

# GATE Overflow

2017 Vol. I



[www.gateoverflow.in](http://www.gateoverflow.in)

[www.facebook.com/groups/gateoverflow](https://www.facebook.com/groups/gateoverflow)

[www.gatecse.in](http://www.gatecse.in)



This book was created programmatically by GATE Overflow on Sep 20, 2017. If you feel any doubt regarding the answer, click on the question link and give a comment on the site. Studying all these questions might get you 60 marks in GATE but that might not be enough for an IIT. So, read standard books, solve exercise questions and use these questions for cementing the concepts and aim 85+. At least if you are not getting the solution to a given problem first refer standard book. If any error is found on any question it shall be updated at <http://gateoverflow.in/corrections>.

PDFs for the remaining subjects will be made available at <http://classroom.gateoverflow.in> and you can enroll in [this course](#) to get notification for the same. Enrollment is free and account details are of GATE Overflow with a new password which have been sent to all registered emails on GATE Overflow. New users will receive this email within a few minutes of confirming their email address.

You can now join our [Facebook group](#) for GATE CSE discussions.

You can visit <http://playlists.gatecse.in> for high quality videos for GATE CSE and how to use GO site/ebook.

This book consists of only previous year GATE, TIFR, ISI and CMI questions (CS from 1987 and all 5 years of IT) all of which are relevant for GATE. Out of syllabus subjects as of GATE 2017 are removed from this book except in rare cases.

Since **GATE Overflow** 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 **Pravne Saini**, **Happy Mittal**, **Sankaranarayanan P.N.**, **Suraj Kumar** etc. have contributed a lot to the answers here. **Pragy Agarwal** even after topping GATE has continuously contributed here with his knowledge as well as in making the contents beautiful with fine latex skills. We also have to thank the work by **Jothee, Misbah, Ishrat** and **Nataliyah** who are continuously adding and keeping the contents here neat and clean. There are also many toppers of GATE 2015, 2016, 2017 and probably 2018 who are contributing a lot here. The list of all the contributors can be found [here](#) but even that does not include the contributions of some like Arif Ali Anapparakkal in helping design this book, **Arvind Devaraj** and others who have provided guidance and help etc. Last but not the least, we thank all the users of GATE Overflow.

We thank the contributions of **Silpa V.S.**, **Rahul Kumar Yadav** and others for getting the **GATECSE Lastrank** page maintained. **Bikram Ballav** is behind most of the exams on GO (<http://mockgate.com>) and **Arindam Sarkar** made the interface for it. **Pragy Agarwal** is also behind the rank and score predictor tool, (<http://mymarks.gatecse.in>) used by GO which has 99-100% accuracy over the last 2 years.

Special thanks to **Sachin Mittal** for making the **How to Use GO vidoes**, **Silpa V.S.** for classifying the questions topicwise for the book, **Pooja Palod** for making the **GATE 2018 schedule** and **Debashish Deka** for GO classroom contributions.

Also thanks to all toppers who took time to write a review for GO.

## Table of Contents

<b>1. Discrete Mathematics: Combinatory</b>	(52)
1. Generating Functions	(4)
2. Modular Arithmetic	(1)
3. Permutations And Combinations	(38)
4. Recurrence	(6)
5. Summation	(3)
<b>2. Discrete Mathematics: Graph Theory</b>	(66)
1. Counting	(6)
2. Degree Of Graph	(14)
3. Euler Graph	(1)
4. Graph Coloring	(9)
5. Graph Connectivity	(22)
6. Graph Isomorphism	(2)
7. Graph Matching	(1)
8. Graph Planarity	(2)
9. Line Graph	(2)
10. Regular Graph	(1)
11. Spanning Tree	(2)
12. Trees	(3)
13. Vertex Cover	(1)
<b>3. Discrete Mathematics: Mathematical Logic</b>	(79)
1. First Order Logic	(33)
2. Logical Reasoning	(10)
3. Propositional Logic	(36)
<b>4. Discrete Mathematics: Set Theory &amp; Algebra</b>	(176)
1. Binary Operation	(8)
2. Counting	(1)
3. Fields	(1)
4. Functions	(34)
5. Generating Functions	(1)
6. Groups	(22)
7. Inequality	(1)
8. Lattice	(9)
9. Lines Curves	(1)
10. Mathematical Induction	(2)
11. Number Theory	(9)
12. Partial Order	(13)
13. Permutations And Combinations	(1)
14. Polynomials	(8)
15. Relations	(31)
16. Ring	(1)
17. Sets	(33)
<b>5. Engineering Mathematics: Calculus</b>	(51)
1. Continuity	(4)
2. Differentiability	(8)
3. Functions	(4)
4. Integration	(11)
5. Limits	(11)
6. Maxima Minima	(12)
7. Polynomials	(1)
<b>6. Engineering Mathematics: Linear Algebra</b>	(68)
1. Determinant	(5)
2. Eigen Value	(21)
3. Matrices	(26)
4. System Of Equations	(11)
5. Vector Space	(5)
<b>7. Engineering Mathematics: Probability</b>	(97)
1. Bayes Theorem	(4)
2. Binomial Distribution	(5)
3. Conditional Probability	(6)
4. Expectation	(9)
5. Exponential Distribution	(1)
6. Normal Distribution	(1)
7. Poisson Distribution	(4)
8. Probability	(57)
9. Random Variable	(8)
10. Uniform Distribution	(2)
<b>8. General Aptitude: Numerical Ability</b>	(197)

1. 2017	(1)
2. Absolute Value	(5)
3. Algebra	(1)
4. Arithmetic Series	(1)
5. Bar Charts	(2)
6. Bayes Theorem	(2)
7. Cartesian Coordinates	(3)
8. Circle	(1)
9. Clock Time	(3)
10. Complex Number	(1)
11. Compound Interest	(1)
12. Conditional Probability	(1)
13. Cost Market Price	(3)
14. Currency Money	(1)
15. Data Interpretation	(17)
16. Direction Sense	(3)
17. Factors	(6)
18. Fractions	(3)
19. Functions	(3)
20. Geometry	(8)
21. Inference	(1)
22. Limits	(1)
23. Logarithms	(2)
24. Logical Reasoning	(21)
25. Maxima Minima	(3)
26. Mean	(1)
27. Modular Arithmetic	(1)
28. No Of Digits	(1)
29. Number Representation	(2)
30. Number Series	(11)
31. Numerical Computation	(14)
32. Odd One	(3)
33. Percentage	(8)
34. Permutations And Combinations	(9)
35. Pie Chart	(4)
36. Pigeonhole	(1)
37. Polynomials	(1)
38. Probability	(11)
39. Proportions	(1)
40. Quadratic Equations	(4)
41. Ratios	(5)
42. Sequence	(4)
43. Sequence Series	(1)
44. Sets	(1)
45. Speed Time Distance	(9)
46. Statement Argument	(1)
47. Statement Sufficiency	(1)
48. Statistics	(1)
49. Summation	(1)
50. System Of Equations	(1)
51. Variance	(1)
52. Venn Diagrams	(2)
53. Work Time	(3)
9. General Aptitude: Verbal Ability	(155)
1. Closest Word	(3)
2. English Grammar	(21)
3. Geometry	(1)
4. Grammatically Incorrect Sentence	(2)
5. Inference	(2)
6. Logical Reasoning	(15)
7. Meaning	(16)
8. Median	(1)
9. Most Appropriate Alternative	(4)
10. Most Appropriate Word	(27)
11. Noun Verb Adjective	(1)
12. Odd One	(3)
13. Opposite	(2)
14. Passage Reading	(21)
15. Percentage	(1)
16. Phrasal Verbs	(1)
17. Probability	(1)

<b>18. Speed Time Distance</b>	(1)
<b>19. Statements Follow</b>	(1)
<b>20. Synonym</b>	(4)
<b>21. Tenses</b>	(3)
<b>22. Venn Diagrams</b>	(1)
<b>23. Verbal Reasoning</b>	(17)
<b>24. Word Pairs</b>	(6)

---

# 1 Discrete Mathematics: Combinatory (52) top

1.1

## Generating Functions(4) top

### 1.1.1 Generating Functions: GATE 2016-1-26 top

<http://gateoverflow.in/39693>

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

[gate2016-1](#) | [permutations-and-combinations](#) | [generating-functions](#) | [normal](#) | [numerical-answers](#)

[Answer](#)

### 1.1.2 Generating Functions: GATE1987-10b top

<http://gateoverflow.in/82451>

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

[gate1987](#) | [permutations-and-combinations](#) | [generating-functions](#)

[Answer](#)

### 1.1.3 Generating Functions: GATE2017-2-47 top

<http://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 \_\_\_\_\_.

[gate2017-2](#) | [permutations-and-combinations](#) | [generating-functions](#) | [numerical-answers](#)

[Answer](#)

### 1.1.4 Generating Functions: TIFR2010-A-12 top

<http://gateoverflow.in/18391>

The coefficient of  $x^3$  in the expansion of  $(1+x)^3(2+x^2)^{10}$  is.

- a.  $2^{14}$
- b.  $31$
- c.  $\binom{3}{3} + \binom{10}{1}$
- d.  $\binom{3}{3} + 2 \binom{10}{1}$
- e.  $\binom{3}{3} \binom{10}{1} 2^9$

[tifr2010](#) | [generating-functions](#)

[Answer](#)

## Answers: Generating Functions

### 1.1.1 Generating Functions: GATE 2016-1-26 top

<http://gateoverflow.in/39693>

Selected Answer

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:

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

Now, put k = 3

$$\text{Coefficient of } [\cancel{x^3}] = \binom{2+3}{3} = 5C3 = 5C2 = 10$$

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

27 votes

-- Praveen Saini (53.5k points)

### 1.1.2 Generating Functions: GATE1987-10b [top](#)

<http://gateoverflow.in/8245>



Selected Answer

$$\text{The general form is } G(x) = \frac{x}{1-x-x^2}$$

and after solving this using partial fraction, we will get

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

5 votes

-- Manu Madhavan (1.2k points)

### 1.1.3 Generating Functions: GATE2017-2-47 [top](#)

<http://gateoverflow.in/118392>



Selected Answer

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

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

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

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

$$a_0 = \text{coefficient of } z^0 = 1$$

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

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

23 votes

-- Manish Joshi (25.2k points)

### 1.1.4 Generating Functions: TIFR2010-A-12 [top](#)

<http://gateoverflow.in/18391>



Selected Answer

$$(1+x)^3 = (1+x^3 + 3x + 3x^2)$$

$$\text{and } (2+x^2)^{10} = {}_{10}C * 2^0 * (x^2)^{10} + {}_{10}C * 2^1 * (x^2)^9 + \dots + {}_{10}C * 2^9 * (x^2)^1 + {}_{10}C * 2^{10} * (x^2)^0$$

$$\text{So, coefficient of } x^3 = {}_{10}C * 2^{10} + 3 * {}_9C * 2^9 = 2^9(32) = 2^{14}$$

As here we need to multiply last term of second expansion with first term of first coefficient ( $x^3$ ) and  $3x$  with  $x^2$  in the second expansion.

11 votes

-- worst\_engineer (5.6k points)

## 1.2

## Modular Arithmetic(1) top

### 1.2.1 Modular Arithmetic: GATE 2016-2-29 top

<http://gateoverflow.in/3958>

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

gate2016-2 | modular-arithmetic | normal | numerical-answers

Answer

## Answers: Modular Arithmetic

### 1.2.1 Modular Arithmetic: GATE 2016-2-29 top

<http://gateoverflow.in/3958>



Selected Answer

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

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

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

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

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

28 votes

-- Gaurav Sharma (2.6k points)

The remainder cycle is 13, 16, 4, 1.

$$13^{99} \pmod{17} = 13^3 \pmod{17} = 4$$

Note:

for remainder cycle,  
 $13 \pmod{17} = 13, \quad 13^2 \pmod{17} = 16, \quad 13^3 \pmod{17} = 4, \quad 13^4 \pmod{17} = 1$

23 votes

-- Ashish Deshmukh (1.5k points)

## 1.3

## Permutations And Combinations(38) top

### 1.3.1 Permutations And Combinations: CMI2010-A-02 top

<http://gateoverflow.in/46132>

We need to choose a team of 11 from a pool of 15 players and also select a captain. The number of different ways this can

be done is

- A.  $\binom{15}{11}$
- B.  $11 \cdot \binom{15}{11}$
- C.  $15 \cdot 14 \cdot 13 \cdot 12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5$
- D.  $(15 \cdot 14 \cdot 13 \cdot 12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5) \cdot 11$

[cmi2010](#) [permutations-and-combinations](#)

[Answer](#)

### 1.3.2 Permutations And Combinations: CMI2014-A-01 [top](#)

<http://gateoverflow.in/46964>

For the inter-hostel six-a-side football tournament, a team of 6 players is to be chosen from 11 players consisting of 5 forwards, 4 defenders and 2 goalkeepers. The team must include at least 2 forwards, at least 2 defenders and at least 1 goalkeeper. Find the number of different ways in which the team can be chosen.

- A.260
- B.340
- C.720
- D.440

[cmi2014](#) [permutations-and-combinations](#)

[Answer](#)

### 1.3.3 Permutations And Combinations: GATE1989-4-i [top](#)

<http://gateoverflow.in/87874>

Provide short answers to the following questions:

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](#) [permutations-and-combinations](#)

[Answer](#)

### 1.3.4 Permutations And Combinations: GATE1991-02,iv [top](#)

<http://gateoverflow.in/514>

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

(A). The number distinct binary trees with $n$ nodes.	(P). $\frac{n!}{2}$
(B). The number of binary strings of 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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.5 Permutations And Combinations: GATE1991-16,a [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.6 Permutations And Combinations: GATE1994\_1.15 [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.7 Permutations And Combinations: GATE1998\_1.23 [top](#)

<http://gateoverflow.in/1660>

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

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

[gate1998](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.8 Permutations And Combinations: GATE1999\_1.3 [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.9 Permutations And Combinations: GATE1999\_2.2 [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.10 Permutations And Combinations: GATE2001-2.1 [top](#)

<http://gateoverflow.in/719>

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

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

[gate2001](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.11 Permutations And Combinations: GATE2002-13 [top](#)

<http://gateoverflow.in/866>

- 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.
- 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. Give only the answer without explanation.
- 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](#) [permutations-and-combinations](#) [normal](#) [descriptive](#)

[Answer](#)

### 1.3.12 Permutations And Combinations: GATE2003-34 [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.13 Permutations And Combinations: GATE2003-4 [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 1.3.14 Permutations And Combinations: GATE2003-5 [top](#)

<http://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.  $2^n C_n$

gate2003 permutations-and-combinations normal

Answer

### 1.3.15 Permutations And Combinations: GATE2004-75 [top](#)

<http://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 permutations-and-combinations

Answer

### 1.3.16 Permutations And Combinations: GATE2004-IT-35 [top](#)

<http://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 permutations-and-combinations normal

Answer

### 1.3.17 Permutations And Combinations: GATE2005-IT-46 [top](#)

<http://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 permutations-and-combinations normal

Answer

### 1.3.18 Permutations And Combinations: GATE2007-84 [top](#)

<http://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 permutations-and-combinations

Answer

### 1.3.19 Permutations And Combinations: GATE2007-85 [top](#)

<http://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](#) | [permutations-and-combinations](#) | [normal](#)

[Answer](#)

### 1.3.20 Permutations And Combinations: GATE2008-IT-25 [top](#)

<http://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](#) | [permutations-and-combinations](#) | [normal](#)

[Answer](#)

### 1.3.21 Permutations And Combinations: GATE2014-1-49 [top](#)

<http://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 \_\_\_\_\_

[gate2014-1](#) | [permutations-and-combinations](#) | [numerical-answers](#) | [normal](#)

[Answer](#)

### 1.3.22 Permutations And Combinations: GATE2015-3\_5 [top](#)

<http://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 \_\_\_\_\_.

[gate2015-3](#) | [permutations-and-combinations](#) | [normal](#) | [numerical-answers](#)

[Answer](#)

### 1.3.23 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123716>

2. A club with  $x$  members is organized into four committees such that
  - (a) each member is in exactly two committees,
  - (b) any two committees have exactly one member in common.

Then  $x$  has

- (A) exactly two values both between 4 and 8
- (B) exactly one value and this lies between 4 and 8
- (C) exactly two values both between 8 and 16
- (D) exactly one value and this lies between 8 and 16.

[permutations-and-combinations](#) | [isi2004](#)

[Answer](#)

### 1.3.24 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123741>

Q 1. The number of permutation of  $\{1,2,3,4,5\}$  that keep at least one integer fixed is.

