and the last sentence of the passage are in order and numbered 1 and 6. The rest of the passage is split into 4 parts and numbered as 2, 3, 4, and 5. These 4 parts are not arranged in proper order. Read the sentences and arrange them in a logical sequence to make a passage and choose the correct sequence from the given options.

1. On Diwali, the family rises early in the morning.
2. The whole family, including the young and the old enjoy doing this.
3. Children let off fireworks later in the night with their friends.
4. At sunset, the lamps are lit and the family performs various rituals.
5. Father, mother, and children visit relatives and exchange gifts and sweets.
6. Houses look so pretty with lighted lamps all around.

- A. 2, 5, 3, 4
- B. 5, 2, 4, 3
- C. 3, 5, 4, 2
- D. 4, 5, 2, 3

[gate2015-ec-3](#) [verbal-aptitude](#) [sentence-ordering](#)

Answer

**Answers: Sentence Ordering****11.14.1 Sentence Ordering: GATE2015 EC-3: GA-7** top ↗<https://gateoverflow.in/39520>

1. On Diwali, the family rises early in the morning.
2. The whole family, including the young and the old enjoy doing this.  
This sentence can come only after another sentence where an action is done.
3. Children let off fireworks later in the night with their friends.  
This sentence can come only after another sentence explaining something happening in early night -- (4) here.
4. At sunset, the lamps are lit and the family performs various rituals.
5. Father, mother, and children visit relatives and exchange gifts and sweets.

Only one suitable for position 2 and sentence (2) can follow this.

6. Houses look so pretty with lighted lamps all around.

So, the correct order will be 5 – 2 – 4 – 3.

Correct Option: B.

1 votes

-- Arjun Suresh (328k points)

11.15

Statement Sufficiency (2)

<https://gateoverflow.in/8006>



### 11.15.1 Statement Sufficiency: GATE CSE 2015 Set 1 | Question: GA-4

Based on the given statements, select the most appropriate option to solve the given question.

If two floors in a certain building are 9 feet apart, how many steps are there in a set of stairs that extends from the first floor to the second floor of the building?

Statements:

- I. Each step is  $\frac{3}{4}$  foot high.
- II. Each step is 1 foot wide.
- A. Statements I alone is sufficient, but statement II alone is not sufficient.
- B. Statements II alone is sufficient, but statement I alone is not sufficient.
- C. Both statements together are sufficient, but neither statement alone is sufficient.
- D. Statements I and II together are not sufficient.

[gate2015-cse-set1](#) [verbal-aptitude](#) [easy](#) [statement-sufficiency](#)

Answer

<https://gateoverflow.in/8033>



### 11.15.2 Statement Sufficiency: GATE CSE 2015 Set 2 | Question: GA-5

Based on the given statements, select the most appropriate option to solve the given question.

What will be the total weight of 10 poles each of same weight?

Statements:

- I. One fourth of the weight of the pole is 5 Kg.
- II. The total weight of these poles is 160 Kg more than the total weight of two poles.
- A. Statement I alone is not sufficient.
- B. Statement II alone is not sufficient.
- C. Either I or II alone is sufficient.
- D. Both statements I and II together are not sufficient.

[gate2015-cse-set2](#) [normal](#) [logical-reasoning](#) [statement-sufficiency](#)

Answer

### Answers: Statement Sufficiency

#### 11.15.1 Statement Sufficiency: GATE CSE 2015 Set 1 | Question: GA-4

<https://gateoverflow.in/8006>



- A. Statements I alone is sufficient, but statement II alone is not sufficient.

15 votes

-- Anoop Sonkar (4.1k points)

#### 11.15.2 Statement Sufficiency: GATE CSE 2015 Set 2 | Question: GA-5

<https://gateoverflow.in/8033>



1. One fourth of the weight of the pole is 5 Kg.  
Weight of 10 poles =  $4 \times 10 \times 5 \text{ Kg} = 200 \text{ Kg}$
2. The total weight of these poles is 160 Kg more than the total weight of two poles.  
This means weight of 8 poles is 160 Kg and thus weight of 10 poles is 200 Kg.

So, either of the statements is sufficient to get the weight of 10 poles.

Correct Option: C

3 votes

-- Arjun Suresh (328k points)

## 11.16

## Statements Follow (2) top ↵

### 11.16.1 Statements Follow: GATE CSE 2015 Set 1 | Question: GA-8 top ↵

<https://gateoverflow.in/8012>

The given statement is followed by some courses of action. Assuming the statement to be true, decide the correct option.

Statement:

There has been a significant drop in the water level in the lakes supplying water to the city.

Course of action:

- I. The water supply authority should impose a partial cut in supply to tackle the situation.
  - II. The government should appeal to all the residents through mass media for minimal use of water.
  - III. The government should ban the water supply in lower areas.
- A. Statements I and II follow.
  - B. Statements I and III follow.
  - C. Statements II and III follow.
  - D. All the statements follow.

[gate2015-cse-set1](#) [verbal-aptitude](#) [normal](#) [statements-follow](#)

Answer

### 11.16.2 Statements Follow: GATE Mechanical 2021 Set 1 | GA Question: 5 top ↵

<https://gateoverflow.in/359480>

"The increased consumption of leafy vegetables in the recent months is a clear indication that the people in the state have begun to lead a healthy lifestyle"

Which of the following can be logically inferred from the information presented in the above statement?

- A. The people in the state did not consume leafy vegetables earlier
- B. Consumption of leafy vegetables may not be the only indicator of healthy lifestyle
- C. Leading a healthy lifestyle is related to a diet with leafy vegetables
- D. The people in the state have increased awareness of healthy hazards causing by consumption of junk foods

[gateme-2021-set1](#) [verbal-aptitude](#) [verbal-reasoning](#) [statements-follow](#)

Answer

## Answers: Statements Follow

### 11.16.1 Statements Follow: GATE CSE 2015 Set 1 | Question: GA-8 top ↵

<https://gateoverflow.in/8012>

✓ Statements I and II are correct measures. Option A,

7 votes

-- Arjun Suresh (328k points)

### 11.16.2 Statements Follow: GATE Mechanical 2021 Set 1 | GA Question: 5 top ↵

<https://gateoverflow.in/359480>

✓

- A. The people in the state did not consume leafy vegetables earlier  
No. "The **increased consumption** of leafy vegetables in the recent months". Talk is about increased consumption and this cannot imply "no consumption" earlier.
- B. Consumption of leafy vegetables may not be the only indicator of healthy lifestyle  
May be true but nothing conclusive in the given passage.
- C. Leading a healthy lifestyle is related to a diet with leafy vegetables  
**True.** "The increased consumption of **leafy vegetables** in the recent months **is a clear indication** that the people in the state have begun to **lead a healthy lifestyle**"
- D. The people in the state have increased awareness of healthy hazards causing by consumption of junk foods  
May be true. But nothing conclusive in the given passage.

Correct option: C.

1 votes

-- Arjun Suresh (328k points)

11.17

Tenses (16) [top](#)

11.17.1 Tenses: GATE CSE 2013 | Question: 59 [top](#)

<https://gateoverflow.in/1563>



Were you a bird, you \_\_\_\_\_ in the sky.

- A. would fly
- B. shall fly
- C. should fly
- D. shall have flown

[gate2013-cse](#) [verbal-aptitude](#) [tenses](#) [normal](#)

Answer

11.17.2 Tenses: GATE CSE 2014 Set 2 | Question: GA-2 [top](#)

<https://gateoverflow.in/1939>



Who \_\_\_\_\_ was coming to see us this evening?

- A. you said
- B. did you say
- C. did you say that
- D. had you said

[gate2014-cse-set2](#) [verbal-aptitude](#) [tenses](#) [normal](#)

Answer

11.17.3 Tenses: GATE CSE 2014 Set 3 | Question: GA-2 [top](#)

<https://gateoverflow.in/2025>



If she \_\_\_\_\_ how to calibrate the instrument, she \_\_\_\_\_ done the experiment.

- A. knows, will have
- B. knew, had
- C. had known, could have
- D. should have known, would have

[gate2014-cse-set3](#) [verbal-aptitude](#) [easy](#) [english-grammar](#) [tenses](#)

Answer

11.17.4 Tenses: GATE CSE 2017 Set 1 | Question: GA-1 [top](#)

<https://gateoverflow.in/118403>



After Rajendra Chola returned from his voyage to Indonesia, he \_\_\_\_\_ to visit the temple in Thanjavur.

- A. was wishing
- B. is wishing
- C. wished
- D. had wished

[gate2017-cse-set1](#) [general-aptitude](#) [verbal-aptitude](#) [tenses](#) [english-grammar](#) [normal](#)

Answer

11.17.5 Tenses: GATE ECE 2021 | GA Question: 5 [top](#)

<https://gateoverflow.in/359797>



Consider the following sentences:

- i. I woke up from sleep.
- ii. I woked up from sleep.
- iii. I was woken up from sleep.
- iv. I was wokened up from sleep.

Which of the above sentences are grammatically CORRECT?

- A. (i) and (ii)
- B. (i) and (iii)
- C. (ii) and (iii)
- D. (i) and (iv)

gateec-2021 verbal-aptitude english-grammar tenses

Answer 

#### 11.17.6 Tenses: GATE2012 AE: GA-1 top ↗

<https://gateoverflow.in/40212>



Choose the most appropriate alternative from the options given below to complete the following sentence:

I \_\_ to have bought a diamond ring.

- A. have a liking
- B. should have liked
- C. would like
- D. may like

gate2012-ae tenses verbal-aptitude

Answer 

#### 11.17.7 Tenses: GATE2013 AE: GA-2 top ↗

<https://gateoverflow.in/40243>



The Headmaster \_\_\_\_\_ to speak to you. Which of the following options is incorrect to complete the above sentence?

- A. is wanting
- B. wants
- C. want
- D. was wanting

gate2013-ae verbal-aptitude english-grammar tenses

Answer 

#### 11.17.8 Tenses: GATE2014 EC-1: GA-1 top ↗

<https://gateoverflow.in/41490>



Choose the most appropriate phrase from the options given below to complete the following sentence.

The aircraft \_\_\_\_\_ take off as soon as its flight plan was filed.

- A. Is allowed to
- B. Will be allowed to
- C. Was allowed to
- D. Has been allowed to

gate2014-ec-1 verbal-aptitude tenses easy

Answer 

#### 11.17.9 Tenses: GATE2015 EC-2: GA- 6 top ↗

<https://gateoverflow.in/39507>



In the following sentence certain parts are underlined and marked P, Q, and R. One of the parts may contain certain error or may not be acceptable in standard written communication. Select the part containing an error. Choose D as your answer if there is no error.

The student corrected all the errors that the instructor marked on the answer book.

P      Q      R

- A. P
- B. Q
- C. R
- D. No error

[gate2015-ec-2](#)
[verbal-aptitude](#)
[english-grammar](#)
[tenses](#)
[Answer](#)
**11.17.10 Tenses: GATE2015 EC-3: GA-1**
[top](#)
<https://gateoverflow.in/39514>


Choose the most appropriate word from the options given below to complete the following sentence.

If the athlete had wanted to come first in the race, he \_\_\_\_\_ several hours every day.

- A. should practise
- B. should have practised
- C. practised
- D. should be practising

[gate2015-ec-3](#)
[general-aptitude](#)
[verbal-aptitude](#)
[tenses](#)
[Answer](#)
**11.17.11 Tenses: GATE2017 CE-1: GA-1**
[top](#)
<https://gateoverflow.in/313489>


The bacteria in milk are destroyed when it \_\_\_\_\_ heated to 80 degree Celsius.

- A. would be
- B. will be
- C. is
- D. was

[gate2017-ce-1](#)
[verbal-aptitude](#)
[tenses](#)
[Answer](#)
**11.17.12 Tenses: GATE2017 CE-2: GA-1**
[top](#)
<https://gateoverflow.in/313420>


The event would have been successful if you \_\_\_\_\_ able to come.

- A. are
- B. had been
- C. have been
- D. would have been

[gate2017-ce-2](#)
[verbal-aptitude](#)
[tenses](#)
[Answer](#)
**11.17.13 Tenses: GATE2017 EC-1: GA-2**
[top](#)
<https://gateoverflow.in/313525>


I \_\_\_\_\_ made arrangements had I \_\_\_\_\_ informed earlier.