- A) 81 B) 76 C) 120 D) 60

[permutations-and-combinations](#) [isi2004](#)

[Answer](#)

### 1.3.25 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123721>

Q.3 A subset S of set of numbers  $\{2,3,4,5,6,7,8,9,10\}$  is said to be good if has exactly 4 elements and their gcd=1, Then number of good subset is

- A) 126 B) 125 C) 123 D) 121

[permutations-and-combinations](#) [isi2004](#)

[Answer](#)

### 1.3.26 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123721>

Q 4) In how many ways can three person, each throwing a single die once, make a score of 11

- A) 22 B) 27 C) 24 D) 38

[permutations-and-combinations](#) [isi2004](#)

[Answer](#)

### 1.3.27 Permutations And Combinations: ISI 2016 [top](#)

<http://gateoverflow.in/45161>

A palindrome is a sequence of digits which reads the same backward or forward. For example, 7447, 1001 are palindromes, but 7455, 1201 are not palindromes. How many 8 digit prime palindromes are there?

[isi-2016](#) [permutations-and-combinations](#)

[Answer](#)

### 1.3.28 Permutations And Combinations: ISI 2017 [top](#)

<http://gateoverflow.in/124372>

For each positive integer  $n$  consider the set  $S_n$  defined as follows:  $S_1 = \{1\}$ ,  $S_2 = \{2, 3\}$ ,  $S_3 = \{4, 5, 6\}$ , ... and, in general,  $S_{n+1}$  consists of  $n + 1$  consecutive integers the smallest of which is one more than the largest integer in  $S_n$ . The sum of all the integers in  $S_{21}$  equals

- A. 1113;
- B. 53361;
- C. 5082;
- D. 4641

[engineering-mathematics](#) [isi2017](#) [permutations-and-combinations](#)

[Answer](#)

### 1.3.29 Permutations And Combinations: TIFR2011-A-2 [top](#)

<http://gateoverflow.in/19829>

In how many ways can the letters of the word ABACUS be rearranged such that the vowels always appear together?

- a.  $\frac{(6+3)!}{2!}$
- b.  $\frac{6!}{2!}$
- c.  $\frac{3!3!}{2!}$
- d.  $\frac{4!3!}{2!}$

- e. None of the above.

tifr2011 permutations-and-combinations

[Answer](#)

### 1.3.30 Permutations And Combinations: TIFR2012-A-10 [top](#)

<http://gateoverflow.in/25014>

In how many different ways can  $r$  elements be picked from a set of  $n$  elements if

- (i) Repetition is not allowed and the order of picking matters?  
(ii) Repetition is allowed and the order of picking does not matter?

- a.  $\frac{n!}{(n-r)!}$  and  $\frac{(n+r-1)!}{r!(n-1)!}$ , respectively.
- b.  $\frac{n!}{(n-r)!}$  and  $\frac{n!}{r!(n-1)!}$ , respectively.
- c.  $\frac{n!}{r!(n-r)!}$  and  $\frac{(n-r+1)!}{r!(n-1)!}$ , respectively.
- d.  $\frac{n!}{r!(n-r)!}$  and  $\frac{n!}{(n-r)!}$ , respectively.
- e.  $\frac{n!}{r!}$  and  $\frac{n!}{n!}$ , respectively.

tifr2012 permutations-and-combinations

[Answer](#)

### 1.3.31 Permutations And Combinations: TIFR2012-A-7 [top](#)

<http://gateoverflow.in/21004>

It is required to divide the  $2n$  members of a club into  $n$  disjoint teams of 2 members each. The teams are not labelled. The number of ways in which this can be done is:

- a.  $\frac{(2n)!}{2^n}$
- b.  $\frac{(2n)!}{n!}$
- c.  $\frac{(2n)!}{2^n \cdot n!}$
- d.  $n!/2$
- e. None of the above.

tifr2012 permutations-and-combinations

[Answer](#)

### 1.3.32 Permutations And Combinations: TIFR2013-A-9 [top](#)

<http://gateoverflow.in/25431>

There are  $n$  kingdoms and  $2n$  champions. Each kingdom gets 2 champions. The number of ways in which this can be done is:

- a.  $\frac{(2n)!}{2^n}$
- b.  $\frac{(2n)!}{n!}$
- c.  $\frac{(2n)!}{2^n \cdot n!}$
- d.  $n!/2$
- e. None of the above.

tifr2013 permutations-and-combinations

[Answer](#)

### 1.3.33 Permutations And Combinations: TIFR2014-A-5 [top](#)

<http://gateoverflow.in/25990>

The rules for the University of Bombay five-a-side cricket competition specify that the members of each team must have birthdays in the same month. What is the minimum number of mathematics students needed to be enrolled in the department to guarantee that they can raise a team of students?

- a. 23
- b. 91

- c. 60
- d. 49
- e. None of the above.

tifr2014 permutations-and-combinations

[Answer](#)

### 1.3.34 Permutations And Combinations: TIFR2015-A-7 [top](#)

<http://gateoverflow.in/29568>

A  $1 \times 1$  chessboard has one (1) square, a  $2 \times 2$  chessboard has (5) squares. Continuing along this fashion, what is the number of squares on the (regular)  $8 \times 8$  chessboard?

- A. 64
- B. 65
- C. 204
- D. 144
- E. 256

tifr2015 permutations-and-combinations

[Answer](#)

### 1.3.35 Permutations And Combinations: TIFR2015-A-8 [top](#)

<http://gateoverflow.in/29571>

There is a set of  $2n$  people:  $n$  male and  $n$  female. A good party is one with equal number of males and females (including the one where none are invited). The total number of good parties is.

- A.  $2^n$
- B.  $n^2$
- C.  $\left(\frac{n}{n/2}\right)^2$
- D.  $\binom{2n}{n}$
- E. None of the above.

tifr2015 permutations-and-combinations

[Answer](#)

### 1.3.36 Permutations And Combinations: TIFR2016-A-15 [top](#)

<http://gateoverflow.in/97624>

In a tournament with 7 teams, each team plays one match with every other team. For each match, the team earns two points if it wins, one point if it ties, and no points if it loses. At the end of all matches, the teams are ordered in the descending order of their total points (the order among the teams with the same total are determined by a whimsical tournament referee). The first three teams in this ordering are then chosen to play in the next round. What is the minimum total number of points a team must earn in order to be guaranteed a place in the next round?

- A. 13
- B. 12
- C. 11
- D. 10
- E. 9

tifr2016 permutations-and-combinations

[Answer](#)

### 1.3.37 Permutations And Combinations: TIFR2017-A-5 [top](#)

<http://gateoverflow.in/94953>

How many distinct ways are there to split 50 identical coins among three people so that each person gets at least 5 coins?

- A.  $3^{35}$
- B.  $3^{50} - 2^{50}$
- C.  $\binom{35}{2}$

- D.  $\binom{50}{15} \cdot 3^{35}$   
 E.  $\binom{37}{2}$

tifr2017 permutations-and-combinations

Answer

### 1.3.38 Permutations And Combinations: TIFR2017-A-6 [top](#)

<http://gateoverflow.in/95033>

How many distinct words can be formed by permuting the letters of the word ABRACADABRA?

- A.  $\frac{11!}{5! 2! 2!}$   
 B.  $\frac{11!}{5! 4!}$   
 C.  $11! 5! 2! 2!$   
 D.  $11! 5! 4!$   
 E.  $11!$

tifr2017 permutations-and-combinations

Answer

## Answers: Permutations And Combinations

### 1.3.1 Permutations And Combinations: CMI2010-A-02 [top](#)

<http://gateoverflow.in/46132>



Selected Answer

$$\text{Number of ways selecting a captain from 15 players} = \binom{15}{1}$$

Number of ways selecting remaining team members from remaining 14 players

$$= \binom{14}{10}$$

The number of different ways to choose a team of 11 from a pool of 15 players and also select a captain

$$= \binom{15}{1} * \binom{14}{10} = 15 * 13 * 11 * 7 = 11 * \binom{15}{11}$$

Hence, Option(B) **11 \***

$\binom{15}{11}$  is The correct choice.

7 votes

-- Leen Sharma (32.2k points)

### 1.3.2 Permutations And Combinations: CMI2014-A-01 [top](#)

<http://gateoverflow.in/46964>



Selected Answer

There are three ways to choose 6 Players.

1.  $5C3 * 4C2 * 2C1 = 120$
2.  $5C2 * 4C2 * 2C2 = 60$
3.  $5C2 * 4C3 * 2C1 = 80$

So total No of ways is 260.

5 votes

-- Manoj Kumar (37.5k points)

### 1.3.3 Permutations And Combinations: GATE1989-4-i [top](#)



Selected Answer

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 string of length 2 = {GA,AT,TE}

set of string of length 3= {GAT,ATE}

set of strings of length 4 = {GATE}

and set of string of length 0 = {}

and we cant have any substring of length 5 as given string has only 4 length .

so total no of substrings are possible = 0's length substring + 1lengths substrings + 2 length substrings +3 length substrings + 4 length substrings = 1+4+3+2+1

means for 1 length string to n length substrings . it will sum of the n natural no from 1 to n .

so  $1+2+3+\dots+n = n(n+1)/2$

so total no substrings possible = 0 length strings +  $n(n+1)/2 = 1+[n(n+1)/2]$

so total no of substrings possible in n length string (All length inclusive )=  $1+[n(n+1)/2]$

9 votes

-- Amit Pal (3.5k points)

### 1.3.4 Permutations And Combinations: GATE1991-02,iv [top](#)



Selected Answer

(A) - S Catalyn no [http://gatecse.in/wiki/Number\\_of\\_Binary\\_trees\\_possible\\_with\\_n\\_nodes](http://gatecse.in/wiki/Number_of_Binary_trees_possible_with_n_nodes)

(B) - R. Choosing n locations out of  $2n$  to place 0. Remaining automatically become 1.

(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  $\frac{n!}{2}$  even permutations. Ref -> <http://mathworld.wolfram.com/EvenPermutation.html>

(D) -> Q

Length =  $6n$ , as it is palindrome, we need to only consider half part.

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

now Choosing  $n$  0's out of  $3n$ . So Q is correct for D.

15 votes

-- Akash (43.8k points)

### 1.3.5 Permutations And Combinations: GATE1991-16,a [top](#)



Selected Answer

Answer to a is  $2nCn/(n+1)$  which is the Catalan number.

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

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

11 votes

-- Arjun Suresh (294k points)

**1.3.6 Permutations And Combinations: GATE1994\_1.15** [top](#)<http://gateoverflow.in/2458>

Selected Answer

no. of substrings of length n is 1

no. of substrings of length n-1 is 2

no. of substrings of length n-2 is 3

so  $n(n+1)/2$

12 votes

-- Bhagirathi Nayak (13.3k points)

**1.3.7 Permutations And Combinations: GATE1998\_1.23** [top](#)<http://gateoverflow.in/1660>

Selected Answer

assuming an 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 string of length n = 1

$$\text{total} = n + (n - 1) + (n - 2) + (n - 3) + \dots + 1 \\ = n(n+1)/2$$

12 votes

-- Digvijay (47k points)

**1.3.8 Permutations And Combinations: GATE1999\_1.3** [top](#)<http://gateoverflow.in/1450>

Selected Answer

answer - 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 =  ${}^{n+1}C_k$

15 votes

-- ankitrokdeonsns (9.1k points)

**1.3.9 Permutations And Combinations: GATE1999\_2.2** [top](#)<http://gateoverflow.in/1480>

Selected Answer

answer - D

number of ways roses can be distributed - { (0, 10), (1, 9), (2, 8).....(10, 0) } - 11 ways

similarly sunflowers and daffodils can be distributed in 16 ways each

total number of ways  $11 \times 16 \times 16 = 2816$

15 votes

-- ankitrokdeonsns (9.1k points)

for each flower, say there are  $n$  number of flowers, we apply star and bars method for each flower.  $n$  flowers of a type will generate  $(n + 1)$  spaces we just need to place one bar. to do that we need to select a position.

so, for roses :  $\binom{10+1}{1}$

for sunflowers :  $\binom{15+1}{1}$

for daffodils :  $\binom{15+1}{1}$

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

10 votes

-- Amar Vashishth (28.7k points)

### 1.3.10 Permutations And Combinations: GATE2001-2.1 [top](#)

<http://gateoverflow.in/719>



Selected Answer

- 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

22 votes

-- yallasrikanthreddy (319 points)

### 1.3.11 Permutations And Combinations: GATE2002-13 [top](#)

<http://gateoverflow.in/866>



Selected Answer

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

so  $x_1+x_2=n$ ,  $x_1, x_2 > 0$  (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.,  $(n-2+1)!/(n-2)! = (n-1)$ . We can also use the following formula

$$n-2+2-1C_{2-1} = n-1C_1$$

$$b. n=3(1+1+1) \quad n=4(1+1+2, 1+2+1, 2+1+1) \quad n=5(1+1+3, 1+3+1, 3+1+1, 2+2+1, 2+1+2, 1+2+2)$$

so  $x_1+x_2+x_3=n$ ,  $x_1, x_2, x_3 > 0$  (no.of integral sol)

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

$$= (n-1)!/(n-1-2)!2!$$

$$= n-1C_2$$

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

14 votes

-- Supromit Roy (727 points)

### 1.3.12 Permutations And Combinations: GATE2003-34 [top](#)

<http://gateoverflow.in/924>



Selected Answer

As there have to be atleast  $k$  balls in each bag, so firstly put  $k$  balls in each bag i.e  $k*n$  balls.

Then now we have total  $m-k*n$  balls remaining.

We can use balls & sticks method now !

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

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

So when we solve it

We get

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

14 votes

-- Akash (43.8k points)

### 1.3.13 Permutations And Combinations: GATE2003-4 [top](#)



Selected Answer

answer - C

select any 3 elements from given 8 elements -  ${}^8C_3$

23 votes

-- ankitrokdeonsns (9.1k points)

### 1.3.14 Permutations And Combinations: GATE2003-5 [top](#)



Selected Answer

Possible outcome for a couple:

1. only wife comes
2. both come
3. none come

Thus 3 possibilities for each couple, so  $3 \times 3 \times 3 \times \dots n$  times =  $3^n$

30 votes

-- Palash Nandi (1.5k points)

### 1.3.15 Permutations And Combinations: GATE2004-75 [top](#)



Selected Answer

This question is slightly ambiguous. So first let us understand what question is asking. So in a book, we have letters A-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 same. Now 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 same colors, thus coloring  $k$  letters, then  $kC2$  other pairs of colors, thus coloring  $kC2$  more letters.

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

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

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)

17 votes

-- Anu (10.6k points)

### 1.3.16 Permutations And Combinations: GATE2004-IT-35 [top](#)



Use Derangement concept  $D_5 = 44$  so answer is A

[http://oeis.org/wiki/Number\\_of\\_derangements](http://oeis.org/wiki/Number_of_derangements)

18 votes

-- pratikb (369 points)

### 1.3.17 Permutations And Combinations: GATE2005-IT-46 [top](#)



Answer should be  $3^N - 1$ .

This is because 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 )

Please Comment , if anyone finds it wrong.

29 votes

-- Afaque Ahmad (849 points)

### 1.3.18 Permutations And Combinations: GATE2007-84 [top](#)



Q.84

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 =

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

Hence, **option A** is true.

24 votes

-- Amar Vashishth (28.7k points)

### 1.3.19 Permutations And Combinations: GATE2007-85 [top](#)



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 =

$\{u, u, u, u, u, u, u, u, u, r, r, r, r, r, r, r, r, r, r\}$  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, r, 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. =  $\binom{20}{10} - \binom{8}{4} \times 1 \times \binom{11}{5}$

17 votes

-- Amar Vashishth (28.7k points)

### 1.3.20 Permutations And Combinations: GATE2008-IT-25 [top](#)



Selected Answer

r red balls can be distributed into n distinct boxes in  $C(n+r-1, r) = (n+r-1)! / (n-1)! r!$

b blue balls can be distributed in  $C(n+b-1, b) = (n+b-1)! / (n-1)! b!$

By product rule total ways are  $(n+b-1)! (n+r-1)! / (n-1)! b! (n-1)! r!$

SO THE ANSWER IS **A**.

20 votes

-- Madhu Veluguri (235 points)

### 1.3.21 Permutations And Combinations: GATE2014-1-49 [top](#)



Selected Answer

Let we 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  $f(10) = 89$ .

32 votes

-- Happy Mittal (10.9k 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 penants =  $1 + 9!/8! + 8!/6!2! + 7!/4!3! + 6!/2!4! + 1 = 89$

21 votes

-- srestha (58.3k points)

### 1.3.22 Permutations And Combinations: GATE2015-3\_5 [top](#)

<http://gateoverflow.in/8399>



Selected Answer

### Dynamic programming Approach

	1 digit	2 digit	3 digit	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

25 votes

-- Arjun Suresh (294k points)

you 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 child 1,2,3 and the construction goes

3 can 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 three levels

and finally count total number of leaves

20 votes

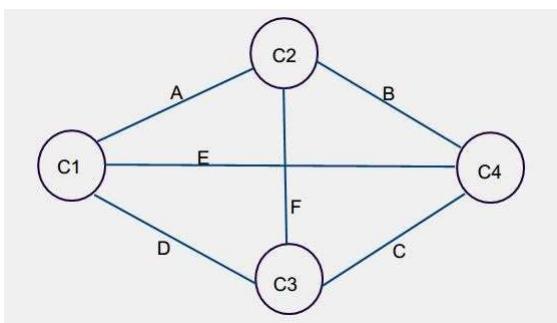
-- Sankaranarayanan P.N (11.2k points)

### 1.3.23 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123718>



Selected Answer



B is ans.