- A. could have, been
- B. would have, being
- C. had, have
- D. had been, been

[gate2017-ec-1](#)
[verbal-aptitude](#)
[tenses](#)
[Answer](#)
**11.17.14 Tenses: GATE2019 IN: GA-5**
[top](#)
<https://gateoverflow.in/313552>


Until Iran came along, India had never been \_\_\_\_\_ in Kabaddi.

- A. defeated
- B. defeating
- C. defeat
- D. defeatist

gate2019-in general-aptitude verbal-aptitude english-grammar tenses

Answer 

### 11.17.15 Tenses: GATE2019 ME-1: GA-2 [top](#)

<https://gateoverflow.in/313603>



\_\_\_\_ I permitted him to leave, I wouldn't have had any problem with him being absent, \_\_\_\_ I?

- A. Had, wouldn't
- B. Have, would
- C. Had, would
- D. Have, wouldn't

gate2019-me-1 general-aptitude verbal-aptitude tenses

Answer 

### 11.17.16 Tenses: GATE2019 ME-2: GA-1 [top](#)

<https://gateoverflow.in/313583>



Once the team of analysis identify the problem, we \_\_\_\_ in a better position to comment on the issue.

Which of the following choices CANNOT fill the given blank?

- A. will be
- B. were to be
- C. are going to be
- D. might be

gate2019-me-2 general-aptitude verbal-aptitude tenses

Answer 

## Answers: Tenses

### 11.17.1 Tenses: GATE CSE 2013 | Question: 59 [top](#)

<https://gateoverflow.in/1563>



- ✓ In conditional sentences if your conditional sentence (if I ...) is in past perfect then in resultant sentence 'would have' will be used.

If I had extra clothes, I would have donated them.

When conditional sentences are imaginary sentences like **if I were a cricketer**.....then in resultant sentences we have to use 'would'.

References:

- [https://en.wikipedia.org/wiki/Conditional\\_sentence](https://en.wikipedia.org/wiki/Conditional_sentence)
- <https://www.grammarly.com/blog/conditional-sentences-was-instead-of-were/>

Correct Option: A would fly.

References



 13 votes

-- Rupendra Choudhary (11.3k points)

### 11.17.2 Tenses: GATE CSE 2014 Set 2 | Question: GA-2 [top](#)

<https://gateoverflow.in/1939>



- ✓ "Who \_\_\_\_\_ was coming to see us this evening?"

So, someone is coming this evening (future tense)

About this you "had said about" (past tense)

So, correct option will be "Who did you say" was

The subject here is "who" - and he/she is coming to see us. So, adding "that" gives a wrong meaning to it.

Correct option: B "did you say"

3 votes

-- Arjun Suresh (328k points)

### 11.17.3 Tenses: GATE CSE 2014 Set 3 | Question: GA-2 [top](#)

<https://gateoverflow.in/2025>



- ✓ A. We can use "will have done" to talk about what will have been achieved by a certain moment in time.  
e.g. I'll have finished this project by Friday.

So, (A) is not the correct option.

B. If + simple past → would/ would be  
e.g.,

1. If It rained, you would get wet.
2. If I spoke Italian, I would be working in Italy.

So, (B) is not the correct option.

C. If + past perfect → would have/could have/ would have been  
e.g.,

If you had studied harder, you could have passed the exam.

**So, (C) is the correct option.**

7 votes

-- Manu Thakur (34k points)



### 11.17.4 Tenses: GATE CSE 2017 Set 1 | Question: GA-1 [top](#)

<https://gateoverflow.in/118403>



- ✓ According to the rule : **when the main clause is in the past or past perfect tense, the subordinate clause must be in the past or past perfect tense.**

so option (C) is correct.

8 votes

-- Akash Verma (2.4k points)



### 11.17.5 Tenses: GATE ECE 2021 | GA Question: 5 [top](#)

<https://gateoverflow.in/359797>



- ✓ wake, woke, woken is the correct sequence for present, past and past participle forms of the word "wake". So, only (i) and (iii) are correct.

Correct option: B.

1 votes

-- Arjun Suresh (328k points)



### 11.17.6 Tenses: GATE2012 AE: GA-1 [top](#)

<https://gateoverflow.in/40212>



- ✓ Ans C

I **would like** to have bought a diamond ring.

We use *would like to have* + v3 form when talking about things in the past that we have missed.

see: <https://dictionary.cambridge.org/grammar/british-grammar/verb-patterns/would-like>

#### References



4 votes

-- Abhilash Panicker (7.6k points)



### 11.17.7 Tenses: GATE2013 AE: GA-2 [top](#)

<https://gateoverflow.in/40243>



- ✓ **option C is correct.**

**Rule:** Subjects and verbs must AGREE with one another in number (singular or plural). Thus, if a subject is singular, its verb must also be singular; if a subject is plural, its verb must also be plural.

Here **headmaster** is singular subject so we don't use **plural verb 'want'** with Headmaster.

8 votes

-- Akash Verma (2.4k points)

#### 11.17.8 Tenses: GATE2014 EC-1: GA-1 [top](#)

<https://gateoverflow.in/41490>



- ✓ Part of sentence is in past tense (was filed) so we should write the entire sentence in past. Only one option (C) "was allowed to" is in past.

Correct Option: C.

3 votes

-- Sutanay Bhattacharjee (3.1k points)

#### 11.17.9 Tenses: GATE2015 EC-2: GA- 6 [top](#)

<https://gateoverflow.in/39507>



- ✓ Q part should be " the instructor had marked"

**Correct Answer: B**

5 votes

-- Prateek kumar (6.7k points)

#### 11.17.10 Tenses: GATE2015 EC-3: GA-1 [top](#)

<https://gateoverflow.in/39514>



- ✓ (B) should have practised.

Sentence is in past tense and to talk about something previous we need past perfect tense.

0 votes

-- Arjun Suresh (328k points)

#### 11.17.11 Tenses: GATE2017 CE-1: GA-1 [top](#)

<https://gateoverflow.in/313489>



The bacteria in milk are destroyed when it **is** heated to 80 degree Celsius.

This is "passive verb" form of "Simple Present Tense".

some references: <https://www.englishpage.com/verbpage/activepassive.html> ,  
<https://www.edudose.com/english/active-and-passive-voice-rules/>

Correct Answer: C

#### References



3 votes

-- Naveen Kumar (9.9k points)

#### 11.17.12 Tenses: GATE2017 CE-2: GA-1 [top](#)

<https://gateoverflow.in/313420>



- ✓ B. had been

"The event would have been successful if you **had been** able to come."

With perfect conditional we have to use "past perfect" in if.

This is Type 3 conditional statement see: <https://www.ef.com/in/english-resources/english-grammar/conditional/>

#### References



2 votes

-- Naveen Kumar (9.9k points)

**11.17.13 Tenses: GATE2017 EC-1: GA-2** [top ↴](#)<https://gateoverflow.in/313525>

- ✓ Answer is A.

When we are talking about something that did not happen in the past, we should use 'past perfect'.

1 votes

-- Jotheeswari (92,9k points)

**11.17.14 Tenses: GATE2019 IN: GA-5** [top ↴](#)<https://gateoverflow.in/313552>

- ✓ "Until Iran came" means we have to use past perfect tense.

**had never been defeated**

Correct option: A

1 votes

-- Arjun Suresh (328k points)

**11.17.15 Tenses: GATE2019 ME-1: GA-2** [top ↴](#)<https://gateoverflow.in/313603>

- ✓ To denote something that happened before in past tense, we have to use past perfect. So, we have to start with "Had".

Since wouldn't have is used in the sentence, and we are forming a question, it must be "would I"?

Correct Option: C.

3 votes

-- Arjun Suresh (328k points)

**11.17.16 Tenses: GATE2019 ME-2: GA-1** [top ↴](#)<https://gateoverflow.in/313583>

- ✓ Option B. were to be

The first part is in future tense, so the next half cannot be in past tense. All other three choices can work.

1 votes

-- Satbir Singh (20,9k points)

**11.18****Verbal Reasoning (39)** [top ↴](#)**11.18.1 Verbal Reasoning: GATE CSE 2012 | Question: 61** [top ↴](#)<https://gateoverflow.in/2209>

**Wanted Temporary, Part-time persons for the post of Field Interviewer to conduct personal interviews to collect and collate economic data. Requirements: High School-pass, must be available for Day, Evening and Saturday work. Transportation paid, expenses reimbursed.**

Which one of the following is the best inference from the above advertisement?

- Gender-discriminatory
- Xenophobic
- Not designed to make the post attractive
- Not gender-discriminatory

[gate2012-cse](#) [verbal-aptitude](#) [verbal-reasoning](#) [normal](#)

Answer

**11.18.2 Verbal Reasoning: GATE CSE 2014 Set 1 | Question: GA-7** [top ↴](#)<https://gateoverflow.in/775>

Geneticists say that they are very close to confirming the genetic roots of psychiatric illnesses such as depression and schizophrenia, and consequently, that doctors will be able to eradicate these diseases through early identification and gene therapy.

On which of the following assumptions does the statement above rely?

Select one:

- Strategies are now available for eliminating psychiatric illnesses
- Certain psychiatric illnesses have a genetic basis
- All human diseases can be traced back to genes and how they are expressed
- In the future, genetics will become the only relevant field for identifying psychiatric illnesses

gate2014-cse-set1 verbal-aptitude verbal-reasoning normal

Answer 

### 11.18.3 Verbal Reasoning: GATE CSE 2015 Set 3 | Question: GA-6 top ↗

<https://gateoverflow.in/8306>



Alexander turned his attention towards India, since he had conquered Persia.

Which one of the statements below is logically valid and can be inferred from the above sentence?

- A. Alexander would not have turned his attention towards India had he not conquered Persia.
- B. Alexander was not ready to rest on his laurels, and wanted to march to India.
- C. Alexander was not completely in control of his army and could command it to move towards India.
- D. Since Alexander's kingdom extended to Indian borders after the conquest of Persia, he was keen to move further.

gate2015-cse-set3 verbal-aptitude normal verbal-reasoning

Answer 

### 11.18.4 Verbal Reasoning: GATE CSE 2016 Set 1 | Question: GA07 top ↗

<https://gateoverflow.in/39613>



Indian currency notes show the denomination indicated in at least seventeen languages. If this is not an indication of the nation's diversity, nothing else is.

Which of the following can be logically inferred from the above sentences?

- A. India is a country of exactly seventeen languages.
- B. Linguistic pluralism is the only indicator of a nation's diversity.
- C. Indian currency notes have sufficient space for all the Indian languages.
- D. Linguistic pluralism is strong evidence of India's diversity.

gate2016-cse-set1 verbal-aptitude verbal-reasoning normal

Answer 

### 11.18.5 Verbal Reasoning: GATE CSE 2017 Set 2 | Question: GA-6 top ↗

<https://gateoverflow.in/118420>



"We lived in a culture that denied any merit to literary works, considering them important only when they were handmaidens to something seemingly more urgent – namely ideology. This was a country where all gestures, even the most private, were interpreted in political terms."

The author's belief that ideology is not as important as literature is revealed by the word:

- A. 'culture'
- B. 'seemingly'
- C. 'urgent'
- D. 'political'

gate2017-cse-set2 passage-reading verbal-reasoning

Answer 

### 11.18.6 Verbal Reasoning: GATE CSE 2019 | Question: GA-6 top ↗

<https://gateoverflow.in/302867>



The police arrested four criminals – *P, Q, R* and *S*. The criminals knew each other. They made the following statements:

- *P* says "Q committed the crime."
- *Q* says "S committed the crime."
- *R* says "I did not do it."
- *S* says "What *Q* said about me is false".

Assume only one of the arrested four committed the crime and only one of the statements made above is true. Who committed the crime?

- A. *P*
- B. *R*
- C. *S*
- D. *Q*

[gate2019-cse](#)
[verbal-aptitude](#)
[verbal-reasoning](#)
**Answer**
**11.18.7 Verbal Reasoning: GATE CSE 2019 | Question: GA-8** [top](#)
<https://gateoverflow.in/302865>


“A recent High Court judgement has sought to dispel the idea of begging as a disease – which leads to its stigmatization and criminalization – and to regard it as a symptom. The underlying disease is the failure of the state to protect citizens who fall through the social security net.”

Which one of the following statements can be inferred from the given passage?

- A. Beggars are lazy people who beg because they are unwilling to work
- B. Beggars are created because of the lack of social welfare schemes
- C. Begging is an offence that has to be dealt with firmly
- D. Begging has to be banned because it adversely affects the welfare of the state

[gate2019-cse](#)
[general-aptitude](#)
[verbal-aptitude](#)
[verbal-reasoning](#)
**Answer**
**11.18.8 Verbal Reasoning: GATE CSE 2020 | Question: GA-4** [top](#)
<https://gateoverflow.in/333237>


The dawn of the 21st century witnessed the melting glaciers oscillating between giving too much and too little to billions of people who depend on them for fresh water. The UN climate report estimates that without deep cuts to man-made emissions, at least 30% of the northern hemisphere’s surface permafrost could melt by the end of the century. Given this situation of imminent global exodus of billions of people displaced by rising seas, nation-states need to rethink their carbon footprint for political concerns, if not for environmental ones.

Which one of the following statements can be inferred from the given passage?

- A. Nation-states do not have environmental concerns.
- B. Nation-states are responsible for providing fresh water to billions of people.
- C. Billions of people are responsible for man-made emissions.
- D. Billions of people are affected by melting glaciers.

[gate2020-cse](#)
[verbal-aptitude](#)
[verbal-reasoning](#)
[passage-reading](#)
**Answer**
**11.18.9 Verbal Reasoning: GATE CSE 2020 | Question: GA-6** [top](#)
<https://gateoverflow.in/333235>


Goods and Services Tax (GST) is an indirect tax introduced in India in 2017 that is imposed on the supply of goods and services, and it subsumes all indirect taxes except few. It is a destination-based tax imposed on goods and services used, and it is not imposed at the point of origin from where goods come. GST also has a few components specific to state governments, central government and Union Territories (UTs).

Which one of the following statements can be inferred from the given passage?

- A. GST is imposed on the production of goods and services.
- B. GST includes all indirect taxes.
- C. GST does not have a component specific to UT.
- D. GST is imposed at the point of usage of goods and services.

[gate2020-cse](#)
[verbal-aptitude](#)
[verbal-reasoning](#)
[passage-reading](#)
**Answer**
**11.18.10 Verbal Reasoning: GATE CSE 2021 Set 1 | GA Question: 10** [top](#)
<https://gateoverflow.in/357467>


Some people suggest anti-obesity measures (AOM) such as displaying calorie information in restaurant menus. Such measures sidestep addressing the core problems that cause obesity: poverty and income inequality.

Which one of the following statements summarizes the passage?

- A. The proposed AOM addresses the core problems that cause obesity
- B. If obesity reduces, poverty will naturally reduce, since obesity causes poverty

- C. AOM are addressing the core problems and are likely to succeed
- D. AOM are addressing the problem superficially

[gate2021-cse-set1](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.11 Verbal Reasoning: GATE CSE 2021 Set 2 | GA Question: 6

 <https://gateoverflow.in/357544>

Listening to music during exercise improves performance and reduces discomfort. Scientists researched whether listening to music while studying can help students learn better and the results were inconclusive. Students who needed external stimulation for studying fared worse while students who did not need any external stimulation benefited from music.

Which one of the following statements is the CORRECT inference of the above passage?

- A. Listening to music has no effect on learning and a positive effect on physical exercise
- B. Listening to music has a clear positive effect both in physical exercise and on learning
- C. Listening to music has a clear positive effect on physical exercise. Music has a positive effect on learning only in some students
- D. Listening to music has a clear positive effect on learning in all students. Music has a positive effect only in some students who exercise

[gate2021-cse-set2](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.12 Verbal Reasoning: GATE Chemical 2020 | GA Question: 4

 <https://gateoverflow.in/359820>

Hit by floods, the kharif (summer sown) crops in various parts of the country have been affected. Officials believe that the loss in production of the kharif crops can be recovered in the output of the rabi (winter sown) crops so that the country can achieve its food-grain production target of 291 million tons in the crop year 2019 – 20 (July – June). They are hopeful that good rains in July-August will help the soil retain moisture for a longer period, helping winter sown crops such as wheat and pulses during the November-February period.

Which of the following statements can be inferred from the given passage?

- A. Officials declared that the food-grain production target will be met due to good rains.
- B. Officials want the food-grain production target to be met by the November-February period.
- C. Officials feel that the food-grain production target cannot be met due to floods.
- D. Officials hope that the food-grain production target will be met due to a good rabi produce.

[gate2020-ch](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.13 Verbal Reasoning: GATE Chemical 2020 | GA Question: 6

 <https://gateoverflow.in/359816>

Repo rate is the rate at which Reserve Bank of India (RBI) lends commercial banks, and reverse repo rate is the rate at which (RBI) borrows money from commercial banks.

Which of the following statements can be inferred from the above passage?

- A. Decrease in repo rate will increase cost of borrowing and decrease lending by commercial banks.
- B. Increase in repo rate will decrease cost of borrowing and increase lending by commercial banks.
- C. Increase in repo rate will decrease cost of borrowing and decrease lending by commercial banks.
- D. Decrease in repo rate will decrease cost of borrowing and increase lending by commercial banks.

[gate2020-ch](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.14 Verbal Reasoning: GATE Civil 2020 Set 1 | GA Question: 6

 <https://gateoverflow.in/359856>

The American psychologist Howard Gardner expounds that human intelligence can be subcategorized into multiple kinds, in such a way that individuals differ with respect to their relative competence in each kind. Based on this theory, modern educationists insist on prescribing multi-dimensional curriculum and evaluation parameters that enable development and assessment of multiple intelligences.

Which of the following statements can be inferred from the given text ?

- A. Howard Gardner insists that the teaching curriculum and evaluation needs to be multi-dimensional.
- B. Howard Gardner wants to develop and assess the theory of multiple intelligences.
- C. Modern educationists want to develop and assess the theory of multiple intelligences.
- D. Modern educationists insist that the teaching curriculum and evaluation needs to be multi-dimensional.

[gate2020-ce-1](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.15 Verbal Reasoning: GATE Civil 2020 Set 2 | GA Question: 6 [top](#)

<https://gateoverflow.in/359836>



Nominal interest rate is defined as the amount paid by the borrower to the lender for using the borrowed amount for a specific period of time. Real interest rate calculated on the basis of actual value (inflation-adjusted), is approximately equal to the difference between nominal rate and expected rate of inflation in the economy.

Which of the following assertions is best supported by the above information?

- A. Under high inflation, real interest rate is low and borrowers get benefited
- B. Under low inflation, real interest rate is high and borrowers get benefited
- C. Under high inflation, real interest rate is low and lenders get benefited
- D. Under low inflation, real interest rate is low and borrowers get benefited

[gate2020-ce-2](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.16 Verbal Reasoning: GATE Civil 2021 Set 1 | GA Question: 10 [top](#)

<https://gateoverflow.in/359871>



Humans have the ability to construct worlds entirely in their minds, which don't exist in the physical world. So far as we know, no other species possesses this ability. This skill is so important that we have different words to refer to its different flavors, such as imagination, invention and innovation.

Based on the above passage, which one of the following is TRUE?

- A. No species possess the ability to construct worlds in their minds
- B. The terms imagination, invention and innovation refer to unrelated skills
- C. We do not know of any species other than humans who possess the ability to construct mental worlds
- D. Imagination, invention and innovation are unrelated to the ability to construct mental worlds

[gatecivil-2021-set1](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.17 Verbal Reasoning: GATE Civil 2021 Set 2 | GA Question: 7 [top](#)

<https://gateoverflow.in/359897>



The author said, "Musicians rehearse before their concerts. Actors rehearse their roles before the opening of a new play. On the other hand, I find it strange that many public speakers think they can just walk onto the stage and start speaking. In my opinion, it is no less important for public speaker to rehearse their talks."

Based on the above passage, which one of the following is TRUE?

- A. The author is of the opinion that rehearsing is important for musicians, actors and public speakers
- B. The author is of the opinion that rehearsing is less important for public speakers than for musicians and actors
- C. The author is of the opinion that rehearsing is more important only for musicians than public speakers
- D. The author is of the opinion that rehearsal is more important for actors than musicians

[gatecivil-2021-set2](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.18 Verbal Reasoning: GATE ECE 2020 | GA Question: 4 [top](#)

<https://gateoverflow.in/359775>



The Canadian constitution requires that equal importance be given to English and French. Last year, Air Canada lost a lawsuit, and had to pay a six-figure fine to a French-speaking couple after they filed complaints about formal in-flight announcements in English lasting 15 seconds, as opposed to informal 5 second messages in French.

The French-speaking couple were upset at \_\_\_\_\_.

- A. the in-flight announcements being made in English.
- B. the English announcements being clearer than the French ones.
- C. the English announcements being longer than the French ones.
- D. equal importance being given to English and French.

[gate2020-ec](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.19 Verbal Reasoning: GATE ECE 2020 | GA Question: 6 [top](#)

<https://gateoverflow.in/359768>



The global financial crisis in 2008 is considered to be the most serious world-wide financial crisis, which started with the sub-prime lending crisis in USA in 2007. The sub-prime lending crisis led to the banking crisis in 2008 with the collapse of Lehman Brothers in 2008. The sub-prime lending refers to the provision of loans to those borrowers who may have difficulties in repaying loans, and it arises because of excess liquidity following the East Asian crisis.

Which one of the following sequences shows the correct precedence as per the given passage?

- A. East Asian crisis → subprime lending crisis → banking crisis → global financial crisis.
- B. Subprime lending crisis → global financial crisis → banking crisis → East Asian crisis.
- C. Banking crisis → subprime lending crisis → global financial crisis → East Asian crisis.
- D. Global financial crisis → East Asian crisis → banking crisis → subprime lending crisis.

[gate2020-ec](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.20 Verbal Reasoning: GATE ECE 2021 | GA Question: 7 [top](#)

<https://gateoverflow.in/359793>



Computers are ubiquitous. They are used to improve efficiency in almost all fields from agriculture to space exploration. Artificial intelligence (AI) is currently a hot topic. AI enables computers to learn, given enough training data. For humans, sitting in front of a computer for long hours can lead to health issues.

Which of the following can be deduced from the above passage?

- i. Nowadays, computers are present in almost all places.
  - ii. Computers cannot be used for solving problems in engineering
  - iii. For humans, there are both positive and negative effects of using computers.
  - iv. Artificial intelligence can be done without data.
- A. (ii) and (iii)
  - B. (ii) and (iv)
  - C. (i), (iii) and (iv)
  - D. (i) and (iii)

[gateec-2021](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.21 Verbal Reasoning: GATE Electrical 2021 | GA Question: 6 [top](#)

<https://gateoverflow.in/359745>



The importance of sleep is often overlooked by students when they are preparing for exams. Research has consistently shown that sleep deprivation greatly reduces the ability to recall the material learnt. Hence, cutting down on sleep to study longer hours can be counterproductive.

Which one of the following statements is the CORRECT inference from the above passage?

- A. Sleeping well alone is enough to prepare for an exam. Studying has lesser benefit.
- B. Students are efficient and are not wrong in thinking that sleep is a waste of time.
- C. If a student is extremely well prepared for an exam, he needs little or no sleep.
- D. To do well in an exam, adequate sleep must be part of the preparation.

[gateee-2021](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

**11.18.22 Verbal Reasoning: GATE Mechanical 2020 Set 1 | GA Question: 6** [top](#)<https://gateoverflow.in/359526>

Crowd funding deals with mobilisation of funds for a project from a large number of people, who would be willing to invest smaller amounts through web-based platforms in the project.

Based on the above paragraph, which of the following is correct about crowd funding?

- A. Funds raised through unwilling contributions on web-based platforms
- B. Funds raised through large contributions on web-based platforms
- C. Funds raised through coerced contributions on web-based platforms
- D. Funds raised through voluntary contributions on web-based platforms

[gateme-2020-set1](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer

**11.18.23 Verbal Reasoning: GATE Mechanical 2020 Set 2 | GA Question: 2** [top](#)<https://gateoverflow.in/359555>

The recent measures to improve the output would \_\_\_\_\_ the level of production to our satisfaction

- A. increase
- B. decrease
- C. speed
- D. equalise

[gateme-2020-set2](#) [verbal-aptitude](#) [verbal-reasoning](#)

Answer

**11.18.24 Verbal Reasoning: GATE Mechanical 2020 Set 2 | GA Question: 4** [top](#)<https://gateoverflow.in/359550>

In one of the greatest innings ever seen in 142 years of Test history, Ben Stokes upped the tempo in a five-and-a-half hour long stay of 219 balls including 11 fours and 8 sixes that saw him finish on a 135 not out as England squared the five-match series.