4 votes

-- 2018 (5.2k points)

### 1.3.24 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123714>



Selected Answer

It is based on inclusion exclusion principle:

Total arrangements - [derangements](#)

$$5! - [5! - 5C_1(4!) + 5C_2(3!) - 5C_3(2!) + 5C_4(1!) - 5C_5(0!) ]$$

$$5C_1(4!) - 5C_2(3!) + 5C_3(2!) - 5C_4(1!) + 5C_5(0!) = 120 - 60 + 20 - 5 + 1 = 76$$

2 votes

-- Heisenberg (1.7k points)

### 1.3.25 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123721>



Selected Answer

(D) 121

Selecting 4 numbers from 9 is  $9C4 = 126$

We have to subtract all the cases where gcd of all numbers is 1 and this can only happen when all number should not be even. Which is  $5C4 = 5$

So answer will be  $126 - 5 = 121$

5 votes

-- Mandeep Singh (1.5k points)

### 1.3.26 Permutations And Combinations: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123727>



Selected Answer

We can solve it by star and bar method.

Suppose 1st person's score is  $x_1$ .

Suppose 2nd person's score is  $x_2$ .

Suppose 3rd person's score is  $x_3$ .

**We want  $x_1+x_2+x_3 = 11$  with constraints**

$$1 \leq x_1 \leq 6,$$

$$1 \leq x_2 \leq 6,$$

$$1 \leq x_3 \leq 6$$

So  $x_1, x_2, x_3$  have minimum values 1. so now remaining 8 can be scored as  $x_1+x_2+x_3 = 8$

$$\text{Total no. of ways to score } 8 = \binom{3+8-1}{2} = \binom{10}{2}$$

Now we have to subtract the ways in which either  $x_1$  or  $x_2$  or  $x_3$  have values  $\geq 7$ .

Putting  $x_1 = 7$ . We get  $6+x_2+x_3=2$  (6 because  $x_1$  is already 1. so  $6+1=7$ )

$$\text{ways} = \binom{3+2-1}{2} = \binom{4}{2}$$

Doing same for  $x_2$  and  $x_3$ .

**Note that only one of the 3 can have score  $\geq 7$  as if 2 suppose  $x_1$  and  $x_2$  both is 7 then total will exceed 8.**

**So total no. of ways =**

$$\binom{10}{2} - \left[ \binom{4}{2} + \binom{4}{2} + \binom{4}{2} \right]$$

$$= 27$$

**So B is the correct answer.**

3 votes

-- Soumya Jain (1.6k points)

### 1.3.27 Permutations And Combinations: ISI 2016 [top](#)

<http://gateoverflow.in/45161>



Selected Answer

I think the answer should be 0, as any even digit palindrome(other than 11) cannot be prime. Even digit palindromes will always be divisible by 11(you can check the divisibility test by 11).

8 votes

-- sourb (171 points)

### 1.3.28 Permutations And Combinations: ISI 2017 [top](#)

<http://gateoverflow.in/124372>



Selected Answer

Every new set  $S_{n+1}$  starts after  $n$  elements from the starting element of  $S_n$ . This means that we can find the starting number of  $S_{21}$  using Arithmetic progression formula.

Let  $\text{Sum}(n)$  denote sum of natural numbers upto  $n$ :

$S_1$  starts with = 1

$S_2$  starts with =  $\text{Sum}(1) + 1 = 2$

$S_3$  starts with =  $\text{Sum}(2) + 1 = (1+2) + 1 = 4$

Similarly  $S_{21}$  starts with  $S(20) + 1 = \frac{20(20+1)}{2} + 1 = 211$

Now we need to find sum of 21 consecutive natural numbers starting from 211

Using A.P. sum formula  $S_n = \frac{n}{2} [2a + (n-1)*d]$  where  $a$ = starting term ,  $d$ = difference

Sum of elements in  $S_{21} = \frac{21}{2} [2(211) + 20] = \frac{21*442}{2} = 4641$ ... Option D is correct

6 votes

-- Heisenberg (1.7k points)

### 1.3.29 Permutations And Combinations: TIFR2011-A-2 [top](#)

<http://gateoverflow.in/10829>



Selected Answer

Take **AAU** together and treat it like 1 entity. Now arrange **AAU BCS** in  $4!$  ways.

Then, the **AAU** can be arranged in  $\frac{3!}{2!}$  ways because **A** has been repeated twice.

$$\text{So, total arrangements} = \frac{4!3!}{2!}$$

**Option d. is the correct answer.**

14 votes

-- yes (2k points)

### 1.3.30 Permutations And Combinations: TIFR2012-A-10 [top](#)



Selected Answer

- (i) Repetition is not allowed and the order of picking matters =  
 $= r \text{ arrangement with no repetition} = nPr = \frac{n!}{(n-r)!}$
- (ii) Repetition is allowed and the order of picking does not matter =  
 $= \text{combination with unlimited repetition} = n-1+rCr = \frac{n-1+r!}{(n-1)!r!}$
- Option A

10 votes

-- Umang Raman (15.1k points)

### 1.3.31 Permutations And Combinations: TIFR2012-A-7 [top](#)



Selected Answer

2n member to be n teams with 2 member each and teams are unordered so we can exchange n team member among them.

$$= \frac{(2n)!}{\underbrace{2! \cdot 2! \cdot 2! \cdots 2!}_{n \text{ times}} \cdot n!}$$

$$= \frac{(2n)!}{2^n \times n!}$$

Option c.

9 votes

-- Umang Raman (15.1k points)

### 1.3.32 Permutations And Combinations: TIFR2013-A-9 [top](#)



Selected Answer

**Option A is correct.**

We have n Kingdoms as  $k_1, k_2, \dots, k_n$ .

Firstly we can select 2 champions from  $2n$  champions and assign to  $k_1$  =  
 $\binom{2n}{2}$  ways (Say  $w_1$ )

Then we can select next 2 champions and assign to  $k_2$  =  
 $\binom{2n-2}{2}$  ways (Say  $w_2$ )

and so on..

For last kingdom, we have 2 champions left =  
 $\binom{2}{2}$  ways (say  $w_n$ )

Total ways for assigning  $2n$  champions to  $n$  kingdoms =  $w_1 * w_2 * \dots * w_n$

$$= \binom{2n}{2} * \binom{2n-2}{2} * \dots * \binom{2}{2}$$

$$= (2n)! / 2^n \text{ So, Option A (Ans).}$$

13 votes

-- Himanshu Agarwal (16.2k points)

### 1.3.33 Permutations And Combinations: TIFR2014-A-5 [top](#)



Selected Answer

There are 12 months and we have to get 5 people having birthdays in the same month in order to form a team . we can apply the pigeon hole principal :

$$\lceil N/12 \rceil = 5$$

On solving we get  $N=49$  .

Hence answer is D.

12 votes

-- Riya Roy(Arayana) (7.1k points)

### 1.3.34 Permutations And Combinations: TIFR2015-A-7 [top](#)



Selected Answer

no of squares on chessboard of  $n \times n$  is equal to sum of squares of  $n$  terms

for  $8 \times 8$  chessboard

$$= n(n+1)(2n+1)/6$$

$$= 8 \times 9 \times 17 / 6$$

$$= 204$$

8 votes

-- Pooja Palod (32.4k points)

### 1.3.35 Permutations And Combinations: TIFR2015-A-8 [top](#)



Selected Answer

There are  $n$  men and  $n$  women

Now we can select 1 woman from  $n$  women in  ${}^n C_1$

With that 1 man can select  ${}^n C_1$  ways

So, by 1 woman and 1 man we can get  ${}^n C_1 * {}^n C_1$  ways.....i

Similarly , Now we can select 2 woman from  $n$  women in  ${}^n C_2$

With that 2 man can select  ${}^n C_2$  ways

So, by 2 woman and 2 man we can get  ${}^n C_2 * {}^n C_2$  ways.....ii

.....

Now, by  $n$  woman and  $n$  man we can get  ${}^n C_n * {}^n C_n$  ways.....iii

So, by adding these equation we get

$${}^n C_0 \cdot {}^n C_0 + {}^n C_1 \cdot {}^n C_1 + {}^n C_2 \cdot {}^n C_2 + {}^n C_3 \cdot {}^n C_3 + \dots + {}^n C_n \cdot {}^n C_n = ({}^{2n} C_n)$$

Ans will be (E)

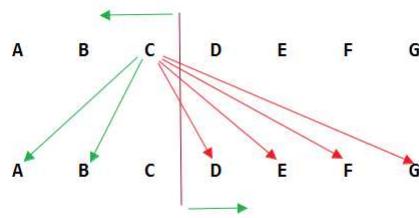
8 votes

-- srestha (58.3k points)

### 1.3.36 Permutations And Combinations: TIFR2016-A-15 [top](#)

<http://gateoverflow.in/9762>

Selected Answer



If someone wants to get into the next round he/she must secure at least **3rd position**. That means that a team must earn as many points as the 3rd team does to keep alive the hope of going into the next round. (sometimes +1 , we will get to that later.)

We assume that these winners are in the order  $A \rightarrow B \rightarrow C$ .

Now we will try to **increase the points** of team  $C$  such that  $\text{points}(A, B) \geq C$  and  $C$  also maintain 3rd position.

**Consider teams**

$A, B, C$

There can be a situation when winners  $A, B, C$  all three team beat  $D, E, F, G$  and play draw among them. Then  $A, B, C$  will get 10 points each.

- $\Rightarrow$  So, 3rd team  $C$  can get maximum 10 points.

$C$  can not get 11 points. Because in that case it has to beat one of the winners , and it will move to higher position but we need  $C$  at 3rd position only.

What happens to  $D$  ? the 4th position holder ? He can get maximum 6 after three consecutive loss to  $A, B$  and  $C$  by beating  $E, F, G$ .

- $\Rightarrow$  So, If a team gets 10 points , that team definitely get into the next round.
- Points of  $C$  and  $D$  are not equal in this case and we need not worry about referee.

 4 votes

-- Debashish Deka (51.4k points)

### 1.3.37 Permutations And Combinations: TIFR2017-A-5 [top](#)

<http://gateoverflow.in/9495>

Selected Answer

Distinct ways are there to split 50 identical coins among three people so that each person gets at least 5 coins

$$x_1+5+x_2+5+x_3+5 = 50$$

$$x_1+x_2+x_3 = 35$$

Solving Non integral solution  $n=35, r=3$

$$n+r-1 \ C_{r-1} = 35+3-1 \ C_{3-1} = 37 \ C_2$$

**Hence E is Answer**

 13 votes

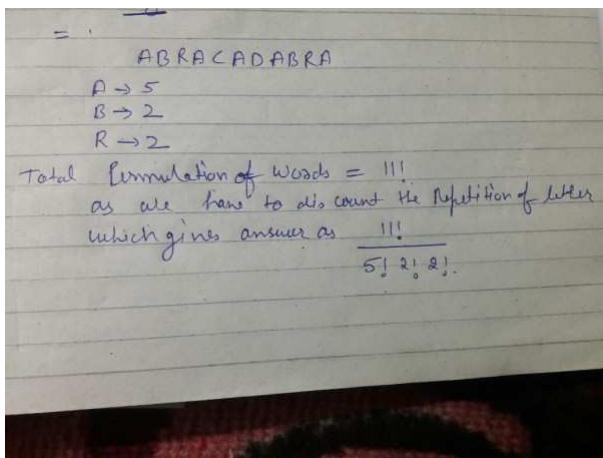
-- Prajwal Bhat (11.9k points)

### 1.3.38 Permutations And Combinations: TIFR2017-A-6 [top](#)

<http://gateoverflow.in/9503>

Selected Answer

a) option answer .



8 votes

-- kunal (20.8k points)

**1.4****Recurrence(6)** [top](#)**1.4.1 Recurrence: GATE 2016-1-2** [top](#)<http://gateoverflow.in/39636>

Let  $a_n$  be the number of  $n$ -bit strings that do **NOT** contain two consecutive 1s. 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.  $a_n = 2a_{n-1} + 2a_{n-2}$

[gate2016-1](#) [permutations-and-combinations](#) [recurrence](#) [easy](#)

Answer

**1.4.2 Recurrence: GATE 2016-1-27** [top](#)<http://gateoverflow.in/39714>

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 \_\_\_\_\_.

[gate2016-1](#) [permutations-and-combinations](#) [recurrence](#) [normal](#) [numerical-answers](#)

Answer

**1.4.3 Recurrence: GATE2004-IT-34** [top](#)<http://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](#) [permutations-and-combinations](#) [normal](#)

Answer

**1.4.4 Recurrence: GATE2007-IT-76** [top](#)<http://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](#) [permutations-and-combinations](#) [normal](#) [recurrence](#)

[Answer](#)

### 1.4.5 Recurrence: TIFR2014-A-3 [top](#)

<http://gateoverflow.in/25988>

The Fibonacci sequence is defined as follows:  $F_0 = 0, F_1 = 1$ , and for all integers  $n \geq 2, F_n = F_{n-1} + F_{n-2}$ . Then which of the following statements is FALSE?

- a.  $F_{n+2} = 1 + \sum_{i=0}^n F_i$  for any integer  $n \geq 0$
- b.  $F_{n+2} \geq \varnothing^n$  for any integer  $n \geq 0$ , where  $\varnothing = (\sqrt{5} + 1)/2$  is the positive root of  $x^2 - x - 1 = 0$ .
- c.  $F_{3n}$  is even, for every integer  $n \geq 0$ .
- d.  $F_{4n}$  is a multiple of 3, for every integer  $n \geq 0$ .
- e.  $F_{5n}$  is a multiple of 4, for every integer  $n \geq 0$ .

[tifr2014](#) [recurrence](#) [easy](#)

[Answer](#)

### 1.4.6 Recurrence: TIFR2017-A-7 [top](#)

<http://gateoverflow.in/85037>

Consider the sequence  $S_0, S_1, S_2, \dots$  defined as follows:  $S_0 = 0, S_1 = 1$  and  $S_n = 2S_{n-1} + S_{n-2}$  for  $n \geq 2$ . Which of the following statements is FALSE?

- A. for every  $n \geq 1, S_{2n}$  is even
- B. for every  $n \geq 1, S_{2n+1}$  is odd
- C. for every  $n \geq 1, S_{3n}$  is multiple of 3
- D. for every  $n \geq 1, S_{4n}$  is multiple of 6
- E. none of the above

[tifr2017](#) [recurrence](#)

[Answer](#)

## Answers: Recurrence

### 1.4.1 Recurrence: GATE 2016-1-2 [top](#)

<http://gateoverflow.in/39636>



Selected Answer

<b>n-bit strings that do NOT contain consecutive 11</b>	$a_n$	<b>those contain 11</b>
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).

31 votes

-- Praveen Saini (53.5k points)

## 1.4.2 Recurrence: GATE 2016-1-27 [top](#)

<http://gateoverflow.in/39714>



Selected Answer

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

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

73 votes

-- Praveen Saini (53.5k points)

$$a_n = 6n^2 + 2n + a_{n-1}$$

Solution = HomogeneousSolution + ParticularSolution .....(1)

Homogeneous solution,

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

$$a_n - a_{n-1} = 0$$

$$\text{let } a_n = x$$

$$x - 1 = 0$$

$$x = 1$$

$$\text{Homogeneous Solution} = d * 1^n = d .....(2)$$

now Particular solution :

$$\text{Here } F(x) = 6n^2 + 2n \quad // \text{Quadratic}$$

let us assume,  $a_n = (an^2 + bn + c)n \quad // \text{here root of homogeneous solution is 1 so we have to multiply General quadratic solution by } n. \dots(3)$

$$\begin{aligned}
 6n^2 + 2n &= a_n - a_{n-1} \\
 &= [n^2(an^2 + bn + c) - (n-1)^2(a(n-1)^2 + b(n-1) + c)] \\
 &= an^3 + bn^2 + cn - (an^3 - a - 3an^2 + 3an + bn^2 + b - 2bn + cn - c) \\
 &= (an^3 + bn^2 + cn - an^3 + a + 3an^2 - 3an - bn^2 - b + 2bn - cn + c) \\
 &= 3an^2 + (2b - 3a)n + (a - b + c)
 \end{aligned}$$

Apply Principle of Homogeneity,

$$\begin{array}{lll}
 3a = 6 & 2b - 3a = 2 & a - b + c = 0 \\
 a = 2 & b = 4 & c = 2
 \end{array}$$

Now put values in equation (3),

$$\text{Particular Solution} = n^2(2n^2 + 4n + 2) = 2n^3 + 4n^2 + 2n \dots(4)$$

from equation (1), (2) and (4)

$$\text{Solution of recurrence} = 2n^3 + 4n^2 + 2n + d$$

here  $a(1) = 8 \quad // \text{given}$

by putting  $n = 1, d = 0$

$$\text{Final Solution of recurrence} = 2n^3 + 4n^2 + 2n = 2n(n+1)^2$$

$$a(99) = 2 * 99 * (10)^4 = 198 * 10^4$$

So K value is 198.