Based on their connotations in the given passage, which one of the following meanings DOES NOT match?

- A. upped = increased
- B. squared = lost
- C. tempo = enthusiasm
- D. saw = resulted in

[gateme-2020-set2](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer

**11.18.25 Verbal Reasoning: GATE Mechanical 2020 Set 2 | GA Question: 6** [top](#)<https://gateoverflow.in/359546>

Climate change and resilience deal with two aspects – reduction of sources of non-renewable energy resources and reducing vulnerability of climate change aspects. The terms ‘mitigation’ and ‘adaptation’ are used to refer to these aspects, respectively.

Which of the following assertions is best supported by the above information?

- A. Mitigation deals with consequences of climate change
- B. Adaptation deals with causes of climate change
- C. Mitigation deals with actions taken to reduce the use of fossil fuels.
- D. Adaptation deals with actions taken to combat green-house gas emissions

[gateme-2020-set2](#) [verbal-aptitude](#) [verbal-reasoning](#) [passage-reading](#)

Answer

**11.18.26 Verbal Reasoning: GATE Mechanical 2021 Set 1 | GA Question: 6** [top](#)<https://gateoverflow.in/359478>

Oxpeckers and rhinos manifest a symbiotic relationship in the wild. The oxpeckers warn the rhinos about approaching poachers, thus possibly saving the lives of the rhinos. Oxpeckers also feed on the parasitic ticks found on rhinos.

In the symbiotic relationship described above, the primary benefits for oxpeckers and rhinos respectively are,

- A. Oxpeckers get a food source, rhinos have no benefit
- B. Oxpeckers save their habitat from poachers while the rhinos have no benefit
- C. Oxpeckers get a food source, rhinos may be saved from the poachers
- D. Oxpeckers save the lives of poachers, rhinos save their own lives

[gateme-2021-set1](#) [verbal-aptitude](#) [easy](#) [verbal-reasoning](#) [passage-reading](#)

Answer 

#### 11.18.27 Verbal Reasoning: GATE Mechanical 2021 Set 2 | GA Question: 10 [top](#) <https://gateoverflow.in/359490>

The world is going through the worst pandemic in the past hundred years. The air travel industry is facing a crisis, as the resulting quarantine requirement for travelers led to weak demand.

In relation to the first sentence above, what does the second sentence do?

- A. Restates an idea from the first sentence
- B. Second sentence entirely contradicts the first sentence
- C. The two statements are unrelated
- D. States an effect of the first sentence

[gateme-2021-set2](#) [verbal-aptitude](#) [verbal-reasoning](#)

Answer 

#### 11.18.28 Verbal Reasoning: GATE2013 AE: GA-3 [top](#) <https://gateoverflow.in/40244>

Mahatma Gandhi was known for his humility as

- A. he played an important role in humiliating exit of British from India.
- B. he worked for humanitarian causes.
- C. he displayed modesty in his interactions.
- D. he was a fine human being

[gate2013-ae](#) [verbal-aptitude](#) [verbal-reasoning](#)

Answer 

#### 11.18.29 Verbal Reasoning: GATE2013 EE: GA-5 [top](#) <https://gateoverflow.in/40292>

**Statement:** You can always give me a ring whenever you need.

Which one of the following is the best inference from the above statement?

- A. Because I have a nice caller tune.
- B. Because I have a better telephone facility.
- C. Because a friend in need is a friend indeed.
- D. Because you need not pay towards the telephone bills when you give me a ring.

[gate2013-ee](#) [verbal-reasoning](#) [verbal-aptitude](#)

Answer 

#### 11.18.30 Verbal Reasoning: GATE2013 EE: GA-7 [top](#) <https://gateoverflow.in/40294>

**Statement:** There were different streams of freedom movements in colonial India carried out by the moderates, liberals, radicals, socialists, and so on.

Which one of the following is the best inference from the above statement?

- A. The emergence of nationalism in colonial India led to our Independence.
- B. Nationalism in India emerged in the context of colonialism.
- C. Nationalism in India is homogeneous.
- D. Nationalism in India is heterogeneous

[gate2013-ee](#) [passage-reading](#) [verbal-aptitude](#) [verbal-reasoning](#)

**Answer****11.18.31 Verbal Reasoning: GATE2014 AG: GA-3** top ↗<https://gateoverflow.in/41667>

Which of the following options is the closest in meaning to the sentence below?

"As a woman, I have no country."

- A. Women have no country.
- B. Women are not citizens of any country.
- C. Women's solidarity knows no national boundaries.
- D. Women of all countries have equal legal rights.

[gate2014-ag](#) [general-aptitude](#) [verbal-aptitude](#) [verbal-reasoning](#) [normal](#)

**Answer****11.18.32 Verbal Reasoning: GATE2014 EC-3: GA-1** top ↗<https://gateoverflow.in/41140>

"India is a country of rich heritage and cultural diversity." Which one of the following facts best supports the claim made in the above sentence?

- A. India is a union of 28 states and 7 union territories.
- B. India has a population of over 1.1 billion.
- C. India is home to 22 official languages and thousands of dialects.
- D. The Indian cricket team draws players from over ten states.

[gate2014-ec-3](#) [verbal-reasoning](#) [verbal-aptitude](#)

**Answer****11.18.33 Verbal Reasoning: GATE2015 EC-2: GA-10** top ↗<https://gateoverflow.in/39511>

Lamenting the gradual sidelining of the arts in school curricula, a group of prominent artists wrote to the Chief Minister last year, asking him to allocate more funds to support arts education in schools. However, no such increase has been announced in this year's Budget. The artists expressed their deep anguish at their request not being approved, but many of them remain optimistic about funding in the future.

Which of the statement(s) below is/are logically valid and can be inferred from the above statements?

- i. The artists expected funding for the arts to increase this year.
  - ii. The Chief Minister was receptive to the idea of increasing funding for the arts.
  - iii. The Chief Minister is a prominent artist.
  - iv. Schools are giving less importance to arts education nowadays.
- A. (iii) and (iv)
  - B. (i) and (iv)
  - C. (i), (ii) and (iv)
  - D. (i) and (iii)

[gate2015-ec-2](#) [passage-reading](#) [verbal-reasoning](#) [verbal-aptitude](#)

**Answer****11.18.34 Verbal Reasoning: GATE2016 EC-1: GA-7** top ↗<https://gateoverflow.in/108087>

In a world filled with uncertainty, he was glad to have many good friends. He had always assisted them in times of need and was confident that they would reciprocate. However, the events of the last week proved him wrong.

Which of the following inference(s) is/are logically valid and can be inferred from the above passage?

- i. His friends were always asking him to help them.
  - ii. He felt that when in need of help, his friends would let him down.
  - iii. He was sure that his friends would help him when in need.
  - iv. His friends did not help him last week.
- A. (i) and (ii)
  - B. (iii) and (iv)

- C. (iii) only  
D. (iv) only

[gate2016-ec-1](#) [passage-reading](#) [verbal-reasoning](#)

Answer 

#### 11.18.35 Verbal Reasoning: GATE2016 EC-1: GA-8 [top](#)

<https://gateoverflow.in/108089>



Leela is older than her cousin Pavithra. Pavithra's brother Shiva is older than Leela. When Pavithra and Shiva are visiting Leela, all three like to play chess. Pavithra wins more often than Leela does.

Which one of the following statements must be TRUE based on the above?

- A. When Shiva plays chess with Leela and Pavithra, he often loses.  
B. Leela is the oldest of the three.  
C. Shiva is a better chess player than Pavithra.  
D. Pavithra is the youngest of the three.

[gate2016-ec-1](#) [verbal-aptitude](#) [passage-reading](#) [verbal-reasoning](#)

Answer 

#### 11.18.36 Verbal Reasoning: GATE2016 ME-2: GA-7 [top](#)

<https://gateoverflow.in/108299>



A smart city integrates all modes of transport, uses clean energy and promotes sustainable use of resources. It also uses technology to ensure safety and security of the city, something which critics argue, will lead to a surveillance state. Which of the following can be logically inferred from the above paragraph?

- All smart cities encourage the formation of surveillance states.
  - Surveillance is an integral part of a smart city.
  - Sustainability and surveillance go hand in hand in a smart city.
  - There is a perception that smart cities promote surveillance.
- A. (i) and (iv) only  
B. (ii) and (iii) only  
C. (iv) only  
D. (i) only

[gate2016-me-2](#) [passage-reading](#) [verbal-reasoning](#)

Answer 

#### 11.18.37 Verbal Reasoning: GATE2017 ME-1: GA-9 [top](#)

<https://gateoverflow.in/313668>



Two very famous sportsmen Mark and Steve happened to be brothers and played for country *K*. Mark teased James, an opponent from country *E*, "There is no way you are good enough to play for your country." James replied, "Maybe not, but at least I am the best player in my own family."

Which one of the following can be inferred from this conversation?

- A. Mark was known to play better than James.  
B. Steve was known to play better than Mark.  
C. James and Steve were good friends.  
D. James played better than Steve.

[gate2017-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [verbal-reasoning](#)

Answer 

#### 11.18.38 Verbal Reasoning: GATE2019 IN: GA-6 [top](#)

<https://gateoverflow.in/313553>



Since the last one year after a 125 basis point reduction in repo rate by the Reserve Bank of India, banking institutions have been making a demand to reduce interest rates on small saving schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes to bring them on par with fixed deposit interest rates.

Which one of the following statements can be inferred from the given passage?

- A. Whenever the Reserve Bank of India reduces the repo rate, the interest rates on small saving schemes are also reduced
- B. Interest rates on small saving schemes are always maintained on par with fixed deposit interest rates
- C. The government sometimes takes into consideration the demands of banking institutions before reducing the interest rates on small saving scheme
- D. A reduction in interest rates on small savings scheme follow only after a reduction in repo rate by the Reserve Bank Of India

[gate2019-in](#) [general-aptitude](#) [verbal-aptitude](#) [passage-reading](#) [verbal-reasoning](#)

Answer 

#### 11.18.39 Verbal Reasoning: GATE2019 ME-1: GA-6 [top](#)

<https://gateoverflow.in/313605>



Under a certain legal system, prisoners are allowed to make one statement. If their statements turns out to be true then they are hanged. If the statements turns to be false then they are shot. One prisoner made a statement and the judge had no option but to set him free. Which one of the following could be that statement?

- A. I did not commit the crime
- B. I committed the crime
- C. I will be shot
- D. You committed the crime

[gate2019-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [verbal-reasoning](#)

Answer 

### Answers: Verbal Reasoning

#### 11.18.1 Verbal Reasoning: GATE CSE 2012 | Question: 61 [top](#)

<https://gateoverflow.in/2209>



- ✓ D. Not gender\_discriminatory. The post mentions "persons" meaning any gender.

Xenophobic means having or showing an intense or irrational dislike or fear of people from other countries, so does not apply.

C and A do not apply.

 13 votes

-- Kathleen Bankson (51.6k points)

#### 11.18.2 Verbal Reasoning: GATE CSE 2014 Set 1 | Question: GA-7 [top](#)

<https://gateoverflow.in/775>



- ✓ B is correct, The first sentence mentions two specific illnesses, (depression and schizophrenia).  
B) is the only one that mentions certain illnesses.

A) states strategies are now available. The statement says they are very close so its not yet available.

C) states that ALL human diseases can be traced back. The statement only mentions two specific illnesses.

D) the statement does not mention at all that it is the only relevant field.

 16 votes

-- Kathleen Bankson (51.6k points)

#### 11.18.3 Verbal Reasoning: GATE CSE 2015 Set 3 | Question: GA-6 [top](#)

<https://gateoverflow.in/8306>



- ✓ Answer should be A as other options required more information

Let  $P$  be "Alexander turned his attention towards India" and  $Q$  be "he had conquered Persia"

$P$  since  $Q \equiv (\neg Q \implies \neg P)$

$\neg P$  is "Alexander would not have turned his attention towards India"

$\neg Q$  is "he had not conquered Persia"

 31 votes

-- Srijay Deshpande (299 points)

**11.18.4 Verbal Reasoning: GATE CSE 2016 Set 1 | Question: GA07** [top ↴](#)<https://gateoverflow.in/39613>

- ✓ Answer is (D) Linguistic pluralism is strong evidence of India's diversity.