13 votes

-- Digvijay (47k points)

### 1.4.3 Recurrence: GATE2004-IT-34 [top](#)

<http://gateoverflow.in/3677>



Selected Answer

The  $n^{th}$  **Harmonic Number** is defined as the summation of the reciprocals of all numbers from 1 to  $n$ .

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

Lets call the value of

$$\sum_{j=1}^n H_j \text{ as } S_n$$

Then,

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

Hence, the answer is option B.

27 votes

-- Pragy Agarwal (19.5k points)

### 1.4.4 Recurrence: GATE2007-IT-76 [top](#)

<http://gateoverflow.in/3528>

Lets take a look when  $c = 1$

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

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.

$$\begin{aligned}x_i &= \lim_{\delta \rightarrow 0} 2 + \delta \\x_{i+1} &= 1 \times x_i^2 - 2 = \lim_{\delta \rightarrow 0} (2 + \delta)^2 - 2 \\&= \lim_{\delta \rightarrow 0} 4 - 2 + \delta^2 + 4\delta \\x_{i+1} &= \lim_{\delta \rightarrow 0} 2 + \delta^2 + 4\delta\end{aligned}$$

We can see that  $x_{i+1}$  is farther 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.

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

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

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

Therefore the answer should be only B.

6 votes

-- Pragy Agarwal (19.5k points)

#### 1.4.5 Recurrence: TIFR2014-A-3 [top](#)

<http://gateoverflow.in/25988>



Selected Answer

F0	F1	F2	F3	F4	F5	F6	F7
0	1	1	2	3	5	8	13

OPTION E) F5n is a multiple of 4, for every integer n≥0 **False**

6 votes

-- Umang Raman (15.1k points)

#### 1.4.6 Recurrence: TIFR2017-A-7 [top](#)

<http://gateoverflow.in/95037>



Selected Answer

$$S_n = 2S_{n-1} + S_{n-2}$$

Characteristic polynomial for this recurrence is  $x^2 = 2x + 1$

$$x^2 - 2x - 1 = 0 \Rightarrow x_1 = (1 + \sqrt{2}), x_2 = (1 - \sqrt{2})$$

The solution to the recurrence relation is of the form :  $S_n = C_1 * x_1^n + C_2 * x_2^n$

Putting  $S(0) = 0$ ,  $C_1 + C_2 = 0$

Putting  $S(1) = 1$ ,  $C_1 * (1 + \sqrt{2}) + C_2 * (1 - \sqrt{2}) = 1$

Solving these two, we get  $C_1 = \frac{1}{2\sqrt{2}}$  and  $C_2 = -\frac{1}{2\sqrt{2}}$

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

$$S_0 = 0, S_1 = 1, S_2 = 2, S_3 = 5, S_4 = 12, S_5 = 29, S_6 = 70$$

Clearly  $S_3$  and  $S_6$  are not a multiple of 3

Hence (C) is correct answer.

9 votes

-- Manish Joshi (25.2k points)

## 1.5

## Summation(3) top

### 1.5.1 Summation: GATE1994-15 top

<http://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)

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

b.

c. Use the result obtained in (a) to prove that

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

[gate1994](#) [permutations-and-combinations](#) [proof](#) [summation](#)

[Answer](#)

### 1.5.2 Summation: GATE2008-24 top

<http://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](#) [permutations-and-combinations](#) [easy](#) [summation](#)

[Answer](#)

### 1.5.3 Summation: GATE2015-1\_26 top

<http://gateoverflow.in/8248>

$$\sum_{x=1}^{99} \frac{1}{x(x+1)} = \underline{\hspace{10em}}.$$

[gate2015-1](#) [permutations-and-combinations](#) [normal](#) [numerical-answers](#) [summation](#)

[Answer](#)

## Answers: Summation

### 1.5.1 Summation: GATE1994-15 top

<http://gateoverflow.in/2511>



Selected Answer

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 right end and then down we get  $2i - 1$ . Then sum up the values of all rows and we get  $n^2$ .

$$\begin{aligned} b. \sum_{i=0}^{n-1} (2i + 1) &= n^2 \\ \implies 1 + \sum_{i=1}^n (2i + 1) &= n^2 + 2n + 1 \\ \implies \sum_{i=1}^n 2i + \sum_{i=1}^n 1 &= n^2 + 2n \\ \implies 2 \cdot \sum_{i=1}^n i + n &= n^2 + 2n \\ \implies 2 \cdot \sum_{i=1}^n i &= n^2 + n \\ \implies \sum_{i=1}^n i &= \frac{n(n+1)}{2} \end{aligned}$$

6 votes

-- Arjun Suresh (294k points)

### 1.5.2 Summation: GATE2008-24 [top](#)

<http://gateoverflow.in/422>

Selected Answer

$$\begin{aligned} P &= 1 + 3 + 5 + 7 + \dots + (2k-1) \\ &= (2-1) + (4-1) + (6-1) + (8-1) + \dots + (2k-1) \\ &= (2+4+6+8+\dots+2k) + (-1-1-1-1-\dots-k \text{ times}) \\ &= Q + (-k) = Q - k \end{aligned}$$

5 votes

-- Pranabesh Ghosh (3.4k points)

### 1.5.3 Summation: GATE2015-1\_26 [top](#)

<http://gateoverflow.in/6246>

Selected Answer

$$\frac{1}{1^2} + \frac{1}{2^2} + \dots + \frac{1}{99^2} = 1 - \frac{1}{2} + \frac{1}{2} - \frac{1}{3} + \frac{1}{3} - \frac{1}{4} + \dots + \frac{1}{99} - \frac{1}{100} = 1 - \frac{1}{100} = 0.99$$

23 votes

-- Arjun Suresh (294k points)

It can be answered by using the concept of partial fraction

$$1/x(x+1) = A/x + B/(x+1)$$

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

so this will form a sequence in which 2 terms will remain  $1-1/100$  so we will get  $99/100$  as ans

20 votes

-- Aditi Tiwari (1.1k points)

## 2 Discrete Mathematics: Graph Theory (66) [top](#)

2.1

Counting(6) [top](#)

### 2.1.1 Counting: GATE1994\_1.6, ISRO2008-29 [top](#)

<http://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](#) [permutations-and-combinations](#) [normal](#) [isro2008](#) [counting](#)

[Answer](#)

### 2.1.2 Counting: GATE2001-2.15 [top](#)

<http://gateoverflow.in/733>

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

[Answer](#)

### 2.1.3 Counting: GATE2004-79 [top](#)

<http://gateoverflow.in/1073>

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

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

[gate2004](#) [graph-theory](#) [permutations-and-combinations](#) [normal](#) [counting](#)

[Answer](#)

### 2.1.4 Counting: GATE2005-35 [top](#)

<http://gateoverflow.in/1371>

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

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

[gate2005](#) [graph-theory](#) [counting](#) [normal](#)

[Answer](#)

### 2.1.5 Counting: GATE2012-38 [top](#)

<http://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 | graph-theory | normal | marks-to-all | counting

[Answer](#)

### 2.1.6 Counting: TIFR2017-B-12 [top](#)

<http://gateoverflow.in/95819>

An undirected graph is complete if there is an edge between every pair of vertices. Given a complete undirected graph on  $n$  vertices, in how many ways can you choose a direction for the edges so that there are no directed cycles?

- A.  $n$
- B.  $\frac{n(n-1)}{2}$
- C.  $n!$
- D.  $2^n$
- E.  $2^m$ , where  $m = \frac{n(n-1)}{2}$

tifr2017 | graph-theory | counting

[Answer](#)

## Answers: Counting

### 2.1.1 Counting: GATE1994\_1.6, ISRO2008-29 [top](#)

<http://gateoverflow.in/2443>



Selected Answer



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 are:  $4+2+1=7$ .

13 votes

-- Rajarshi Sarkar (35k points)

answer = option C

\*

• • • —

• • • | • • | • | •

18 votes

-- Amar Vashishth (28.7k points)

### 2.1.2 Counting: GATE2001-2.15 [top](#)

<http://gateoverflow.in/733>



Selected Answer



with  $n$  vertices we have  ${}^nC_2$  edges and each subset of these edges will form a graph, so total number of undirected graph possible =  $2^{n(n-1)/2}$

18 votes

-- Vikrant Singh (13.4k points)

### 2.1.3 Counting: GATE2004-79 [top](#)



Selected Answer

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

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 :

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

Option D..

27 votes

-- Digvijay (47k points)

### 2.1.4 Counting: GATE2005-35 [top](#)



Selected Answer

answer - B

number of distinct BSTs =  ${}^nC_n/(n+1)$

10 votes

-- ankitrokdeonsns (9.1k points)

### 2.1.5 Counting: GATE2012-38 [top](#)



Selected Answer

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 =  $15 * 3 = 45$ .

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.

49 votes

gatecse (13.4k points)

## 2.1.6 Counting: TIFR2017-B-12 top

<http://gateoverflow.in/95819>

They are asking to convert Complete Undirected graph into Directed graph without cycle by choosing direction for the edges.

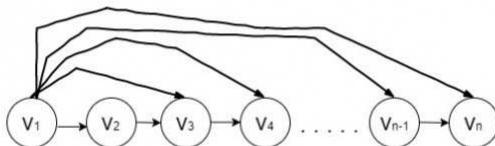
See this  $K_3$  graph-



([Image ref](#))

By this time you must have got Problem statement meaning. Your resultant graph should be acyclic.

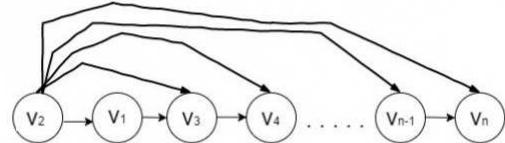
Lets say you have a complete graph  $G$  which has  $n$  vertices,  $v_1, v_2, \dots, v_n$ . To convert it into resultant graph we have to assign direction to each edge. Now see, our resultant graph is acyclic therefore it must have topological order.



(I have not drawn all edges except  $V_1$  edges.)

here every rearangement of vertices in topological sort leads to one particular combination to choose direction of edges.

Hence -  $n!$  is answer.

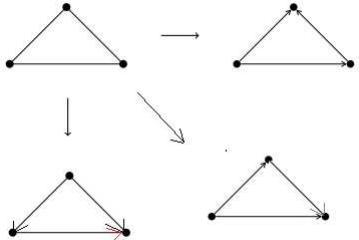


Just to illustrate more, see one of the permutation out of  $n!$

These two permutation shows that undirected edge between  $V_1$  and  $V_2$ , was first chosen as  $V_1 \rightarrow V_2$  and then  $V_2 \rightarrow V_1$

Dont think about labelling of vertices, If I do unlabelling of all  $n!$  permutations then all structures are same. But it doesn't matter If I am arriving to same structure, What matters is, In how many ways I can reach to that.

See this-



All these structures are Isomorphic...But still there are  $3!$  ways to reach such structure.

**C.**

4 votes

-- Sachin Mittal (7.1k points)

**2.2****Degree Of Graph(14) top****2.2.1 Degree Of Graph: CMI2013-A-06 top**<http://gateoverflow.in/46596>

A simple graph is one in which there are no self loops and each pair of distinct vertices is connected by at most one edge. Let  $G$  be a simple graph on 8 vertices such that there is a vertex of degree 1, a vertex of degree 2, a vertex of degree 3, a vertex of degree 4, a vertex of degree 5, a vertex of degree 6 and a vertex of degree 7. Which of the following can be the degree of the last vertex?

- A. 3
- B. 0
- C. 5
- D. 4

[cmi2013](#) [graph-theory](#) [normal](#) [degree-of-graph](#)

Answer

**2.2.2 Degree Of Graph: CMI2015-A-05 top**<http://gateoverflow.in/47039>

An undirected graph has 10 vertices labelled  $1, 2, \dots, 10$  and 37 edges. Vertices  $1, 3, 5, 7, 9$  have degree 8 and vertices  $2, 4, 6, 8$  have degree 7. What is the degree of vertex 10?

- A. 5
- B. 6
- C. 7
- D. 8

[cmi2015](#) [graph-theory](#) [degree-of-graph](#)

Answer

**2.2.3 Degree Of Graph: GATE1991-16,b top**<http://gateoverflow.in/26647>

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](#)

Answer

**2.2.4 Degree Of Graph: GATE1995\_24 top**<http://gateoverflow.in/2663>

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

[gate1995](#) [graph-theory](#) [degree-of-graph](#)

Answer

**2.2.5 Degree Of Graph: GATE2003-40 top**<http://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](#) [graph-theory](#) [normal](#) [degree-of-graph](#)

Answer

**2.2.6 Degree Of Graph: GATE2006-71 top**<http://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](#) [graph-theory](#) [normal](#) [degree-of-graph](#)

[Answer](#)

## 2.2.7 Degree Of Graph: GATE2006-72 [top](#)

<http://gateoverflow.in/4356>

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

[gate2006](#) [graph-theory](#) [normal](#) [degree-of-graph](#)

[Answer](#)

## 2.2.8 Degree Of Graph: GATE2009-3 [top](#)

<http://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](#) [graph-theory](#) [normal](#) [degree-of-graph](#)

[Answer](#)

## 2.2.9 Degree Of Graph: GATE2010-28 [top](#)

<http://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](#) [graph-theory](#) [normal](#) [degree-of-graph](#)

[Answer](#)

## 2.2.10 Degree Of Graph: GATE2013\_25 [top](#)

<http://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 graph-theory easy degree-of-graph

[Answer](#)

### 2.2.11 Degree Of Graph: GATE2014-1-52 [top](#)

<http://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.  $(3, 2, 1, 1, 1, 0)$

gate2014-1 graph-theory normal degree-of-graph

[Answer](#)

### 2.2.12 Degree Of Graph: GATE2017-2-23 [top](#)

<http://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 \_\_\_\_\_.

gate2017-2 graph-theory numerical-answers degree-of-graph

[Answer](#)

### 2.2.13 Degree Of Graph: TIFR2010-B-36 [top](#)

<http://gateoverflow.in/19248>

In a directed graph, every vertex has exactly seven edges coming in. What can one always say about the number of edges going out of its vertices?

- A. Exactly seven edges leave every vertex.
- B. Exactly seven edges leave some vertex.
- C. Some vertex has at least seven edges leaving it.
- D. The number of edges coming out of vertex is odd.
- E. None of the above.

tifr2010 graph-theory degree-of-graph

[Answer](#)

### 2.2.14 Degree Of Graph: TIFR2012-B-2 [top](#)

<http://gateoverflow.in/25047>

In a graph, the degree of a vertex is the number of edges incident (connected) on it. Which of the following is true for every graph  $G$ ?

- a. There are even number of vertices of even degree.
- b. There are odd number of vertices of even degree.
- c. There are even number of vertices of odd degree.
- d. There are odd number of vertices of odd degree.
- e. All the vertices are of even degree.

tifr2012 graph-theory degree-of-graph

[Answer](#)

## Answers: Degree Of Graph

### 2.2.1 Degree Of Graph: CMI2013-A-06 [top](#)

<http://gateoverflow.in/46596>

We know, sum of degrees of all vertices =  $2 \times$  no of edges

Say no. of edges is  $E$

Degree of last vertices is  $x$

then,

$$1+2+3+4+5+6+7+x=2\times E$$

$$\Rightarrow 28+x = 2\times E$$

Now putting options we get answer B)0 or D)4

But One vertex of degree 7 means it connected to all other vertex

So, degree must be D)4

2 votes

-- srestha (58.3k points)

## 2.2.2 Degree Of Graph: CMI2015-A-05 [top](#)



Selected Answer

Vertices 1, 3, 5, 7, 9 have degree 8 and vertices 2, 4, 6, 8 have degree 7.

We know **Sum of degree = 2 \* No of edges**

Let X = degree of vertex 10

$$8 + 7 + 8 + 7 + 8 + 7 + 8 + 7 + 8 + X = 2 \times 37$$

$$68 + X = 74$$

$$X=6$$

**Hence, Degree of vertex 10 is 6.**

Hence, Option (B)6 is the correct choice.