[1 vote](#)

-- sushma nayak (131 points)

**11.18.5 Verbal Reasoning: GATE CSE 2017 Set 2 | Question: GA-6** [top ↴](#)<https://gateoverflow.in/118420>

- ✓ Seemingly means external appearance as **distinguished from** true character – means it is not actually what it looks like.

"considering them important only when they were handmaidens (means assisting or helping) to something seemingly more urgent" means it looks like urgent but in real it is not so urgent.

So, ideology is not as important as literature, is revealed by the word "seemingly".

[12 votes](#)

-- Bikram (58.3k points)

**11.18.6 Verbal Reasoning: GATE CSE 2019 | Question: GA-6** [top ↴](#)<https://gateoverflow.in/302867>

- ✓ Option B. R

Assuming S is saying the truth.

P says Q committed the crime (FALSE) means Q has not

Q says S committed the crime(FALSE) means S has not

R says I did not (FALSE) means R has committed the crime.

[16 votes](#)

-- Piyush Tiwari (457 points)

**11.18.7 Verbal Reasoning: GATE CSE 2019 | Question: GA-8** [top ↴](#)<https://gateoverflow.in/302865>

- ✓ Option B is the correct answer.

The last sentence of the text mentions

**! the underlying disease(cause) is the failure of state to protect citizens who fall through the social security net.**

which means beggars are created due to lack of social welfare schemes by the state.

- Beggars are lazy people who beg because they are unwilling to work - may or may not be true but cannot be inferred from the passage.
- Beggars are created because of the lack of social welfare schemes - Can be inferred from the last sentence.
- Begging is an offense that has to be dealt with firmly - It is given that High Court dispelled the idea of treating begging as an offense.
- Begging has to be banned because it adversely affects the welfare of the state - may or may not be true but cannot be inferred from the passage.

[9 votes](#)

-- Sayan Bose (5k points)

**11.18.8 Verbal Reasoning: GATE CSE 2020 | Question: GA-4** [top ↴](#)<https://gateoverflow.in/333237>

- A. Nation-states do not have environmental concerns.

The only statement in the given passage referring to nation-states is “nation-states need to rethink their carbon footprint”.

But this does not imply that nation-states do not have environmental concerns.

- B. Nation-states are responsible for providing fresh water to billions of people.

Like the previous statement this is also not said anywhere in the given passage

- C. Billions of people are responsible for man-made emissions.

“nation-states need to rethink their carbon footprint” – means nation-states are responsible for man-made emissions but it does not mean “billions of people” – could be a few hundreds or thousands.

- D. Billions of people are affected by melting glaciers.

“situation of imminent global exodus of billions of people displaced by rising seas” clearly implies this.

Correct option: D.

[1 vote](#)

-- Arjun Suresh (328k points)

**11.18.9 Verbal Reasoning: GATE CSE 2020 | Question: GA-6** [top](#)<https://gateoverflow.in/333235>

- ✓ Let us look at some important points given in the paragraph

1. GST is imposed on **supply** of goods and services
2. It subsumes all indirect taxes **except few**
3. It is a **destination** based tax implied **on goods used**
4. It is not imposed at point of origin from where good comes
5. GST also has **few components specific to** state government , central government and **union territories**

Now we can eliminate the options based on above points

A. GST is imposed on production of goods and services

It is **FALSE** due to point 1. To make it correct, in place of **production** it should be **supply**

B. GST includes all indirect taxes.

It is **FALSE** due to point 2 due to **except few** words

C. GST does not have component specific to UT

It is **FALSE** due to point 5 since it has few components specific to UT.

D. GST is imposed at point of usage of goods and services.

It is **TRUE** due to point 3. we can relate **point of usage** to **goods used at destination**

Hence Option **D** is the correct option.

7 votes

-- Satbir Singh (20.9k points)

**11.18.10 Verbal Reasoning: GATE CSE 2021 Set 1 | GA Question: 10** [top](#)<https://gateoverflow.in/357467>

- ✓ Option (D). AOM are addressing the problem superficially.

Such measures **sidestep** addressing the core problems

As AOM are not addressing the core problems, they are superficial.

**superficial**, shallow, cursory mean lacking in depth or solidity. **superficial** implies a concern only with surface aspects or obvious features. a **superficial** analysis of the problem shallow is more generally derogatory in implying lack of depth in knowledge, reasoning, emotions, or character.

4 votes

-- zxy123 (2.5k points)

**11.18.11 Verbal Reasoning: GATE CSE 2021 Set 2 | GA Question: 6** [top](#)<https://gateoverflow.in/357544>

- ✓
1. Listening to music during exercise improves performance and reduces discomfort
  2. listening to music while studying can help students learn better and the results were inconclusive.

These two statements suggests that Music listening helps **everyone** during exercise but we cannot conclude anything on its effect on studying as results were **inconclusive**. For some students it works, and for some it does not.

Personally for me, it does. :)

**Option C** is the correct one.

3 votes

-- Shashank Rustagi (5k points)

**11.18.12 Verbal Reasoning: GATE Chemical 2020 | GA Question: 4** [top](#)<https://gateoverflow.in/359820>

- ✓ “Officials **believe** that the loss in production of the kharif crops can be recovered in the **output of the rabi** (winter sown) crops so that the country can **achieve its food-grain production target** of 291 million tons”.

So, option D should be the answer.

1 votes

-- Arjun Suresh (328k points)

**11.18.13 Verbal Reasoning: GATE Chemical 2020 | GA Question: 6**[top ↴](https://gateoverflow.in/359816)

- ✓ “Repo rate is the rate at which Reserve Bank of India (RBI) **lends commercial banks**”

So a decrease in repo rate means commercial banks have to pay less.

Correct option: D.

1 votes

-- Arjun Suresh (328k points)

**11.18.14 Verbal Reasoning: GATE Civil 2020 Set 1 | GA Question: 6**[top ↴](https://gateoverflow.in/359856)

- ✓ **expounds:** present and explain (a theory or idea) in detail.

- A. Howard Gardner insists that the teaching curriculum and evaluation needs to be multi-dimensional.  
Not true. “**modern educationists insist on** prescribing multi-dimensional”
- B. Howard Gardner wants to develop and assess the theory of multiple intelligences.  
Not true. “Howard Gardner **expounds** that human intelligence can be subcategorized into multiple kinds” meaning he explains the theory of multiple intelligence but we cannot infer if he wants to develop and assess that theory.
- C. Modern educationists want to develop and assess the theory of multiple intelligences.  
Not true. “**Based on this theory**, modern educationists insist on prescribing multi-dimensional curriculum” meaning modern educationists are using the theory – but we cannot infer if they want to develop it.
- D. Modern educationists insist that the teaching curriculum and evaluation needs to be multi-dimensional.  
True. This can be clearly inferred from “modern educationists **insist on prescribing multi-dimensional curriculum**”

Correct option: D.

1 votes

-- Arjun Suresh (328k points)

**11.18.15 Verbal Reasoning: GATE Civil 2020 Set 2 | GA Question: 6**[top ↴](https://gateoverflow.in/359836)

- ✓ ! Real interest rate calculated on the basis of actual value (inflation-adjusted), is approximately equal to the **difference between nominal rate and expected rate of inflation** in the economy

This means, when inflation is high real interest rate is low (we can assume nominal rate is fixed as the time of borrowing based on an expected inflation rate). So, this must benefit the borrower. He pays the same amount of money to the lender but the value of that money has gone down.

Correct option: A.

1 votes

-- Arjun Suresh (328k points)

**11.18.16 Verbal Reasoning: GATE Civil 2021 Set 1 | GA Question: 10**[top ↴](https://gateoverflow.in/359871)

- ✓
- A. No species possess the ability to construct worlds in their minds  
False. “**Humans have** the ability to construct worlds entirely in their minds” and humans is a species.
  - B. The terms imagination, invention and innovation refer to unrelated skills  
False. “**This skill** is so important that we have different words to refer to its different flavors, such as imagination, invention and innovation” meaning the three terms are related to the same skill.
  - C. We do not know of any species other than humans who possess the ability to construct mental worlds  
True. “So far as we know, **no other species possesses** this ability.”
  - D. Imagination, invention and innovation are unrelated to the ability to construct mental worlds  
False. “This skill is so important that we have different **words to refer to its different flavors**, such as imagination, invention and innovation.”

Correct option: C.

1 votes

-- Arjun Suresh (328k points)

**11.18.17 Verbal Reasoning: GATE Civil 2021 Set 2 | GA Question: 7**[top ↴](https://gateoverflow.in/359897)



In my opinion, it is **no less important** for public speaker to rehearse their talks.

This means that the author considers rehearsal either equally or more important for public speakers than for musicians and actors. So, options B and C are clearly false. Option D is not true as the author is not comparing musicians and actors.

Correct option: A

1 votes

-- Arjun Suresh (328k points)

#### 11.18.18 Verbal Reasoning: GATE ECE 2020 | GA Question: 4 [top](#)

<https://gateoverflow.in/359775>



French-speaking couple after they filed complaints about formal in-flight announcements in English lasting **15 seconds**, as opposed to informal **5 second** messages in French

This clearly shows that the French couple were upset that the English announcements were longer than the French.

Correct option: C

1 votes

-- Arjun Suresh (328k points)

#### 11.18.19 Verbal Reasoning: GATE ECE 2020 | GA Question: 6 [top](#)

<https://gateoverflow.in/359768>



The global financial crisis in 2008 is considered to be the most serious world-wide financial crisis, which started with the sub-prime lending crisis in USA in 2007.

- $\implies$  subprime lending crisis  $\rightarrow$  global financial crisis

The sub-prime lending crisis led to the banking crisis in 2008 with the collapse of Lehman Brothers in 2008.

- $\implies$  subprime lending crisis  $\rightarrow$  banking crisis

The sub-prime lending refers to the provision of loans to those borrowers who may have difficulties in repaying loans, and it arises because of excess liquidity following the East Asian crisis.

- $\implies$  east Asian crisis  $\rightarrow$  subprime lending crisis

So, the correct answer is Option A.

1 votes

-- Arjun Suresh (328k points)

#### 11.18.20 Verbal Reasoning: GATE ECE 2021 | GA Question: 7 [top](#)

<https://gateoverflow.in/359793>



- i. Nowadays, computers are present in almost all places.  
True. “efficiency in **almost all fields** from agriculture to space exploration”
- ii. Computers cannot be used for solving problems in engineering  
False. This is contradictory to the given passage. “from agriculture **to space exploration**”
- iii. For humans, there are both positive and negative effects of using computers.  
True. “**can lead to health issues**” shows the negative effect and positive effect is shown by “**improve efficiency** in almost all fields”
- iv. Artificial intelligence can be done without data.  
False. This is contradictory to the given passage. “**given enough training data**”

So, correct option: D.

1 votes

-- Arjun Suresh (328k points)

#### 11.18.21 Verbal Reasoning: GATE Electrical 2021 | GA Question: 6 [top](#)

<https://gateoverflow.in/359745>



- A. Sleeping well alone is enough to prepare for an exam. Studying has lesser benefit.  
No where in the passage this is implied. The given passage only says that “sleeping well” is a necessity. It doesn’t say

- sleeping well is “sufficient” to prepare for an exam.
- B. Students are efficient and are not wrong in thinking that sleep is a waste of time.  
This is contradictory to the given passage.
- C. If a student is extremely well prepared for an exam, he needs little or no sleep.  
False. “sleep deprivation greatly reduces the ability **to recall** the material learnt.”
- D. To do well in an exam, adequate sleep must be part of the preparation.  
True. “cutting down on sleep to study longer hours can be **counterproductive**”

Correct option: D.

1 votes

-- Arjun Suresh (328k points)

#### 11.18.22 Verbal Reasoning: GATE Mechanical 2020 Set 1 | GA Question: 6 [top](#)



- ✓
- A. Funds raised through unwilling contributions on web-based platforms  
“who would be **willing to invest**”: so False.
- B. Funds raised through large contributions on web-based platforms  
“invest **smaller amounts**”: so False
- C. Funds raised through coerced contributions on web-based platforms  
Coerced means “forced”. So, similar to option A this must be False.
- D. Funds raised through voluntary contributions on web-based platforms  
“willing to invest smaller amounts through web-based platforms”: True.

Correct Answer: D.

1 votes

-- Arjun Suresh (328k points)

#### 11.18.23 Verbal Reasoning: GATE Mechanical 2020 Set 2 | GA Question: 2 [top](#)



- ✓ Measures are for improving the output. So, level of production is expected to “increase”.

Correct option: A.

1 votes

-- Arjun Suresh (328k points)

#### 11.18.24 Verbal Reasoning: GATE Mechanical 2020 Set 2 | GA Question: 4 [top](#)



- ✓ Option B: squared = lost does not match.

Based on the given passage all other three usages are apt. The usage “squared” (earlier was behind) should mean that the series was tied after this match – either 1 – 1 or 2 – 2, meaning the current match was won.

1 votes

-- Arjun Suresh (328k points)

#### 11.18.25 Verbal Reasoning: GATE Mechanical 2020 Set 2 | GA Question: 6 [top](#)



- ✓ reduction of sources of non-renewable energy resources and reducing vulnerability of climate change aspects. The terms ‘mitigation’ and ‘adaptation’ are used to refer to these aspects, respectively.

This means

1. mitigation: reduction of sources of non-renewable energy resources
2. adaptation: reducing vulnerability of climate change aspects

Lets see options.

- A. Mitigation deals with consequences of climate change  
False. Adaptation deals with consequences of climate change
- B. Adaptation deals with causes of climate change  
False. Mitigation deals with causes of climate change
- C. Mitigation deals with actions taken to reduce the use of fossil fuels.  
True.
- D. Adaptation deals with actions taken to combat green-house gas emissions

False. This should be mitigation.

Correct option: C.

1 votes

-- Arjun Suresh (328k points)

### 11.18.26 Verbal Reasoning: GATE Mechanical 2021 Set 1 | GA Question: 6 [top](#)



- ✓ Oxpeckers and rhinos manifest a symbiotic relationship in the wild. The oxpeckers warn the rhinos about approaching poachers, thus possibly saving the lives of the rhinos.
- rhinos may be saved from the poachers  
Oxpeckers also feed on the parasitic ticks found on rhinos.
- Oxpeckers get a food source

Correct option: C.

1 votes

-- Arjun Suresh (328k points)

### 11.18.27 Verbal Reasoning: GATE Mechanical 2021 Set 2 | GA Question: 10 [top](#)



- ✓ The air travel industry is facing a crisis, as the **resulting** quarantine requirement

The usage of “resulting” shows that the second statement is a result/effect of the first one.

Correct option: D

1 votes

-- Arjun Suresh (328k points)

### 11.18.28 Verbal Reasoning: GATE2013 AE: GA-3 [top](#)



- ✓ Answer C: He displayed modesty in his interactions.
- hu·mil·i·ty**  
(h)yoo'-mildē/  
**noun**

1. a modest or low view of one's own importance; humbleness.

**synonyms:** modesty, humbleness, meekness, diffidence, unassertiveness; **More**

4 votes

-- Kathleen Bankson (51.6k points)

### 11.18.29 Verbal Reasoning: GATE2013 EE: GA-5 [top](#)



- ✓ "You can always give me a ring whenever you need."

This means that I'm always available if you need any help.

(C) is the most appropriate option.

5 votes

-- Monanshi Jain (7k points)

### 11.18.30 Verbal Reasoning: GATE2013 EE: GA-7 [top](#)



- ✓ Option D. Hetero means different.

It is clearly mentioned that the movement comprised of moderates, liberals, radicals, socialists and so on.

9 votes

-- Mojo Jojo (2.8k points)

### 11.18.31 Verbal Reasoning: GATE2014 AG: GA-3 [top](#)





| ! As a women I have no country

What this statement means? Does it mean that women are not accepted in any country? Definitely no. Rather it means that a women does not consider people from other countries any different. i.e., we are not talking about nationalist women here rather we are talking about women who considers those from other countries the same as from their own country (of course it does not make them anti-national as some believe). If interested you can read more [here](#).

Now, when a statement is given and asked for the meaning we cannot consider any external facts into consideration.

- A. Wrong as this statement means that no country is welcome to women as against the meaning conveyed by the given sentence
- B. Wrong - the given statement says nothing about citizenship
- C. Correct - expresses the same meaning as given sentence
- D. Wrong - this may or may not be universally true, but in no way expresses the same meaning as given statement

#### References



3 votes

-- Arjun Suresh (328k points)

#### 11.18.32 Verbal Reasoning: GATE2014 EC-3: GA-1 [top](#)

» <https://gateoverflow.in/41140>



- ✓ Answer C) India is home to 22 official languages and thousands of dialects.  
It talks about 22 languages and 1000s of dialects, which clearly show existence of rich heritage and cultural diversity.  
Other options A,B and D only show there are many states, which does not necessarily imply the rich heritage and diversity,

6 votes

-- Abhilash Panicker (7.6k points)

#### 11.18.33 Verbal Reasoning: GATE2015 EC-2: GA-10 [top](#)

» <https://gateoverflow.in/39511>



- ✓ Ans: (B)

From first line in para its clear that schools are giving less importance to arts education. hence (iv)

| ! However, no such increase has been announced in this year's Budget.

From this line we can infer that artists are expected funding for arts to increase this year.

5 votes

-- Desert\_Warrior (6k points)

#### 11.18.34 Verbal Reasoning: GATE2016 EC-1: GA-7 [top](#)

» <https://gateoverflow.in/108087>



- ✓ (iii) He was sure that his friends would help him when in need.
- (iv) His friends did not help him last week.

Only these 2 statements can be inferred. Option B.

3 votes

-- Shobhit (13.5k points)

#### 11.18.35 Verbal Reasoning: GATE2016 EC-1: GA-8 [top](#)

» <https://gateoverflow.in/108089>



- ✓ Shiva > Leela > Pavithra

Pavithra is the youngest. Option D.

4 votes

-- Shobhit (13.5k points)

**11.18.36 Verbal Reasoning: GATE2016 ME-2: GA-7** [top](#)<https://gateoverflow.in/108299>

- ✓ "It also uses technology to ensure safety and security of the city, something which critics argue, will lead to a surveillance state."

critics argue because of perception that smart city promotes surveillance that makes statement (iv) correct.

There is nothing mention in passage about encouragement about formation of surveillance states so that makes statement (i) false.

And, "will lead to a surveillance state tis makes " this line makes statement (ii) false.

and there is nothing mention about " both Sustainability and surveillance" in passage so statement (iii) is wrong too.

Hence only statement (iv) is correct which is option C .

6 votes

-- Bikram (58.3k points)

**11.18.37 Verbal Reasoning: GATE2017 ME-1: GA-9** [top](#)<https://gateoverflow.in/313668>

- ✓ "Maybe not, but at least I am the best player in my own family"

This reply by James to Mark shows that Mark is not the best player in his own family which means Steve is a better player.

Correct Option: B

1 votes

-- Arjun Suresh (328k points)

**11.18.38 Verbal Reasoning: GATE2019 IN: GA-6** [top](#)<https://gateoverflow.in/313553>

- ✓ "banking institutions have been making a demand to reduce interest rates on small saving schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes"

This means that government after considering the demand reduced the interest rates. So, option C can be inferred from the given passage.

Options A, B and D cannot be inferred from the given passage.

Correct option: C

0 votes

-- Arjun Suresh (328k points)

**11.18.39 Verbal Reasoning: GATE2019 ME-1: GA-6** [top](#)<https://gateoverflow.in/313605>

- ✓ "I'll be shot"

If this is true he must be hanged but for the statement to be true he must be shot. So, not possible.

Correct Option: C.

1 votes

-- Arjun Suresh (328k points)

**11.19****Word Meaning (3)** [top](#)**11.19.1 Word Meaning: GATE2017 EC-1: GA-1** [top](#)<https://gateoverflow.in/313524>

She has a sharp tongue and it can occasionally turn \_\_\_\_\_

- A. Hurtful
- B. Left
- C. Methodical
- D. Vital

[gate2017-ec-1](#) [general-aptitude](#) [verbal-aptitude](#) [word-meaning](#)

Answer

**11.19.2 Word Meaning: GATE2017 ME-1: GA-2** [top](#)<https://gateoverflow.in/313664>

As the two speakers become increasingly agitated, the debate became \_\_\_\_\_.

- A. lukewarm
- B. poetic
- C. forgiving
- D. heated

[gate2017-me-1](#) [general-aptitude](#) [verbal-aptitude](#) [word-meaning](#)

Answer

**11.19.3 Word Meaning: GATE2017 ME-2: GA-2** [top](#)<https://gateoverflow.in/313676>

If you choose plan *P*, you will have to \_\_\_\_\_ plan *Q*, as these two are mutually \_\_\_\_\_.

- A. forgo, exclusive
- B. forget, inclusive
- C. accept, exhaustive
- D. adopt, intrusive

[gate2017-me-2](#) [general-aptitude](#) [verbal-aptitude](#) [word-meaning](#)

Answer

**Answers: Word Meaning****11.19.1 Word Meaning: GATE2017 EC-1: GA-1** [top](#)<https://gateoverflow.in/313524>

- ✓ Correct Answer: (A) Hurtful.

The given sentence means sharp tongue can cause her problem. So, "vital" and "methodical" (systematic) are not correct as they are positive words. "left" does not suit the meaning here. "hurtful" fits the sentence perfectly.

2 votes

-- Arjun Suresh (328k points)

**11.19.2 Word Meaning: GATE2017 ME-1: GA-2** [top](#)<https://gateoverflow.in/313664>

- ✓ A. lukewarm - *moderately warm*
- B. poetic - *characterized by romantic imagery*
- C. forgiving - *inclined or able to forgive and show mercy*
- D. heated - *marked by emotional heat*

So, the answer is *heated*, i.e. *D* as the speakers are becoming increasingly agitated (troubled emotionally).

2 votes

-- Mukunda Madhava Nath (259 points)

**11.19.3 Word Meaning: GATE2017 ME-2: GA-2** [top](#)<https://gateoverflow.in/313676>

- ✓ The correct sentence will be "If you choose plan P, you will have to **forgo** (meaning go without) plan Q, as these two are mutually **exclusive**."

Correct choice: *A*

2 votes

-- Naveen Kumar (9.9k points)

**11.20****Word Pairs (21)** [top](#)**11.20.1 Word Pairs: GATE CSE 2010 | Question: 60** [top](#)<https://gateoverflow.in/2368>

The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair.

**Unemployed : Worker**

- A. fallow : land

- B. unaware : sleeper
- C. wit : jester
- D. renovated : house

[gate2010-cse](#) [verbal-aptitude](#) [word-pairs](#) [normal](#)

Answer 

#### 11.20.2 Word Pairs: GATE CSE 2013 | Question: 57 [top](#)

<https://gateoverflow.in/1560>



Complete the sentence:

Universalism is to particularism as diffuseness is to \_\_\_\_\_.

- A. specificity
- B. neutrality
- C. generality
- D. adaptation

[gate2013-cse](#) [verbal-aptitude](#) [normal](#) [word-pairs](#)

Answer 

#### 11.20.3 Word Pairs: GATE CSE 2015 Set 1 | Question: GA-5 [top](#)

<https://gateoverflow.in/8008>



Which one of the following combinations is incorrect?