3 votes

-- Leen Sharma (32.2k points)

## 2.2.3 Degree Of Graph: GATE1991-16,b [top](#)



Selected Answer

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 any more. Thus for  $n$  vertices we now have only  $n-1$  possible degrees meaning at least one must repeat- pigeon comes here :)

16 votes

-- Arjun Suresh (294k points)

## 2.2.4 Degree Of Graph: GATE1995\_24 [top](#)



Selected Answer

In any finite graph,

Sum of degree of all the vertices =  $2 \times$  number of edges

sum of degree of all the vertices with even degree + sum of degree of all the vertices with odd degree =  $2 \times$  number of edges

even number + sum of degree of all the vertices with odd degree = even number

It is possible iff Number of odd degree vertices are even.

7 votes

-- suraj (5.1k points)

## 2.2.5 Degree Of Graph: GATE2003-40 [top](#)

<http://gateoverflow.in/931>



Selected Answer

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:

$$\begin{array}{c} \frac{\min \times |v|}{2} \leq 3 \times |v| - 6 \\ \frac{6 \times |v|}{2} \leq 3 \times |v| - 6 \\ 3 \times |v| - 6 \leq 3 \times |v| - 6 \\ 0 \leq -6 \end{array}$$

which is definitely inconsistent.

Hence, answer = **option D**

16 votes

-- Amar Vashishth (28.7k points)

Let the min-degree of G is x. then G has at least  $|v| * x/2$  edges.

$$|v| * x/2 \leq 3 * |v| - 6$$

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

Correct answer is (D).

alternative approach ,

let the min\_degree of a graph is 'x' , then

$x \leq (2e / n)$  ,  
given ,  $e \leq (3n - 6)$  { it will be planner graph}  
put the value of e , then min\_degree will be ,

$$x \leq (2(3n-6))/n$$

$$x \leq (6n - 12) / n$$

$$x \leq (6n/n - 12/n)$$

$$x \leq (6 - 12/n)$$

when number of vertices is more , then value of  $(12/n)$  will be less , ( $12/n = 0.000001$  assume) , then min\_degree will be ,

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

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

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

$$x = 5 , \text{ maximum value of min_degree of defined graph (i.e. planner graph)}$$

14 votes

-- suraj (5.1k points)

## 2.2.6 Degree Of Graph: GATE2006-71 [top](#)

<http://gateoverflow.in/1850>



Selected Answer

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.

17 votes

-- Vikrant Singh (13.4k points)

## 2.2.7 Degree Of Graph: GATE2006-72 [top](#)

<http://gateoverflow.in/43566>



Selected Answer

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

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

$${}^k C_2 \cdot 2^{n-k}$$

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 on wards, 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  $3 \cdot 2^{n-3}$ .

16 votes

-- Vikrant Singh (13.4k points)

## 2.2.8 Degree Of Graph: GATE2009-3 [top](#)

<http://gateoverflow.in/804>



Selected Answer

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.

$$\frac{n}{n-1}$$

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

19 votes

-- gatecse (13.4k points)

## 2.2.9 Degree Of Graph: GATE2010-28 [top](#)

<http://gateoverflow.in/1154>



Selected Answer

The answer is clearly D.

You can eliminate the last sequence i.e 4th one as... the total number of vertices is 8 and the maximum degree given is 8 too. which isn't possible at all. The maximum degree you can have out of 8 vertices is 7.

Now coming to the method for solving such questions is through Havel-Hakimi Algorithm.

you can implement it by following one simple video. Here it is. :)

13 votes

-- Gate Keeda (19.1k points)

## 2.2.10 Degree Of Graph: GATE2013\_25 [top](#)

<http://gateoverflow.in/1536>



Selected Answer

Both are correct

P: sum of odd degree + sum of even degree = 2 \* no of edges

sum of odd degree = 2 \* 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

17 votes

-- Bhagirathi Nayak (13.3k points)

## 2.2.11 Degree Of Graph: GATE2014-1-52 [top](#)



Selected Answer

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, (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.

20 votes

-- Happy Mittal (10.9k points)

## 2.2.12 Degree Of Graph: GATE2017-2-23 [top](#)



Selected Answer

Let  $m$  be mindegree and  $M$  be maxdegree of a graph, then  $m \leq \frac{2E}{V} \leq M$

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

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

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

$V \leq 16.667 \Rightarrow V = 16$

20 votes

-- Manish Joshi (25.2k points)

## 2.2.13 Degree Of Graph: TIFR2010-B-36 [top](#)



Selected Answer

Since 7 edges come to every vertex, total no. of edges leaving  $n$  vertices must be  $7n$ . So, option a is a possibility but it needn't be always true. We can have 8 edges leave one vertex and 6 edges leave another (and similarly any other combination of outgoing edges ensuring total no. of outgoing edges remain constant). But option c must always be true as if none of the  $n$  vertices have at least 7 edges leaving, sum of outgoing edges can never be  $7n$ .

10 votes

-- Arjun Suresh (294k points)

## 2.2.14 Degree Of Graph: TIFR2012-B-2 [top](#)

<http://gateoverflow.in/25047>



As we know that sum of degree of vertex =  $2 \times \text{edges}$   
let there are  $u$  vertex with odd degrees and  $v$  vertex with even degrees

Then  $\sum(u) + \sum(v) = 2e$

now  $2e = \text{even}$

$\sum(v) = \text{sum of even number will be even}$

$\sum(u) = \text{if you consider odd number of vertices of odd degree then sum will be odd and this will violate } 2e$   
so there will be always even number of vertices with odd degree

C) There are even number of vertices of odd degree

6 votes

-- Umang Raman (15.1k points)

## 2.3

## Euler Graph(1) [top](#)

<http://gateoverflow.in/1221>

### 2.3.1 Euler Graph: GATE2007-23 [top](#)

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 graph-theory normal graph-connectivity euler-graph

Answer

## Answers: Euler Graph

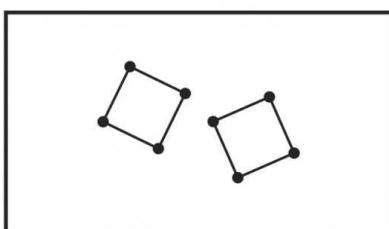
### 2.3.1 Euler Graph: GATE2007-23 [top](#)

<http://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 has a Euler Cycle.

It is connected because, there is a theorem which says, " $G$  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]

Here Degree of each vertex is 22, which is of course greater than  $\frac{25-1}{2} (= 12)$ .

answer = **Option C**

32 votes

-- Mithlesh Upadhyay (5.4k points)

## 2.4

## Graph Coloring(9) top

### 2.4.1 Graph Coloring: GATE 2016-2-03 top

<http://gateoverflow.in/39553>

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

gate2016-2 graph-theory graph-coloring normal numerical-answers

Answer

### 2.4.2 Graph Coloring: GATE2002-1.4 top

<http://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.  $n - 2 \lfloor \frac{n}{2} \rfloor + 2$

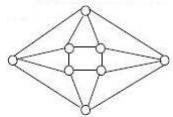
gate2002 graph-theory graph-coloring normal

Answer

### 2.4.3 Graph Coloring: GATE2004-77 top

<http://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 graph-theory graph-coloring easy

Answer

### 2.4.4 Graph Coloring: GATE2006-IT-25 top

<http://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

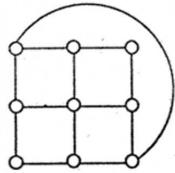
- A.  $1/(2^{n-1})$
- B.  $1/n$
- C.  $2/n$
- D.  $3/n$

[gate2006-it](#) [graph-theory](#) [graph-coloring](#) [normal](#)
**Answer**

### 2.4.5 Graph Coloring: GATE2008-IT-3 [top](#)

<http://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**

### 2.4.6 Graph Coloring: GATE2009-2 [top](#)

<http://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](#) [graph-theory](#) [graph-coloring](#) [normal](#)
**Answer**

### 2.4.7 Graph Coloring: TIFR2013-B-1 [top](#)

<http://gateoverflow.in/25508>

Let  $G = (V, E)$  be a simple undirected graph on  $n$  vertices. A colouring of  $G$  is an assignment of colours to each vertex such that endpoints of every edge are given different colours. Let  $\chi(G)$  denote the chromatic number of  $G$ , i.e. the minimum numbers of colours needed for a valid colouring of  $G$ . A set  $B \subseteq V$  is an independent set if no pair of vertices in  $B$  is connected by an edge. Let  $a(G)$  be the number of vertices in a largest possible independent set in  $G$ . In the absence of any further information about  $G$  we can conclude.

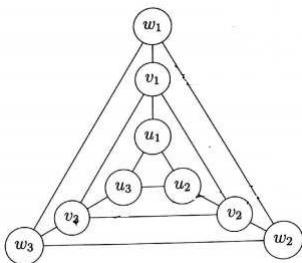
- A.  $\chi(G) \geq a(G)$
- B.  $\chi(G) \leq a(G)$
- C.  $a(G) \geq n/\chi(G)$
- D.  $a(G) \leq n/\chi(G)$
- E. None of the above.

[tifr2013](#) [graph-theory](#) [graph-coloring](#)
**Answer**

### 2.4.8 Graph Coloring: TIFR2017-B-1 [top](#)

<http://gateoverflow.in/95669>

A vertex colouring with three colours of a graph  $G = (V, E)$  is a mapping  $c : V \rightarrow \{R, G, B\}$  so that adjacent vertices receive distinct colours. Consider the following undirected graph.



How many vertex colouring with three colours does this graph have?

- A.  $3^9$
- B.  $6^3$
- C.  $3 \times 2^8$
- D. 27
- E. 24

[tifr2017](#) [graph-theory](#) [graph-coloring](#)

[Answer](#)

## 2.4.9 Graph Coloring: TIFR2017-B-10 [top](#)

<http://gateoverflow.in/95817>

A vertex colouring of a graph  $G = (V, E)$  with  $k$  colours is a mapping  $c : V \rightarrow \{1, \dots, k\}$  such that  $c(u) \neq c(v)$  for every  $(u, v) \in E$ . Consider the following statements:

- i. If every vertex in  $G$  has degree at most  $d$  then  $G$  admits a vertex colouring using  $d + 1$  colours.
- ii. Every cycle admits a vertex colouring using 2 colours
- iii. Every tree admits a vertex colouring using 2 colours

Which of the above statements is/are TRUE? Choose from the following options:

- A. only i
- B. only i and ii
- C. only i and iii
- D. only ii and iii
- E. i, ii, and iii

[tifr2017](#) [graph-theory](#) [graph-coloring](#)

[Answer](#)

## Answers: Graph Coloring

### 2.4.1 Graph Coloring: GATE 2016-2-03 [top](#)

<http://gateoverflow.in/39553>



Selected Answer

Four colour theorem is famous result, it says that any planar graphs can be coloured with only 4 colours !

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 , so , here ANY means literally any one of graph can be selected !

What are you saying , is something like There exists, but in that case, they will say, That specific graph directly..

Any man alive is gonna die => This means all men are gonna die ! Not specific to anyone !  
Hope this clears thing a bit !

22 votes

-- Akash (43.8k points)

## 2.4.2 Graph Coloring: GATE2002-1.4 [top](#)

<http://gateoverflow.in/808>



Selected Answer

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

17 votes

-- Madhur Rawat (2.6k points)

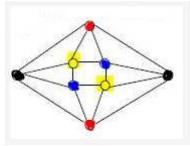
## 2.4.3 Graph Coloring: GATE2004-77 [top](#)

<http://gateoverflow.in/1071>



Selected Answer

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



answer = option C

10 votes

-- Amar Vashishth (28.7k points)

## 2.4.4 Graph Coloring: GATE2006-IT-25 [top](#)

<http://gateoverflow.in/3564>



Selected Answer

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 be 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 2/n.

The given graph is actually hypercube graph.

[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)

13 votes

-- Sandeep\_Uniyal (7.3k points)

## 2.4.5 Graph Coloring: GATE2008-IT-3 [top](#)

<http://gateoverflow.in/3263>



Selected Answer

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(**option 2**)

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

12 votes

-- vinodmits (367 points)

## 2.4.6 Graph Coloring: GATE2009-2 [top](#)

<http://gateoverflow.in/796>



Selected Answer

**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/MITHFH\\_lecturenotes\\_9.pdf](http://ocw.mit.edu/high-school/mathematics/combinatorics-the-fine-art-of-counting/lecture-notes/MITHFH_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)

14 votes

-- Mithlesh Upadhyay (5.4k points)

## 2.4.7 Graph Coloring: TIFR2013-B-1 [top](#)

<http://gateoverflow.in/23508>



Selected Answer

Independence number : Size of largest maximum independent set.  $a(G)$  (it covers all adjacent vertices)

Chromatic Number : Minimum No. of color required to properly color the graph  $\chi(G)$

The vertices of G can be partitioned into  $\chi(G)$  monochromatic classes. Each class is an independent set, and hence cannot have size larger than  $a(G)$

**a(G) x(G) ≥ n** (its a theorem)  
option C

8 votes

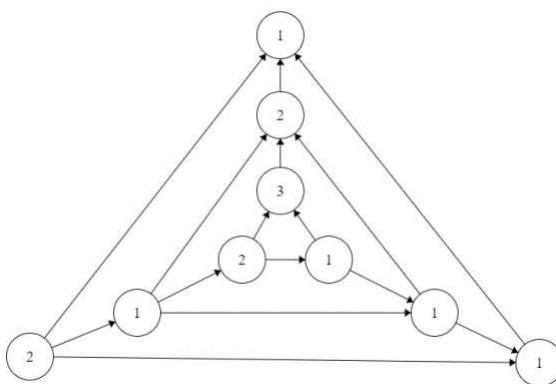
-- Umang Raman (15.1k points)

## 2.4.8 Graph Coloring: TIFR2017-B-1 [top](#)

<http://gateoverflow.in/95669>



Selected Answer



Start with the Inner one which can be filled in =>  $3 * 2 * 1 = 6$  ways

Then, middle one can be filled in =>  $2 * 1 * 1 = 2$  ways

Then, similarly outermost can be filled in =>  $2 * 1 * 1 = 2$  ways

Hence, Total number of ways to fill this figure =>  $6 * 2 * 2 = 24$  ways

16 votes

-- Kapil Phulwani (47.9k points)

### 2.4.9 Graph Coloring: TIFR2017-B-10 [top](#)



Selected Answer

i is true, since in worst case the graph can be complete. So,  $d+1$  colours are necessary for graph containing vertices with degree atmost 'd' .

ii is false since cycles with odd no of vertices require 3 colours.

iii is true, since each level of the tree must be coloured in an alternate fashion. We can do this with two colours.

Therefore, option c is correct.

4 votes

-- tarun\_svbk (1k points)

## 2.5

### Graph Connectivity(22) [top](#)

#### 2.5.1 Graph Connectivity: CMI2011-A-07 [top](#)

<http://gateoverflow.in/46194>

Let  $G = (V, E)$  be a graph. Define  $\bar{G}$  to be  $(V, \bar{E})$ , where for all  $u, v \in V$ ,  $(u, v) \in \bar{E}$  if and only if  $(u, v) \notin E$ . Then which of the following is true?

- A.  $\bar{G}$  is always connected.
- B.  $\bar{G}$  is connected if  $G$  is not connected.
- C. At least one of  $G$  and  $\bar{G}$  connected.
- D.  $G$  is not connected or  $\bar{G}$  is not connected

[cmi2011](#) [graph-theory](#) [graph-connectivity](#)

Answer

#### 2.5.2 Graph Connectivity: CMI2012-B-01 [top](#)

<http://gateoverflow.in/46545>

Let  $G = (V, E)$  be a graph where  $|V| = n$  and the degree of each vertex is strictly greater than  $\frac{n}{2}$ . Prove that  $G$  has a Hamiltonian path. (Hint: Consider a path of maximum length in  $G$ .)

[cmi2012](#) [descriptive](#) [graph-theory](#) [graph-connectivity](#)

Answer

#### 2.5.3 Graph Connectivity: GATE1990-1-viii [top](#)

<http://gateoverflow.in/83854>

Fill in the blanks:

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](#)

Answer

#### 2.5.4 Graph Connectivity: GATE1991\_01,xv [top](#)

<http://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](#)

Answer

#### 2.5.5 Graph Connectivity: GATE1993\_8.1 [top](#)

<http://gateoverflow.in/229>

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

[Answer](#)

## 2.5.6 Graph Connectivity: GATE1995\_1.25 [top](#)

<http://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

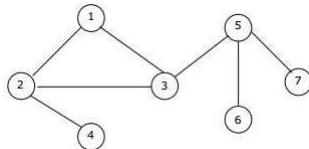
gate1995 graph-theory graph-connectivity easy

[Answer](#)

## 2.5.7 Graph Connectivity: GATE1999\_1.15 [top](#)

<http://gateoverflow.in/1468>

The number of articulation points of the following graph is



- A. 0
- B. 1
- C. 2
- D. 3

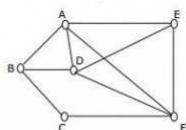
gate1999 graph-theory graph-connectivity normal

[Answer](#)

## 2.5.8 Graph Connectivity: GATE1999\_5 [top](#)

<http://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.



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

gate1999 graph-theory graph-connectivity normal

Answer

## 2.5.9 Graph Connectivity: GATE2002-1.25, ISRO2008-30, ISRO2016-6 [top](http://gateoverflow.in/830)

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 graph-theory easy isro2008 isro2016 graph-connectivity

Answer

## 2.5.10 Graph Connectivity: GATE2003-8, ISRO2009-53 [top](http://gateoverflow.in/899)

<http://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 graph-theory graph-connectivity normal isro2009

Answer

## 2.5.11 Graph Connectivity: GATE2004-IT-37 [top](http://gateoverflow.in/3680)

<http://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

## 2.5.12 Graph Connectivity: GATE2004-IT-5 [top](http://gateoverflow.in/3646)

<http://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

## 2.5.13 Graph Connectivity: GATE2005-IT-56 [top](http://gateoverflow.in/3817)

<http://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](#)

## 2.5.14 Graph Connectivity: GATE2006-73 [top](#)

<http://gateoverflow.in/4356>

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.  $2^{n/2}$   
D.  $\frac{2^n}{n}$

[gate2006](#) [graph-theory](#) [normal](#) [graph-connectivity](#)

[Answer](#)

## 2.5.15 Graph Connectivity: GATE2006-IT-11 [top](#)

<http://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](#)

## 2.5.16 Graph Connectivity: GATE2008-IT-27 [top](#)

<http://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](#)

## 2.5.17 Graph Connectivity: GATE2014-1-51 [top](#)

<http://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\_\_\_\_\_.

[gate2014-1](#) [graph-theory](#) [numerical-answers](#) [normal](#) [graph-connectivity](#)

[Answer](#)

## 2.5.18 Graph Connectivity: GATE2014-2-3 [top](#)

<http://gateoverflow.in/1955>

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

[gate2014-2](#) [graph-theory](#) [graph-connectivity](#) [numerical-answers](#) [normal](#)

[Answer](#)

## 2.5.19 Graph Connectivity: GATE2014-3-51 [top](#)

<http://gateoverflow.in/2085>

If  $G$  is the forest with  $n$  vertices and  $k$  connected components, how many edges does  $G$  have?

- A.  $\lfloor n/k \rfloor$
- B.  $\lceil n/k \rceil$
- C.  $n - k$
- D.  $n - k + 1$

[gate2014-3](#) | [graph-theory](#) | [graph-connectivity](#) | [normal](#)

[Answer](#)

## 2.5.20 Graph Connectivity: GATE2015-2\_50 [top](#)

<http://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

[gate2015-2](#) | [graph-theory](#) | [graph-connectivity](#) | [easy](#)

[Answer](#)

## 2.5.21 Graph Connectivity: ISI 2015 PCB C3 [top](#)

<http://gateoverflow.in/120885>

For a positive integer  $n$ , let  $G = (V, E)$  be a graph, where  $V = \{0,1\}^n$ , i.e.,  $V$  is the set of vertices has one to one correspondence with the set of all  $n$ -bit binary strings and  $E = \{(u,v) \mid u, v \text{ belongs to } V, u \text{ and } v \text{ differ in exactly one bit position}\}$ .

- i) Determine size of  $E$
- ii) Show that  $G$  is connected

[graph-theory](#) | [engineering-mathematics](#) | [isi2015](#) | [graph-connectivity](#)

[Answer](#)

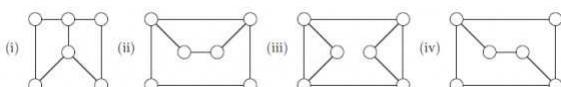
## 2.5.22 Graph Connectivity: TIFR2015-B-5 [top](#)

<http://gateoverflow.in/29858>

Suppose

$$\begin{pmatrix} 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 \end{pmatrix}$$

is the adjacency matrix of an undirected graph with six vertices: that is, the rows and columns are indexed by vertices of the graph, and an entry is 1 if the corresponding vertices are connected by an edge and is 0 otherwise; the same order of vertices is used for the rows and columns. Which of the graphs below has the above adjacency matrix?



- A. Only (i)
- B. Only (ii)
- C. Only (iii)
- D. Only (iv)
- E. (i) and (ii)

Answer

## Answers: Graph Connectivity

### 2.5.1 Graph Connectivity: CMI2011-A-07 [top](#)

<http://gateoverflow.in/46194>


Correct answer would be **C) At least one of G and G-bar is connected.**

Option A: Its straight forwardly wrong.

Option B: This is a **subset** of Option C.

Option D: This also implies that **G and G-bar is not connected at the same time, which is impossible.**

Here is the total Possibility

G	G-bar	Possible/Not-Possible
Connected	Connected	Possible
Connected	Dis-connected	Possible
Dis-Connected	Connected	Possible
Dis - Connected	Dis-Connected	Not-Possible

8 votes

-- Muktinath Vishwakarma (34.1k points)

### 2.5.2 Graph Connectivity: CMI2012-B-01 [top](#)

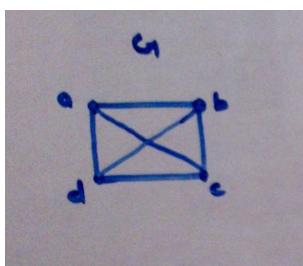
<http://gateoverflow.in/46545>

The prove is similar to **Dirac theorem** In an  $n$ -vertex graph in which each vertex has degree at least  $n/2$  must have a Hamiltonian cycle.

So we can say **If a graph which contain Hamiltonian cycle will surely contain a Hamiltonian Path.**

**But the converse of this is not true.**

Here consider a graph with 4 vertices and 6 edges which is  $K_4$  and the degree of each vertex is 3 (i.e  $>n/2$ ).



So the graph contains a b c d one path.

b c d a another and even more.

And even it contains Hamiltonian cycle .

2 votes

-- Manoj Kumar (37.5k points)

### 2.5.3 Graph Connectivity: GATE1990-1-viii [top](#)

<http://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  $K_n$  =  $n(n-1)/2$

So no of edges of each of the above 2 graph(a graph and its complement) =  $n(n-1)/4$

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..**

2 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

## 2.5.4 Graph Connectivity: GATE1991\_01,xv top

<http://gateoverflow.in/510>



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

$$\begin{aligned} \binom{a+b-1}{2} + \binom{1}{2} &= \frac{1}{2}(a+b-1)(a+b-2) \\ &= \frac{1}{2}(a^2 + 2ab - 3a + b^2 - 3b + 2) \text{ edges.} \end{aligned}$$

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>

19 votes

-- Mithlesh Upadhyay (5.4k points)

## 2.5.5 Graph Connectivity: GATE1993\_8.1 [top](#)

<http://gateoverflow.in/2299>

Selected Answer

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) B is false as if graph is cyclic graph then removing any edge will not disconnect graph.

ANSWER -> C & D.

7 votes

-- Akash (43.8k points)

## 2.5.6 Graph Connectivity: GATE1995\_1.25 [top](#)

<http://gateoverflow.in/2612>

Selected Answer

B.

For making a cyclic graph, the minimum number of edges have to be equal to the number of vertices.

16 votes

-- Gate Keeda (19.1k points)

## 2.5.7 Graph Connectivity: GATE1999\_1.15 [top](#)

<http://gateoverflow.in/1468>

Selected Answer

**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.

14 votes

-- kunal (20.8k points)

## 2.5.8 Graph Connectivity: GATE1999\_5 [top](#)

<http://gateoverflow.in/1504>

Answer :-

a

(i) Not a cut. We have spanning tree after removing this edges.

(ii) This is cut. we break graph into two pieces.

B) Min cut size -> 2. (BC,CF). Removing this two edges disconnects C from remaining graph.

5 votes

-- Akash (43.8k points)

## 2.5.9 Graph Connectivity: GATE2002-1.25, ISRO2008-30, ISRO2016-6 [top](http://gateoverflow.in/830)



Selected Answer

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  $n(n-1)/2$

17 votes

-- Bhagirathi Nayak (13.3k points)

## 2.5.10 Graph Connectivity: GATE2003-8, ISRO2009-53 [top](http://gateoverflow.in/899)



Selected Answer

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).

30 votes

-- Danish (3.6k points)

## 2.5.11 Graph Connectivity: GATE2004-IT-37 [top](http://gateoverflow.in/3680)



Selected Answer

sum of degree of all the vertices =  $2 * \text{number of edges}$

$$2*6 + 4*3 + 3*x = 27*2$$

$$x=10.$$

Number of vertices =  $6 + 3 + x = 19$   
The correct answer is (D).

14 votes

-- suraj (5.1k points)

## 2.5.12 Graph Connectivity: GATE2004-IT-5 [top](http://gateoverflow.in/3646)



Selected Answer

This is possible with spanning tree.

A spanning tree with  $n$  nodes has  $n-1$  edges.

Therefore, Answer is (A)

11 votes

-- Dhananjay (995 points)

## 2.5.13 Graph Connectivity: GATE2005-IT-56 [top](http://gateoverflow.in/3817)



Selected Answer

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 - 3 - 9 - 10 - 11 - 33 - 99 - 100 which consists of 7 edges.  
The answer is option 2.

24 votes

-- Shridhar (393 points)

The conditions are given

Edge set consists of edges from i to j using either

- 1)  $j = i+1$  OR
- 2)  $j=3i$

what we think from here

minimum we take vertex 1 max we take vertex 100

now one important point is to reach 100 the maximum no. which get  $j=3i$  is  $i=33$  so  $j=3*33=99$

half problem is solved.

we got 1--33--99--100

now see to reach 33 how many minimum edge needed.

max no between which get value  $j=3i$ ,  $i=11$  so  $j=3*11=33$

what we get 1--11--33--99--100

so problem solved almost minimum edge need to reach 11 from 1

max no.  $i$  which get  $j=3i$ ,  $i=3$  so  $j=3*i=9$  to reach 11 ..9--10--11

so we got another point

1--9--10--11--33--99--100

now to reach 11 from 1

max value of  $i = 3$  so  $j=3*i=9$  so 3--9

1--3--9--10--11--33--99--100

Solved problem into half give u idea how to get minimum for rest of graph.

13 votes

-- Prashant Singh (49.2k points)

## 2.5.14 Graph Connectivity: GATE2006-73 [top](#)

<http://gateoverflow.in/43567>



Selected Answer

B.

$n + 1$  (subsets of size  $< 2$  are all disconnected)  
 $+1$  (subsets of size  $\geq 2$  are all connected)  
 $= n + 2$ .

20 votes

-- Vikrant Singh (13.4k points)

## 2.5.15 Graph Connectivity: GATE2006-IT-11 [top](#)

<http://gateoverflow.in/3550>



Selected Answer

A) Hamiltonian cycle -> This is cycle guys. 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 -> This is unrelated concept. This is false.

ref-> [https://en.wikipedia.org/wiki/Electrical\\_grid](https://en.wikipedia.org/wiki/Electrical_grid)

C) Hypercube -> This is also unrelated concept. Also it have cycles too..This is false.

D) Tree -> This is answer. We need to have Minimum spanning Tree to be exact.

Ref -> [https://en.wikipedia.org/wiki/Minimum\\_spanning\\_tree](https://en.wikipedia.org/wiki/Minimum_spanning_tree)

"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.

13 votes

-- Akash (43.8k points)

## 2.5.16 Graph Connectivity: GATE2008-IT-27 [top](#)

<http://gateoverflow.in/3317>



Selected Answer

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.

20 votes

-- Happy Mittal (10.9k points)

## 2.5.17 Graph Connectivity: GATE2014-1-51 [top](#)

<http://gateoverflow.in/1931>



Selected Answer

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 =  $132 + 132 + 242 = 506$ .

69 votes

-- Happy Mittal (10.9k 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)

$$2|E| = \text{sum of the degrees}$$

$$2|E| = 4 * 3 + 40 * 5 + 100 * 8 = 1012$$

$$|E| = 1012/2 = 506 \text{ edges.}$$

39 votes

-- Mithlesh Upadhyay (5.4k points)

## 2.5.18 Graph Connectivity: GATE2014-2-3 [top](#)



Selected Answer

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.

19 votes

-- Happy Mittal (10.9k points)

## 2.5.19 Graph Connectivity: GATE2014-3-51 [top](#)



Selected Answer

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** =  $(n-k)$

20 votes

-- Amar Vashishth (28.7k points)

**A forest** is an acyclic **graph(with no cycle)** , i.e all these components are a tree. With  $k$  components there are  $k$  roots. And whenever a new node is added to a tree only a single edge is introduced.

With  $k$  roots , remaining nodes are  $(n-k)$  each of which introduces an edge. Hence there are  $(n-k)*1=(n-k)$  edges.

18 votes

-- Srinath Jayachandran (3.7k points)

## 2.5.20 Graph Connectivity: GATE2015-2\_50 [top](#)



Selected Answer

Ans B

In a cycle if we remove an edge, it will still be connected. So, bridge cannot be part of a cycle.

24 votes

-- Vikrant Singh (13.4k points)

## 2.5.21 Graph Connectivity: ISI 2015 PCB C3 [top](#)



Selected Answer

These types of graphs are also known as hypercube graphs.

Part i:

Consider any vertex  $v$ . Exactly  $n$  vertices have a hamming distance of 1 from  $v$ . (Reason: Consider the vertex which is exactly the same bit pattern as  $v$  except the first bit as  $v_1$ .  $v_2$  differs from  $v$  in only the 2nd bit and so on till  $v_n$  which is different from  $v$  in last bit).

Now there are total of  $2^n$  vertices (Since each vertex corresponds to a bit string and for  $n$  bits there are  $2^n$  bit strings.).

Consider the basic theorem for undirected graphs which says that sum of degrees of vertices is equal to twice the no. of edges.

Using that here we get:

$$2^n * n = 2 * e \text{ where } e \text{ is the no. of edges.}$$

$$\text{Thus no. of edges} = 2^{n-1}n$$

Part ii)

A graph is called connected if there's a path between any two vertices.

Consider any vertices  $v_x$  and  $v_y$ . Suppose hamming distance between them is  $k$ . Consider the first different bit  $k_1$ . You simply reach  $v_{k_1}$  from  $v_x$  which differs from  $v_x$  only in that bit. Now  $v_{k_1}$  and  $v_y$  differ from each other by  $k - 1$  bits. You continue to do this until you reach  $v_y$ . Thus any two vertices are connected by a path of  $k$  where  $k$  is the hamming distance between them.

3 votes

-- Akshay Arora (2.3k points)

## 2.5.22 Graph Connectivity: TIFR2015-B-5 [top](#)

<http://gateoverflow.in/2985>



Selected Answer

Yes, Option (e) must be the right answer.

### Number of edges in the graph:

Since the graphs are undirected, it can be observed that there will be two 1's in the adjacency matrix corresponding to each edge in the graph.

For example, suppose there is an edge between nodes A & B, then there will be 1 in position [A, B] & there will be a 1 in position [B, A] of the adjacency matrix.

That's why the given adjacency matrix is symmetric.

So the number of edges in the graph must be equal to half the number of 1's in the adjacency matrix.

Hence number of edges will be 7 in the graph.

All the other graphs except (iii), have 7 edges. So it is clear that the adjacency matrix does not represent graph (iii).

### Isomorphism:

From the definition of Isomorphic graphs, it can be inferred that,

### Isomorphic graphs must have same (adjacency matrix) representation.

Thus after eliminating graph (iii) we have to check for isomorphism among graphs (i), (ii) & (iv).

It can clearly be observed that graphs (ii) & (iv) are not isomorphic to each other.

It can also be observed that graph (i) & (ii) are isomorphic (Rotate graph (i) by 90 degree left/right).

Graph (ii) is looking like a closed envelope in the figure, try to view it like an open envelope, like a trapezium over a rectangle.)

So now it can be inferred that either the adjacency matrix is representing both graphs (i) & (ii) or it is only representing (iv).

### Cycles of length 6 :

Now from the adjacency matrix it can be observed that there should be a cycle of length 6 in the graph, since [1, 2], [2,

$[3], [3, 4], [4, 5], [5, 6], [6, 1]$  are all 1's in the matrix.(as 1 at any position  $[x, y]$  represents an edge between  $x$  &  $y$  in the graph).

& both graphs (i) & (ii) have cycles of length 6, but graph (iv) does not have any cycle of length 6, it has cycles of length 4 & 5 only.

Thus graph (iv) can not have the above adjacency matrix.

Hence the adjacency matrix represents graphs (i) & (ii).