- A. Acquiescence - Submission
- B. Wheedle - Roundabout
- C. Flippancy - Lightness
- D. Profligate - Extravagant

[gate2015-cse-set1](#) [verbal-aptitude](#) [difficult](#) [word-pairs](#)

Answer 

#### 11.20.4 Word Pairs: GATE CSE 2015 Set 3 | Question: GA-4 [top](#)

<https://gateoverflow.in/8302>



Select the pair of best expresses a relationship similar to that expressed in the pair:

**Children : Pediatrician**

- A. Adult : Orthopaedist
- B. Females : Gynaecologist
- C. Kidney : Nephrologist
- D. Skin : Dermatologist

[gate2015-cse-set3](#) [verbal-aptitude](#) [easy](#) [word-pairs](#)

Answer 

#### 11.20.5 Word Pairs: GATE CSE 2020 | Question: GA-3 [top](#)

<https://gateoverflow.in/333238>



Select the word that fits the analogy:

Cook : Cook :: Fly : \_\_\_\_\_

- A. Flyer
- B. Flying
- C. Flew
- D. Flighter

[gate2020-cse](#) [verbal-aptitude](#) [word-pairs](#)

Answer 

**11.20.6 Word Pairs: GATE CSE 2021 Set 1 | GA Question: 5** top ↗<https://gateoverflow.in/357472>

\_\_\_\_\_ is to *surgery* as *writer* is to \_\_\_\_\_

Which one of the following options maintains a similar logical relation in the above sentence?

- A. Plan, outline
- B. Hospital, library
- C. Doctor, book
- D. Medicine, grammar

[gate2021-cse-set1](#) [verbal-aptitude](#) [word-pairs](#)

Answer 

**11.20.7 Word Pairs: GATE CSE 2021 Set 2 | GA Question: 5** top ↗<https://gateoverflow.in/357545>

Pen : Write :: Knife : \_\_\_\_\_

Which one of the following options maintains a similar logical relation in the above?

- A. Vegetables
- B. Sharp
- C. Cut
- D. Blunt

[gate2021-cse-set2](#) [verbal-aptitude](#) [word-pairs](#)

Answer 

**11.20.8 Word Pairs: GATE Chemical 2020 | GA Question: 3** top ↗<https://gateoverflow.in/359822>

Select the word that fits the analogy:

Cover : Uncover :: Associate : \_\_\_\_\_

- A. Unassociate
- B. Inassociate
- C. Misassociate
- D. Dissociate

[gate2020-ch](#) [verbal-aptitude](#) [word-pairs](#)

Answer 

**11.20.9 Word Pairs: GATE Civil 2020 Set 1 | GA Question: 3** top ↗<https://gateoverflow.in/359864>

Select the word that fits the analogy:

Fuse : Fusion :: Use : \_\_\_\_\_

- A. Usage
- B. User
- C. Uses
- D. Usion

[gate2020-ce-1](#) [verbal-aptitude](#) [word-pairs](#) [easy](#)

Answer 

**11.20.10 Word Pairs: GATE Civil 2020 Set 2 | GA Question: 3** top ↗<https://gateoverflow.in/359842>

Select the word that fits the analogy:

Partial : Impartial :: Popular : \_\_\_\_\_

- A. Impopular
- B. Dispopular
- C. Mispopular
- D. Unpopular

[gate2020-ce-2](#)
[verbal-aptitude](#)
[word-pairs](#)
**Answer**
**11.20.11 Word Pairs: GATE ECE 2020 | GA Question: 3** [top](#)
<https://gateoverflow.in/359778>


Select the word that fits the analogy:

Explicit: Implicit :: Express: \_\_\_\_\_

- A. Impress
- B. Repress
- C. Compress
- D. Suppress

[gate2020-ec](#)
[verbal-aptitude](#)
[word-pairs](#)
**Answer**
**11.20.12 Word Pairs: GATE ECE 2021 | GA Question: 4** [top](#)
<https://gateoverflow.in/359799>


*Nostalgia* is to *anticipation* as \_\_\_\_\_ is to \_\_\_\_\_

Which one of the following options maintains a similar logical relation in the above sentence?

- A. Present, past
- B. Future, past
- C. Past, future
- D. Future, present

[gateec-2021](#)
[verbal-aptitude](#)
[word-pairs](#)
**Answer**
**11.20.13 Word Pairs: GATE Electrical 2020 | GA Question: 3** [top](#)
<https://gateoverflow.in/359728>


Select the word that fits the analogy:

Do : Undo :: Trust : \_\_\_\_\_

- A. Entrust
- B. Intrust
- C. Distrust
- D. Untrust

[gate2020-ee](#)
[verbal-aptitude](#)
[word-pairs](#)
**Answer**
**11.20.14 Word Pairs: GATE Electrical 2021 | GA Question: 5** [top](#)
<https://gateoverflow.in/359747>


*Oasis* is to *sand* as *island* is to \_\_\_\_\_

Which one of the following options maintains a similar logical relation in the above sentence?

- A. Stone
- B. Land
- C. Water
- D. Mountain

[gateee-2021](#)
[verbal-aptitude](#)
[word-pairs](#)
**Answer**
**11.20.15 Word Pairs: GATE Mechanical 2020 Set 1 | GA Question: 3** [top](#)
<https://gateoverflow.in/359532>


Select the word that fits the analogy:

Build : Building :: Grow : \_\_\_\_\_

- A. Grown

- B. Grew
- C. Growth
- D. Growded

[gateme-2020-set1](#) [verbal-aptitude](#) [word-pairs](#)

Answer 

### 11.20.16 Word Pairs: GATE Mechanical 2020 Set 2 | GA Question: 3

 <https://gateoverflow.in/359553>



Select the word that fits the analogy:

White: Whitening : : Light : \_\_\_\_\_

- A. Lightning
- B. Lightening
- C. Lighting
- D. Enlightening

[gateme-2020-set2](#) [verbal-aptitude](#) [word-pairs](#)

Answer 

### 11.20.17 Word Pairs: GATE2010 MN: GA-2

 <https://gateoverflow.in/312010>



The question below consists of a pair of related words followed by four pairs of words . Select the pair that best expresses the relation in the original pair.

#### Preamble : Constitution

- A. amendment : law
- B. prologue : play
- C. episode : serial
- D. plot : story

[general-aptitude](#) [verbal-aptitude](#) [gate2010-mn](#) [word-pairs](#)

Answer 

### 11.20.18 Word Pairs: GATE2010 TF: GA-2

 <https://gateoverflow.in/312021>



The question below consists of a pair of related words followed by four pairs of words. Select the pair the best expresses the relation in the original pair.

#### Erudition : Scholar

- A. steadfast : mercurial
- B. competence : strict
- C. skill : craftsman
- D. nurse : doctor

[general-aptitude](#) [verbal-aptitude](#) [gate2010-tf](#) [word-pairs](#)

Answer 

### 11.20.19 Word Pairs: GATE2011 AG: GA-5

 <https://gateoverflow.in/312124>



The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair.

#### Gladiator : Arena

- A. dancer : stage
- B. commuter : train
- C. teacher : classroom
- D. lawyer : courtroom

[general-aptitude](#) [verbal-aptitude](#) [gate2011-ag](#) [word-pairs](#)

Answer 

**11.20.20 Word Pairs: GATE2013 AE: GA-5** [top](#)<https://gateoverflow.in/40246>

Select the pair that best expresses a relationship similar to that expressed in the pair:

**water: pipe::**

- A. cart: road
- B. electricity: wire
- C. sea: beach
- D. music: instrument

[gate2013-ae](#) [verbal-aptitude](#) [word-pairs](#)

Answer

**11.20.21 Word Pairs: GATE2013 CE: GA-5** [top](#)<https://gateoverflow.in/40272>

Select the pair that best expresses a relationship similar to that expressed in the pair:

**Medicine: Health**

- A. Science: Experiment
- B. Wealth: Peace
- C. Education: Knowledge
- D. Money: Happiness

[gate2013-ce](#) [word-pairs](#) [verbal-aptitude](#)

Answer

**Answers: Word Pairs****11.20.1 Word Pairs: GATE CSE 2010 | Question: 60** [top](#)<https://gateoverflow.in/2368>

✓ **Answer (A) Fallow: Land**

**Fallow** is **land** that is uncultivated

**Unemployed** is a **worker** without a job

21 votes

-- Kathleen Bankson (51.6k points)

**11.20.2 Word Pairs: GATE CSE 2013 | Question: 57** [top](#)<https://gateoverflow.in/1560>

✓ A. Specificity. This is asking for opposites.

**Specificity**

Direct, to the point, purposeful in relating  
Precise, blunt, definitive and transparent  
Principles and consistent moral stands  
independent of the person being addressed

**Diffuseness**

Indirect, circuitous, seemingly "aimless"  
forms of relating  
Evasive, tactful, ambiguous, even opaque  
Highly situational morality depending  
upon the person and context encountered

14 votes

-- Kathleen Bankson (51.6k points)

**11.20.3 Word Pairs: GATE CSE 2015 Set 1 | Question: GA-5** [top](#)<https://gateoverflow.in/8008>

✓ **B Wheedle - Roundabout**

13 votes

-- Kathleen Bankson (51.6k points)

**11.20.4 Word Pairs: GATE CSE 2015 Set 3 | Question: GA-4** [top](#)<https://gateoverflow.in/8302>

✓ **Option B**

**Orthopaedist:** An orthopaedic surgeon, a doctor who corrects congenital or functional abnormalities of the bones with surgery, casting, and bracing.

**Gynaecologist** a physician or surgeon qualified to practice in functions and diseases specific to women and girls, especially

those affecting the reproductive system.

**Nephrologist** is a medical doctor who specializes in kidney care and treating diseases of the kidneys.

**Dermatologist** is a medical practitioner qualified to diagnose and treat skin disorders.

Kidney and skin are parts of a body. Females is the only option which represents **group of people** like children which is the correct option.

14 votes

-- Anoop Sonkar (4.1k points)

#### 11.20.5 Word Pairs: GATE CSE 2020 | Question: GA-3 [top](#)

→ <https://gateoverflow.in/333238>



- ✓ Correct Option: A. Flyer.

Relation here is Verb: Noun. One who cooks is a cook and one who flies any aircraft is a flyer.

10 votes

-- Anshul Sharma (525 points)

#### 11.20.6 Word Pairs: GATE CSE 2021 Set 1 | GA Question: 5 [top](#)

→ <https://gateoverflow.in/357472>



- ✓ A doctor performs a surgery, and a writer writes a book.

So **option C.**

4 votes

-- zxy123 (2.5k points)

#### 11.20.7 Word Pairs: GATE CSE 2021 Set 2 | GA Question: 5 [top](#)

→ <https://gateoverflow.in/357545>



- ✓ First and second terms are connected by usage.

**pen** is used **to write**.

Similarly **knife** is used **to cut**.

5 votes

-- chirudeepnamini (2.9k points)

#### 11.20.8 Word Pairs: GATE Chemical 2020 | GA Question: 3 [top](#)

→ <https://gateoverflow.in/359822>



- ✓ Uncover is the antonym of Cover. Dissociate is the antonym of Associate.

Correct Option: D.

1 votes

-- Arjun Suresh (328k points)

#### 11.20.9 Word Pairs: GATE Civil 2020 Set 1 | GA Question: 3 [top](#)

→ <https://gateoverflow.in/359864>



- ✓ Fusion is the **noun form** of Fuse.

Usage is the **noun form** of Use.

Correct option: A

1 votes

-- Arjun Suresh (328k points)

#### 11.20.10 Word Pairs: GATE Civil 2020 Set 2 | GA Question: 3 [top](#)

→ <https://gateoverflow.in/359842>



- ✓ The analogy here is of antonym.

- Partial × Impartial
- Popular × Unpopular

Correct option: D.

1 votes

-- Arjun Suresh (328k points)

#### 11.20.11 Word Pairs: GATE ECE 2020 | GA Question: 3 [top](#)

→ <https://gateoverflow.in/359778>



- ✓ Option **B. Repress**

repress is used in the context of *hold something back* mostly in sociological or psychological contexts.

whereas suppress is used in the context of *force something to stop*.

e.g. You repress a smile, but your medicine suppresses your cold.

2 votes

-- Madhav kumar (1.5k points)

#### 11.20.12 Word Pairs: GATE ECE 2021 | GA Question: 4 [top](#)

<https://gateoverflow.in/359799>



- ✓ C. Past, Future

As Nostalgia: recalling memories (of past) and Anticipate: Foresee ( see the future)

2 votes

-- Dhruov (180 points)

#### 11.20.13 Word Pairs: GATE Electrical 2020 | GA Question: 3 [top](#)

<https://gateoverflow.in/359728>



- ✓ Ans. C

this is analogy question – a comparison of two otherwise unlike things based on resemblance of a particular aspect

**Do** is verb and **Undo** is used as its opposite term

**Trust** opposite is **distrust. (or mistrust)**

**Entrust** – put (something) into someone's care or protection.

**Intrust** – archaic spelling of entrust.

**Untrust** (wrong word)

2 votes

-- Vijay Purohit (2.8k points)

#### 11.20.14 Word Pairs: GATE Electrical 2021 | GA Question: 5 [top](#)

<https://gateoverflow.in/359747>



- ✓ **Oasis:** a fertile spot in a desert, where water is found

So, we find oasis **surrounded by** sand.