12 votes

-- Anurag Pandey (13.1k points)

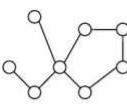
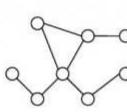
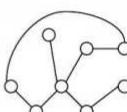
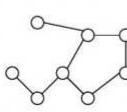
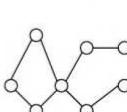
## 2.6

## Graph Isomorphism(2) top

### 2.6.1 Graph Isomorphism: GATE2012\_26 top

<http://gateoverflow.in/1611>

Which of the following graphs is isomorphic to

- 
- (A)
- 
- (B)
- 
- (C)
- 
- (D)
- 

gate2012 graph-theory graph-isomorphism normal

Answer

### 2.6.2 Graph Isomorphism: GATE2014-2-51 top

<http://gateoverflow.in/2018>

A cycle on  $n$  vertices is isomorphic to its complement. The value of  $n$  is \_\_\_\_\_.

gate2014-2 graph-theory numerical-answers normal graph-isomorphism

Answer

## Answers: Graph Isomorphism

### 2.6.1 Graph Isomorphism: GATE2012\_26 top

<http://gateoverflow.in/1611>



Selected Answer

for this type of questions find which are **not isomorphic**

The graph in option A has a 3 length cycle whereas the original graph does not have a 3 length cycle

The graph in option C has vertex with degree 3 whereas the original graph does not have a vertex with degree 3

The graph in option D has a 4 length cycle whereas the original graph does not have a 4 length cycle

so option B is correct

13 votes

-- Bhagirathi Nayak (13.3k points)

## 2.6.2 Graph Isomorphism: GATE2014-2-51 [top](#)

<http://gateoverflow.in/2014>



Selected Answer

A cycle with  $n$  vertices has  $n$  edges.

Number of edges in cycle =  $n$

$$\text{Number of edges in its complement} = \frac{n(n-1)}{2} - n$$

To be isomorphism, Both graphs should have equal number of edges.

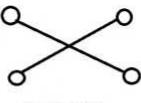
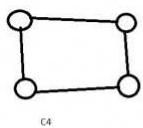
$$\begin{aligned} \text{This gives } & \frac{n(n-1)}{2} - n = n \\ \implies & n = 5 \end{aligned}$$

25 votes

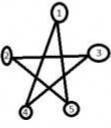
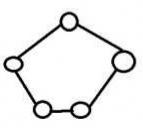
-- Sachin Mittal (7.1k points)

its  $n=5$  only.

only  $C_5$  is isomorphic to its complement.



Here,  $C_4$  and its complement is not isomorphic because both have different structure.



Here,  $C_5$  is isomorphic to its complement. just imagine the reorganization of vertices in complement of  $C_5$  it will become same as  $C_5$ .

Imagine 1 is below 4 & 5 and then flip 2 & 3. imagine the structure it is same as  $C_5$ .

17 votes

-- jayendra (8.1k points)

## 2.7

## Graph Matching(1) [top](#)

### 2.7.1 Graph Matching: GATE2003-36 [top](#)

<http://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](#) [graph-theory](#) [graph-matching](#) [normal](#)

Answer

## Answers: Graph Matching

### 2.7.1 Graph Matching: GATE2003-36 [top](#)

<http://gateoverflow.in/926>



Selected Answer

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 =  $90/3! = 90/6 = 15$ .

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\*3=15.

25 votes

-- Arjun Suresh (294k 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=  $5*3*1=15$

16 votes

-- Hunain (485 points)

## 2.8

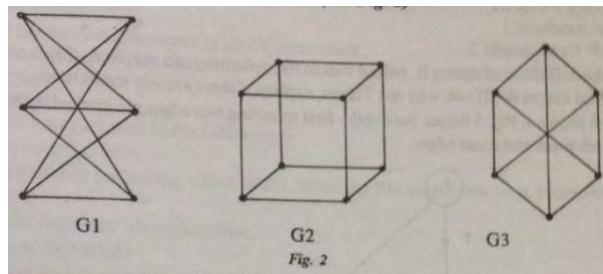
## Graph Planarity(2) top

### 2.8.1 Graph Planarity: GATE1990-3-vi top

<http://gateoverflow.in/87129>

Answer the following:

Which of the following graphs is/are planer? (see Fig. 2)



[gate1989](#) [normal](#) [graph-theory](#) [graph-planarity](#)

[Answer](#)

### 2.8.2 Graph Planarity: GATE1990-3-xi top

<http://gateoverflow.in/85384>

Choose the correct alternatives (More than one may be correct).

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](#)

[Answer](#)

## Answers: Graph Planarity

**2.8.1 Graph Planarity: GATE1990-3-vi** [top](#)<http://gateoverflow.in/87129>

Selected Answer

graph G2 is planar because we can draw all its edges without crossing each other .

 2 votes-- **kunal** (20.8k points)**2.8.2 Graph Planarity: GATE1990-3-xi** [top](#)<http://gateoverflow.in/85384>

Ans is D

 2 votes-- **vaishalitanna** (53 points)**2.9****Line Graph(2)** [top](#)**2.9.1 Line Graph: GATE2013\_26** [top](#)<http://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](#) [graph-theory](#) [normal](#) [line-graph](#)

Answer

**2.9.2 Line Graph: TIFR2017-B-13** [top](#)<http://gateoverflow.in/95821>

For an undirected graph  $G = (V, E)$ , the line graph  $G' = (V', E')$  is obtained by replacing each edge in  $E$  by a vertex, and adding an edge between two vertices in  $V'$  if the corresponding edges in  $G$  are incident on the same vertex. Which of the following is TRUE of line graphs?

- A. the line graph for a complete graph is complete
- B. the line graph for a connected graph is connected
- C. the line graph for a bipartite graph is bipartite
- D. the maximum degree of any vertex in the line graph is at most the maximum degree in the original graph
- E. each vertex in the line graph has degree one or two

[tifr2017](#) [graph-theory](#) [line-graph](#)

Answer

**Answers: Line Graph****2.9.1 Line Graph: GATE2013\_26** [top](#)<http://gateoverflow.in/1537>

Selected Answer

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  $m$ .

19 votes

-- prashant singh (475 points)

## 2.9.2 Line Graph: TIFR2017-B-13 [top](#)

<http://gateoverflow.in/95821>

The line graph of a connected graph is connected. If  $G$  is connected, it contains a path connecting any two of its edges, which translates into a path in  $L(G)$  containing any two of the vertices of  $L(G)$ . Therefore, option B is correct.

We can also do this question using elimination of options.

You can view the following google drive link for the example - <https://drive.google.com/open?id=0B1OKeqz0MEWwNTh4czgzaIVDNGM>

2 votes

-- tarun\_svbk (1k points)

## 2.10

## Regular Graph(1) [top](#)

### 2.10.1 Regular Graph: GATE1994\_2.5 [top](#)

<http://gateoverflow.in/2472>

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

gate1994 graph-theory easy regular-graph

Answer

## Answers: Regular Graph

### 2.10.1 Regular Graph: GATE1994\_2.5 [top](#)

<http://gateoverflow.in/2472>



Selected Answer

in a complete graph which is  $(n-1)$  regular (where  $n$  is the no of vertices) has edges  $n(n-1)/2$   
 $n$  vertices are adjacent to  $n-1$  vertices and an edge contributes two degree so dividing by 2.

so in  $d$  regular graph No of edges will be  $n*d/2$

8 votes

-- Manu Thakur (6k points)

**2.11****Spanning Tree(2)** [top](#)**2.11.1 Spanning Tree: GATE2007-IT-25** [top](#)<http://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](#) [spanning-tree](#) [normal](#)

[Answer](#)

**2.11.2 Spanning Tree: TIFR2015-B-11** [top](#)<http://gateoverflow.in/30043>

Let  $K_n$  be the complete graph on  $n$  vertices labelled  $\{1, 2, \dots, n\}$  with  $m = n(n - 1)/2$  edges. What is the number of spanning trees of  $K_n$ ?

- A.  $\frac{m}{n-1}$
- B.  $m^{n-1}$
- C.  $n^{n-2}$
- D.  $n^{n-1}$
- E. None of the above.

[tifr2015](#) [graph-theory](#) [spanning-tree](#)

[Answer](#)

**Answers: Spanning Tree****2.11.1 Spanning Tree: GATE2007-IT-25** [top](#)<http://gateoverflow.in/3458>

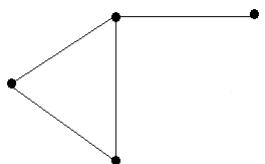
Selected Answer

**OPTION (C)** is Correct , reason is as follows:

Graph is **connected** and has '**n**' **edges** means **exactly one cycle** is there , if  $n$  vertices are 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 atleast 3 spanning trees in any such Graph.



Consider this 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 atleast 3 spanning trees.

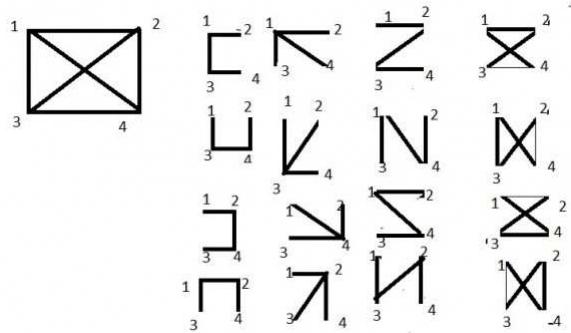
25 votes

-- **Himanshu Agarwal** (16.2k points)

**2.11.2 Spanning Tree: TIFR2015-B-11** [top](#)<http://gateoverflow.in/30043>

Selected Answer

Answer will be (C)



e.g. for  $K_4$  no. of spanning tree will be 16

3 votes

-- srestha (58.3k points)

## 2.12

## Trees(3) top

### 2.12.1 Trees: GATE2010-1 top

<http://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](#) [graph-theory](#) [normal](#) [trees](#)

Answer

### 2.12.2 Trees: ISI Entrance Exam MTech (CS) top

<http://gateoverflow.in/124367>

Consider all possible trees with  $n$  nodes. Let  $k$  be the number of nodes with degree greater than 1 in a given tree. What is the maximum possible value of  $k$ ?

[isi2016](#) [graph-theory](#) [trees](#)

Answer

### 2.12.3 Trees: TIFR2011-B-33 top

<http://gateoverflow.in/20624>

Which of the following is NOT a sufficient and necessary condition for an undirected graph  $G$  to be a tree?

- A.  $G$  is connected and has  $n - 1$  edges.
- B.  $G$  is acyclic and connected.
- C.  $G$  is acyclic and has  $n - 1$  edges.
- D.  $G$  is acyclic, connected and has  $n - 1$  edges.
- E.  $G$  has  $n - 1$  edges.

[tifr2011](#) [graph-theory](#) [trees](#)

Answer

## Answers: Trees

### 2.12.1 Trees: GATE2010-1 top

<http://gateoverflow.in/1147>



Selected Answer

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  $\text{No of Edges} = \text{No of vertices} - 1$ , in a tree.

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

28 votes

-- Digvijay (47k points)

## 2.12.2 Trees: ISI Entrance Exam MTech (CS) [top](#)

<http://gateoverflow.in/124367>

Maximum value of  $k$  is  $n-2$  which is example of line graph because every tree should contain at least 2 pendent vertices (i.e vertex with degree 1). Therefore value of  $k$  cannot exceed  $n-2$

5 votes

-- Heisenberg (1.7k points)

## 2.12.3 Trees: TIFR2011-B-33 [top](#)

<http://gateoverflow.in/20824>



### Option a

$\iff$  Option b  
 $\iff$  Option c  
 $\iff$  Option d.

- You need atleast  $n - 1$  edges to have a connected graph. This leaves no edges to make any cycles. Thus, Option a  $\implies G$  is acyclic.
- A connected graph with  $n - 1$  edges is acyclic, as shown above. Now, if we add any more edges to this graph, we will be connecting two vertices that are already connected. Thus, adding any more than edges to a connected graph will cause cycles. So, if a graph is acyclic and connected, it has exactly  $(n - 1)$  edges.
- You can't fit  $(n - 1)$  edges between  $(n - 1)$  vertices without causing cycles. Thus, if graph with  $(n - 1)$  edges is acyclic, it must connect  $n$  vertices. Hence, an acyclic graph with  $(n - 1)$  edges is connected.

Thus, all options, a to d are equivalent.

### Option b

$\iff$   $G$  is a tree.

- Any acyclic connected graph is a tree by definition.
- A graph  $G$  is a tree if it is both acyclic and connected by definition.

**Thus, all option a to d are both necessary and sufficient for an undirected graph  $G$  to be a tree.**

### Option e

$\not\implies$   $G$  is a tree.

- Since  $G$  is not constrained to be acyclic, we can create a cyclic graph with  $(n - 1)$  edges. This graph will be cyclic, and it won't be connected. And thus, it won't be a tree.

**Hence, option e is the correct answer.**

12 votes

-- Pragy Agarwal (19.5k points)

## 2.13

## Vertex Cover(1) [top](#)

### 2.13.1 Vertex Cover: GATE2005-11 [top](#)

<http://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:

- 12
- 8
- less than 8
- more than 12

[gate2005](#) [graph-theory](#) [normal](#) [vertex-cover](#)[Answer](#)

## Answers: Vertex Cover

### 2.13.1 Vertex Cover: GATE2005-11 [top](#)

<http://gateoverflow.in/1161>

Selected Answer

Vertex cover: A set of vertices such that each edge of the graph is incident to atleast 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).

20 votes

-- suraj (5.1k points)

## 3 Discrete Mathematics: Mathematical Logic (79) [top](#)

### 3.1

#### First Order Logic(33) [top](#)

##### 3.1.1 First Order Logic: GATE1989-14a [top](#)

<http://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: GATE1991-15,b [top](#)

<http://gateoverflow.in/26748>

(b)

Consider the following first order formula:

$$\left( \begin{array}{c} \forall x \exists y : R(x, y) \\ \wedge \\ \forall x \forall y : \\ \quad \left( \begin{array}{c} \forall x \forall y \forall z : \\ \wedge \\ \forall x : \neg R(x, x) \end{array} \right) \\ \wedge \\ R(x, y) \implies \neg R(y, x) \\ R(x, y) \wedge R(y, z) \implies R(x, z) \end{array} \right)$$

Does it have finite models?

Is it satisfiable? If so, give a countable model for it.

gate1991 first-order-logic

Answer

##### 3.1.3 First Order Logic: GATE1992\_92,xv [top](#)

<http://gateoverflow.in/256>

Which of the following predicate calculus statements is/are valid?

- (1)  $(\forall(x))P(x) \vee (\forall(x))Q(x) \implies (\forall(x))(P(x) \vee Q(x))$
- (2)  $(\exists(x))P(x) \wedge (\exists(x))Q(x) \implies (\exists(x))(P(x) \wedge Q(x))$
- (3)  $(\forall(x))(P(x) \vee Q(x)) \implies (\forall(x))P(x) \vee (\forall(x))Q(x)$
- (4)  $(\exists(x))(P(x) \vee Q(x)) \implies \sim (\forall(x))P(x) \vee (\exists(x))Q(x)$

gate1992 mathematical-logic normal first-order-logic

Answer

##### 3.1.4 First Order Logic: GATE2003-32 [top](#)

<http://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](#) [mathematical-logic](#) [first-order-logic](#) [normal](#)

[Answer](#)

### 3.1.5 First Order Logic: GATE2003-33 [top](#)

<http://gateoverflow.in/823>

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](#) [mathematical-logic](#) [difficult](#) [first-order-logic](#)

[Answer](#)

### 3.1.6 First Order Logic: GATE2004-23, ISRO2007-32 [top](#)

<http://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](#) [mathematical-logic](#) [easy](#) [isro2007](#) [first-order-logic](#)

[Answer](#)

### 3.1.7 First Order Logic: GATE2004-IT-3 [top](#)

<http://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 | first-order-logic

Answer

### 3.1.8 First Order Logic: GATE2005-41 [top](#)

<http://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 | mathematical-logic | easy | first-order-logic

Answer

### 3.1.9 First Order Logic: GATE2005-IT-36 [top](#)

<http://gateoverflow.in/3783>

Let  $P(x)$  and  $Q(x)$  be arbitrary predicates. Which of the following statements is always TRUE?

- A.  $((\forall x(P(x) \vee Q(x)))) \Rightarrow ((\forall xP(x)) \vee (\forall xQ(x)))$   
 B.  $(\forall x(P(x) \Rightarrow Q(x))) \Rightarrow ((\forall xP(x)) \Rightarrow (\forall xQ(x)))$   
 C.  $(\forall x(P(x)) \Rightarrow \forall x(Q(x))) \Rightarrow (\forall x(P(x) \Rightarrow Q(x)))$   
 D.  $(\forall x(P(x)) \Leftrightarrow (\forall x(Q(x)))) \Rightarrow (\forall x(P(x) \Leftrightarrow Q(x)))$

gate2005-it | mathematical-logic | first-order-logic | normal

Answer

### 3.1.10 First Order Logic: GATE2006-26 [top](#)

<http://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 | mathematical-logic | normal | first-order-logic

Answer

### 3.1.11 First Order Logic: GATE2006-IT-21 [top](#)

<http://gateoverflow.in/3560>

Consider the following first order logic formula in which  $R$  is a binary relation symbol.