Similarly, **island** is surrounded by **water**.

Correct option: C.

1 votes

-- Arjun Suresh (328k points)

#### 11.20.15 Word Pairs: GATE Mechanical 2020 Set 1 | GA Question: 3 [top](#)

<https://gateoverflow.in/359532>



- ✓ “building” is the “noun” related to the verb “build”.

Similarly, “growth” is the noun related to the verb “grow”.

Correct Answer: C.

1 votes

-- Arjun Suresh (328k points)

#### 11.20.16 Word Pairs: GATE Mechanical 2020 Set 2 | GA Question: 3 [top](#)

<https://gateoverflow.in/359553>



- ✓ Whitening making a thing white.

Lightening makes a thing light.

Correct option: B.

1 votes

-- Arjun Suresh (328k points)

#### 11.20.17 Word Pairs: GATE2010 MN: GA-2 [top](#)

<https://gateoverflow.in/312010>



- ✓ Preamble is like an "introductory" passage for Constitution.

So, the similar pair will be "prologue: play" where prologue is a "separate introductory part" for the play.

Correct Option B.

2 votes

-- Arjun Suresh (328k points)

**11.20.18 Word Pairs: GATE2010 TF: GA-2** top ↴[➡ https://gateoverflow.in/312021](https://gateoverflow.in/312021)

- ✓ Erudition means scholarship

So it is scholarship : Scholar Scholar has scholarship.

⇒ steadfast : mercurial – there is no "has a" relationship.

⇒ competence : strict – there is no "has a" relationship.

⇒ nurse : doctor – there is no "has a" relationship.

∴ skill : craftsman Craftsman has skill – is the most appropriate choice.

So, option C. skill : craftsman is the correct answer.

↳ 3 votes-- Satbir Singh (20.9k points)**11.20.19 Word Pairs: GATE2011 AG: GA-5** top ↴[➡ https://gateoverflow.in/312124](https://gateoverflow.in/312124)

- ✓ **Gladiator : Arena**

Gladiator fights in Arena. i.e. X(person) shows his talent at Y(place).

A. **dancer : stage** Dancer dances on the Stage.

B. **commuter : train** Commuter travels in train or Traveller travels in Train. (commuter means traveller)

C. **teacher : classroom** Teacher teaches in Classroom.

D. **lawyer : courtroom** Lawyer practices law in courtroom.

Now if you notice option B, Train is not a place where as in all the other options we have a place (Arena, stage, Classroom, courtroom.) So option B is eliminated.

So, options A, C and D are left and we need to pick the best among these. i.e. a dancer, a lawyer or a teacher.

Among these the best option is Option D. **lawyer : courtroom** because we can relate a **Gladiator** with the **Lawyer**. The **Gladiator** fights in the Arena to win battles, similarly a **lawyer** fights in the court to win cases.

∴ Option D. **lawyer : courtroom** is the most appropriate choice.

↳ 7 votes-- Satbir Singh (20.9k points)**11.20.20 Word Pairs: GATE2013 AE: GA-5** top ↴[➡ https://gateoverflow.in/40246](https://gateoverflow.in/40246)

- ✓ Answer B: Water runs through a pipe like electricity runs through a wire.

↳ 9 votes-- Kathleen Bankson (51.6k points)**11.20.21 Word Pairs: GATE2013 CE: GA-5** top ↴[➡ https://gateoverflow.in/40272](https://gateoverflow.in/40272)

- ✓ C.

Medicine improves health; education improves knowledge

↳ 15 votes-- Rahul Singla (193 points)

## Answer Keys

11.1.1	C
11.3.2	A
11.3.7	D
11.3.12	A
11.3.17	A
11.3.22	D
11.3.27	C

11.1.2	D
11.3.3	C
11.3.8	B
11.3.13	B
11.3.18	D
11.3.23	B
11.3.28	C

11.1.3	A
11.3.4	C
11.3.9	A
11.3.14	B
11.3.19	A
11.3.24	B
11.3.29	A

11.2.1	D
11.3.5	A
11.3.10	D
11.3.15	C
11.3.20	D
11.3.25	A
11.3.30	C

11.3.1	D
11.3.6	B
11.3.11	C
11.3.16	C
11.3.21	B
11.3.26	A
11.3.31	C

11.3.32	A	11.3.33	D	11.3.34	C	11.3.35	A	11.3.36	C
11.3.37	A	11.3.38	B	11.3.39	B	11.3.40	C	11.3.41	A
11.4.1	D	11.4.2	C	11.4.3	A	11.4.4	D	11.4.5	D
11.4.6	D	11.5.1	B	11.5.2	A	11.5.3	A	11.5.4	B
11.5.5	B	11.5.6	C	11.5.7	A	11.5.8	C	11.5.9	C
11.5.10	C	11.5.11	A	11.5.12	A	11.5.13	C	11.5.14	D
11.5.15	A	11.5.16	A	11.5.17	D	11.5.18	B	11.5.19	B
11.5.20	A	11.5.21	B	11.5.22	B	11.5.23	B	11.5.24	C
11.5.25	D	11.5.26	A	11.5.27	B	11.5.28	B	11.5.29	B
11.5.30	C	11.5.31	D	11.5.32	B	11.5.33	D	11.5.34	C
11.5.35	C	11.6.1	B	11.6.2	C	11.6.3	C	11.6.4	C
11.7.1	C	11.7.2	D	11.7.3	C	11.7.4	B	11.7.5	A
11.7.6	C	11.7.7	A	11.7.8	D	11.7.9	B	11.7.10	B
11.7.11	A	11.7.12	C	11.7.13	D	11.7.14	C	11.7.15	B
11.7.16	B	11.7.17	C	11.7.18	A	11.7.19	A	11.7.20	B
11.7.21	B	11.7.22	C	11.7.23	C	11.7.24	D	11.7.25	A
11.7.26	C	11.7.27	D	11.7.28	C	11.7.29	C	11.7.30	C
11.7.31	D	11.7.32	B	11.7.33	C	11.7.34	C	11.7.35	D
11.7.36	A	11.7.37	A	11.7.38	D	11.7.39	B	11.7.40	A
11.7.41	B	11.7.42	D	11.7.43	A	11.7.44	B	11.7.45	B
11.7.46	C	11.7.47	B	11.7.48	B	11.7.49	B	11.7.50	A
11.7.51	B	11.7.52	B	11.7.53	A	11.7.54	C	11.7.55	C
11.7.56	A	11.7.57	B	11.7.58	B	11.7.59	A	11.7.60	C
11.7.61	A	11.7.62	A	11.7.63	A	11.7.64	A	11.7.65	A
11.7.66	C	11.7.67	B	11.7.68	A	11.7.69	A	11.7.70	D
11.7.71	C	11.7.72	D	11.7.73	A	11.7.74	C	11.7.75	D
11.7.76	D	11.7.77	D	11.7.78	C	11.7.79	B	11.7.80	A
11.7.81	D	11.7.82	A	11.7.83	A	11.8.1	B	11.8.2	C
11.9.1	D	11.9.2	C	11.9.3	B	11.9.4	B	11.9.5	D
11.9.6	A	11.10.1	D	11.10.2	C	11.10.3	D	11.10.4	C
11.10.5	B	11.10.6	D	11.10.7	B	11.10.8	D	11.10.9	B
11.10.10	D	11.10.11	B	11.10.12	B	11.10.13	D	11.10.14	A
11.10.15	B	11.10.16	D	11.10.17	A	11.10.18	D	11.10.19	A
11.10.20	D	11.10.21	C	11.10.22	B	11.10.23	B	11.10.24	B
11.10.25	D	11.10.26	A	11.10.27	A	11.10.28	B	11.10.29	A
11.10.30	C	11.10.31	A	11.10.32	C	11.10.33	D	11.10.34	D
11.10.35	C	11.10.36	B	11.10.37	B;D	11.10.38	D	11.10.39	C
11.10.40	A	11.10.41	D	11.10.42	C	11.10.43	A	11.10.44	A
11.10.45	B	11.11.1	A	11.11.2	C	11.12.1	B	11.12.2	A
11.13.1	B	11.13.2	D	11.13.3	B	11.13.4	B	11.13.5	C
11.14.1	B	11.15.1	A	11.15.2	C	11.16.1	A	11.16.2	C

11.17.1	A	11.17.2	B	11.17.3	C	11.17.4	C	11.17.5	B
11.17.6	C	11.17.7	C	11.17.8	C	11.17.9	B	11.17.10	B
11.17.11	C	11.17.12	B	11.17.13	A	11.17.14	A	11.17.15	C
11.17.16	B	11.18.1	D	11.18.2	B	11.18.3	A	11.18.4	D
11.18.5	B	11.18.6	B	11.18.7	B	11.18.8	D	11.18.9	D
11.18.10	D	11.18.11	C	11.18.12	D	11.18.13	D	11.18.14	D
11.18.15	A	11.18.16	C	11.18.17	A	11.18.18	C	11.18.19	A
11.18.20	D	11.18.21	D	11.18.22	D	11.18.23	A	11.18.24	B
11.18.25	C	11.18.26	C	11.18.27	D	11.18.28	C	11.18.29	C
11.18.30	D	11.18.31	C	11.18.32	C	11.18.33	B	11.18.34	B
11.18.35	D	11.18.36	C	11.18.37	B	11.18.38	C	11.18.39	C
11.19.1	A	11.19.2	D	11.19.3	A	11.20.1	A	11.20.2	A
11.20.3	B	11.20.4	B	11.20.5	A	11.20.6	C	11.20.7	C
11.20.8	D	11.20.9	A	11.20.10	D	11.20.11	B	11.20.12	C
11.20.13	C	11.20.14	C	11.20.15	C	11.20.16	B	11.20.17	B
11.20.18	C	11.20.19	D	11.20.20	B	11.20.21	C		

Since GATE Overflow (GO) started in August 2014, a lot of people have dedicated their time and effort in bringing this book now. Initiated by Omesh Pandita and Arjun Suresh as a Q/A platform for CSE students, Kathleen Bankson was instrumental in getting all previous year GATE questions here. Then experts like Praveen Saini, Happy Mittal, Sankaranarayanan P.N., Suraj Kumar etc. have contributed a lot to the answers in GATE Overflow. Pragy Agarwal even after topping GATE has continuously contributed to GATE Overflow with his knowledge as well as in making the contents beautiful with fine latex skills. Shaik Masthan and Deepak Poonia are other GATE toppers who have contributed to make the GATE Overflow contents error-free. We also have to thank the work done by our editors Jotheeswari Arasakumar, Lakshman Patel, Soujanya Reddy, Sabiha Banu, Misbah Ghaya, Ishrat Jahan, Nataliyah Ahmad, Kanza Bayad, Andrijana Milicevik and Pavan Singh who are continuously adding and keeping the contents in GATE Overflow neat and clean. There are also many toppers of GATE 2015-21 who are contributing a lot in GATE Overflow. The list of all the contributors can be found on GATE Overflow site but even that does not include the contributions of some like Arif Ali Anapparakkal for the book design, Arvind Devaraj and others for guidance and help, Aravind S.R. for fixing the page numbering issue, Marilyn Joseph for book printing support, Ajay K. Soni and Akshat Joshi for book design support and finally Shiva Sagar Rao, Hira Thakur and Ankit Singh for flagging and correcting the errors on GATE Overflow site which is reflected in this book also. Our final proof reading and editing were done with the help of Soujanya Reddy, Lakshman Patel, Ajay K. Soni, Lakshman Patel, M. Chandrakiruthiga, Pooja Khatri, Shikha Mallick, Manoja Rajalakshmi Aravindakshan, Subarna Das and Sukanya Das. Special mention to Ajay K. Soni, Lakshman Patel, Aditya Ravishankar, Sweta Kumari Rawani, Gyanendra Singh, Sabiha Banu, Sukanya Das, Subarna Das and Pooja Khatri for handling all the difficult images in Tikz.

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