$\forall$

$x$

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****3.1.12 First Order Logic: GATE2007-22** [top](#)<http://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](#) [mathematical-logic](#) [easy](#) [first-order-logic](#)**Answer****3.1.13 First Order Logic: GATE2007-IT-21** [top](#)<http://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****3.1.14 First Order Logic: GATE2008-30** [top](#)<http://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](#) [easy](#) [mathematical-logic](#) [first-order-logic](#)**Answer****3.1.15 First Order Logic: GATE2008-IT-21** [top](#)<http://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****3.1.16 First Order Logic: GATE2008-IT-22** [top](#)<http://gateoverflow.in/3283>

Which of the following is the negation of  $[\forall x, a \rightarrow (\exists y, \beta \rightarrow (\forall u, \exists v, y))]$

- A.  $[\exists x, a \rightarrow (\forall y, \beta \rightarrow (\exists u, \forall v, y))]$
- B.  $[\exists x, a \rightarrow (\forall y, \beta \rightarrow (\exists u, \forall v, \neg y))]$
- C.  $[\forall x, \neg a \rightarrow (\exists y, \neg \beta \rightarrow (\forall u, \exists v, \neg y))]$
- D.  $[\exists x, a \wedge (\forall y, \beta \wedge (\exists u, \forall v, \neg y))]$

[gate2008-it](#)
[mathematical-logic](#)
[normal](#)
[first-order-logic](#)
**Answer****3.1.17 First Order Logic: GATE2009-23** [top](#)<http://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](#)
[mathematical-logic](#)
[easy](#)
[first-order-logic](#)
**Answer****3.1.18 First Order Logic: GATE2009-26** [top](#)<http://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](#)
[mathematical-logic](#)
[normal](#)
[first-order-logic](#)
**Answer****3.1.19 First Order Logic: GATE2010-30** [top](#)<http://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

 $\forall$ 
 $?$

- (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](#) | [mathematical-logic](#) | [easy](#) | [first-order-logic](#)

[Answer](#)

### 3.1.20 First Order Logic: GATE2011\_30 [top](#)

<http://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](#) | [mathematical-logic](#) | [normal](#) | [first-order-logic](#)

[Answer](#)

### 3.1.21 First Order Logic: GATE2012\_13 [top](#)

<http://gateoverflow.in/45>

What is the correct translation of the following statement into mathematical logic?

"Some real numbers are rational"

- (A)  $\exists x (real(x) \vee rational(x))$
- (B)  $\forall x (real(x) \rightarrow rational(x))$
- (C)  $\exists x (real(x) \wedge rational(x))$
- (D)  $\exists x (rational(x) \rightarrow real(x))$

[gate2012](#) | [mathematical-logic](#) | [easy](#) | [first-order-logic](#)

[Answer](#)

### 3.1.22 First Order Logic: GATE2013\_27 [top](#)

<http://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](#) | [mathematical-logic](#) | [easy](#) | [first-order-logic](#)

[Answer](#)

### 3.1.23 First Order Logic: GATE2013\_47 [top](#)

<http://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](#) [first-order-logic](#)

[Answer](#)

### 3.1.24 First Order Logic: GATE2014-1-1 [top](#)

<http://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.  $\exists x : glitters(x) \wedge \neg gold(x)$

[gate2014-1](#) [mathematical-logic](#) [first-order-logic](#)

[Answer](#)

### 3.1.25 First Order Logic: GATE2014-3-53 [top](#)

<http://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.  $\exists d(Rainy(d) \wedge \neg Cold(d))$

[gate2014-3](#) [mathematical-logic](#) [easy](#) [first-order-logic](#)

[Answer](#)

### 3.1.26 First Order Logic: GATE2015-2\_55 [top](#)

<http://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.  $\forall x \forall y P(x, y) \rightarrow \forall x \forall y P(y, x)$

[gate2015-2](#) [mathematical-logic](#) [normal](#) [first-order-logic](#)

[Answer](#)

### 3.1.27 First Order Logic: GATE2016-2-27 [top](#)

<http://gateoverflow.in/39616>

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.  $\forall x(p(x) \vee q(x)) \implies (\forall x p(x) \vee \forall x q(x))$

[gate2016-2](#) [mathematical-logic](#) [first-order-logic](#) [normal](#)

[Answer](#)

### 3.1.28 First Order Logic: GATE2017-1-02 [top](#)

<http://gateoverflow.in/118701>

Consider the first-order logic sentence  $F : \forall x(\exists yR(x, y))$ . Assuming non-empty logical domains, which of the sentences below are implied by  $F$ ?

- I.  $\exists y(\exists xR(x, y))$
- II.  $\exists y(\forall xR(x, y))$
- III.  $\forall y(\exists xR(x, y))$
- 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

[gate2017-1](#) | [mathematical-logic](#) | [first-order-logic](#)

[Answer](#)

### 3.1.29 First Order Logic: TIFR2010-A-8 [top](#)

<http://gateoverflow.in/18239>

Which of the following is NOT necessarily true? { Notation: The symbol " $\neg$ " notes negation;  $P(x, y)$  means that for given  $x$  and  $y$ , the property  $P(x, y)$  is true }.

- a.  $(\forall x\forall yP(x, y)) \Rightarrow (\forall y\forall xP(x, y))$
- b.  $(\forall x\exists y\neg P(x, y)) \Rightarrow \neg(\exists x\forall yP(x, y))$
- c.  $(\exists x\exists yP(x, y)) \Rightarrow (\exists y\exists xP(x, y))$
- d.  $(\exists x\forall yP(x, y)) \Rightarrow (\forall y\exists xP(x, y))$
- e.  $(\forall x\exists yP(x, y)) \Rightarrow (\exists y\forall xP(x, y))$

[tifr2010](#) | [mathematical-logic](#) | [first-order-logic](#)

[Answer](#)

### 3.1.30 First Order Logic: TIFR2012-A-2 [top](#)

<http://gateoverflow.in/20939>

If Mr. M is guilty, then no witness is lying unless he is afraid. There is a witness who is afraid. Which of the following statements is true?

(Hint: Formulate the problem using the following predicates

$G$  – Mr. M is guilty

$W(x)$  –  $x$  is a witness

$L(x)$  –  $x$  is lying

$A(x)$  –  $x$  is afraid )

- A. Mr. M is guilty.
- B. Mr. M is not guilty.
- C. From these facts one cannot conclude that Mr. M is guilty.
- D. There is a witness who is lying.
- E. No witness is lying.

[tifr2012](#) | [mathematical-logic](#) | [first-order-logic](#)

[Answer](#)

### 3.1.31 First Order Logic: TIFR2012-B-3 [top](#)

<http://gateoverflow.in/25048>

For a person  $p$ , let  $w(p)$ ,  $A(p, y)$ ,  $L(p)$  and  $J(p)$  denote that  $p$  is a woman,  $p$  admires  $y$ ,  $p$  is a lawyer and  $p$  is a judge respectively. Which of the following is the correct translation in first order logic of the sentence: "All woman who are lawyers admire some judge"?

- a.  $\forall x : [(w(x) \Lambda L(x)) \Rightarrow (\exists y : (J(y) \Lambda w(y) \Lambda A(x, y)))]$

- b.  $\forall x : [(w(x) \Rightarrow L(x)) \Rightarrow (\exists y : (J(y) \Lambda A(x, y)))]$   
 c.  $\forall x \forall y : [(w(x) \Lambda L(x)) \Rightarrow (J(y) \Lambda A(x, y))]$   
 d.  $\exists y \forall x : [(w(x) \Lambda L(x)) \Rightarrow (J(y) \Lambda A(x, y))]$   
 e.  $\forall x : [(w(x) \Lambda L(x)) \Rightarrow (\exists y : (J(y) \Lambda A(x, y)))]$

tifr2012 | mathematical-logic | first-order-logic

Answer

### 3.1.32 First Order Logic: TIFR2016-B-4 [top](#)

<http://gateoverflow.in/97634>

In the following,  $A$  stands for a set of apples, and  $S(x, y)$  stands for " $x$  is sweeter than  $y$ ". Let

$$\Psi \equiv \exists x : x \in A$$

$$\Phi \equiv \forall x \in A : \exists y \in A : S(x, y).$$

Which of the following statements implies that there are infinitely many apples (i.e.,  $A$  is an infinite set)?

- A.  $\Psi \wedge \Phi \wedge [\forall x \in A : \neg S(x, x)]$   
 B.  $\Psi \wedge \Phi \wedge [\forall x \in A : S(x, x)]$   
 C.  $\Psi \wedge \Phi \wedge [\forall x, y \in A : S(x, x) \wedge S(x, y) \rightarrow S(y, y)]$   
 D.  $\Psi \wedge \Phi \wedge [\forall x \in A : \neg S(x, x)] \wedge [\forall x, y, z \in A : S(x, y) \wedge S(y, z) \rightarrow S(y, x)]$   
 E.  $\Psi \wedge \Phi \wedge [\forall x \in A : \neg S(x, x)] \wedge [\forall x, y, z \in A : S(x, y) \wedge S(y, z) \rightarrow S(x, z)]$

tifr2016 | mathematical-logic | first-order-logic

Answer

### 3.1.33 First Order Logic: TIFR2017-B-11 [top](#)

<http://gateoverflow.in/95818>

Given that

- $B(x)$  means " $x$  is a bat",
- $F(x)$  means " $x$  is a fly", and
- $E(x, y)$  means " $x$  eats  $y$ ",

what is the best English translation of

$$\forall x(F(x) \rightarrow \forall y(E(y, x) \rightarrow B(y)))?$$

- A. all flies eat bats  
 B. every fly is eaten by some bat  
 C. bats eat only flies  
 D. every bat eats flies  
 E. only bats eat flies

tifr2017 | first-order-logic

Answer

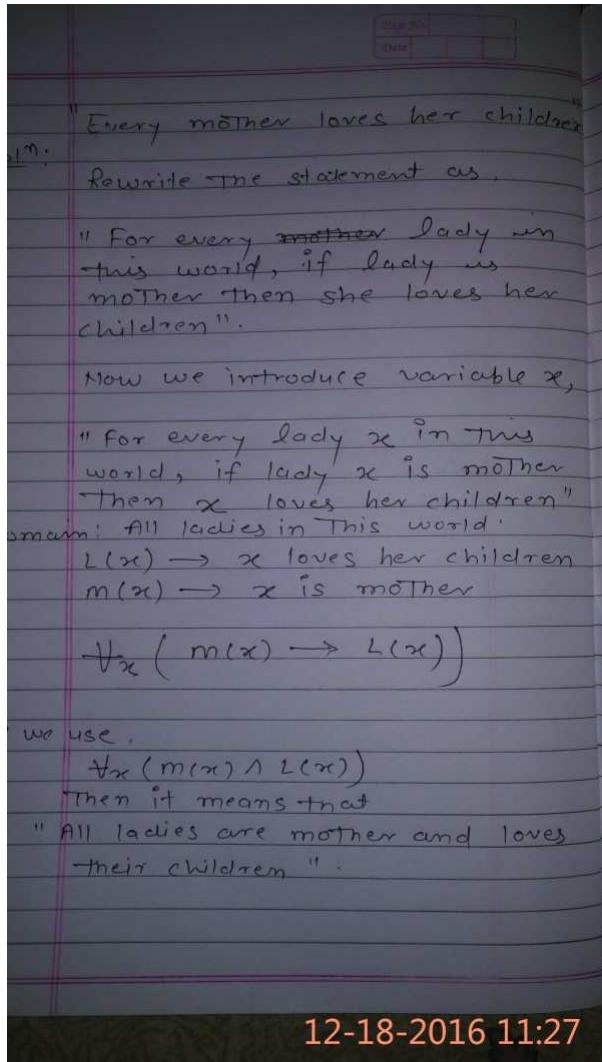
## Answers: First Order Logic

### 3.1.1 First Order Logic: GATE1989-14a [top](#)

<http://gateoverflow.in/93179>

I think this is the approach for this question.

first statement is the correct answer for this question.



4 votes

-- Ravishankar (63 points)

### 3.1.2 First Order Logic: GATE1991-15,b top

<http://gateoverflow.in/26748>



Selected Answer

Let's break it down. Consider an ordered structure (directed graph).

- A.  $\forall x \exists y : R(x, y)$   $\equiv$  Every vertex has atleast 1 outgoing edge.
- B.  $\forall x \forall y : (R(x, y) \implies \neg R(y, x))$   $\equiv$  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.
- C.  $\forall x \forall y \forall z : (R(x, y) \wedge R(y, z) \implies R(x, z))$   $\equiv$  If  $u \rightarrow v \rightarrow z$ , then  $u \rightarrow z$  is also true. That is, our relation  $R(x, y)$  is transitive.
- D.  $\forall x : \neg R(x, x)$   $\equiv$  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,  $\nearrow v_n \rightarrow v_{n+1} \swarrow$

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,  $P(n) \Rightarrow P(n + 1)$ .

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.**

9 votes

-- Pragy Agarwal (19.5k points)

### 3.1.3 First Order Logic: GATE1992\_92,XV top

<http://gateoverflow.in/256>



Selected Answer

(1) 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)

(2) 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.

(3) 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.

(4) 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:

$$\exists(x)(P(x)) \equiv \neg\forall(x)(\neg P(x))$$

23 votes

-- gatecse (13.4k points)

### 3.1.4 First Order Logic: GATE2003-32 [top](#)

<http://gateoverflow.in/922>



Selected Answer

(D) is the answer.

(A) Let  $X = \{3, 6, 9, 8\}$ . Let  $a$  denote multiple of 3 and  $\beta$  denote multiple of 4.  $(\forall x)[a]$  becomes false as 8 is not a multiple of 3, and so  $(\forall x)[a] \Rightarrow (\forall x)[\beta]$  becomes TRUE. Now, this won't imply  $(\forall x)[a \Rightarrow \beta]$  as multiple of 3 doesn't imply multiple of 4 for 3, 6 or 9.

(B) Let  $X = \{3, 6, 9\}$ . Let  $a$  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  $a$  denote multiple of 3 and  $\beta$  denote multiple of 4. Now  $(\forall x)[a \vee \beta]$  becomes false and hence  $LHS = ((\forall x)[a \vee \beta]) \Rightarrow (\exists x)[a]$  becomes true. But RHS is false as 7 is not a multiple of 3.

(D) This is valid. LHS is saying that if  $a$  is holding for any  $x$ , then  $\beta$  also holds for that  $x$ . RHS is saying if  $a$  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  $X = \{4, 8, 12\}$ ,  $a$  denote multiple of 2 and  $\beta$  denote multiple of 4.  $LHS = (\forall x)[a \Rightarrow \beta]$ , 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.

18 votes

-- Arjun Suresh (294k points)

### 3.1.5 First Order Logic: GATE2003-33 [top](#)

<http://gateoverflow.in/923>

Selected Answer

@Arjun Sir plz verify this method.

 $Q_{yy}$  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  $(\forall y)[\neg Q_{xy}]$  $\alpha: (\forall x)[P_x \Leftrightarrow (\forall y)[\neg Q_{xy}]] \Rightarrow (\forall x)[\neg P_x]$ 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  $x$ , It is true irrespective of  $x$  being prime or composite. Even if  $x$  is composite then only its factor divides  $x$  not all values.Now LHS becomes  $(\forall x)[P_x \Leftrightarrow \text{True}]$ , " $P_x \Leftrightarrow \text{True}$ " this means  $P_x$  is True, which is same as writing " $P_x$ " only.Finally, we reduced LHS to  $(\forall x)[P_x]$  $\alpha: (\forall x)[P_x] \Rightarrow (\forall x)[\neg P_x]$ LHS:  $(\forall x)[P_x]$ .LHS is false for  $I_1$  bcoz not all  $x$  are primes False  $\Rightarrow$  Anything is True. For  $I_1$   $\alpha$  is true hence  $I_1$  satisfies  $\alpha$ .Similarly, LHS is false for  $I_2$  also bcoz not all  $x$  are composite. hence  $I_2$  satisfies  $\alpha$ .

Option D.

24 votes

-- Sachin Mittal (7.1k 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.

25 votes

-- Arjun Suresh (294k points)

### 3.1.6 First Order Logic: GATE2004-23, ISRO2007-32 [top](#)

<http://gateoverflow.in/1020>

Selected Answer

Now many people get confused when to use  $\wedge$  and when to use  $\rightarrow$ . 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  $\rightarrow$  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 atleast a boy in class. So we want to proceed with " $(\exists x) (boy(x) \wedge$ " and not " $(\exists x) (boy(x) \rightarrow$ ", 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)

138 votes

-- Anu (10,6k points)

### 3.1.7 First Order Logic: GATE2004-IT-3 [top](#)

<http://gateoverflow.in/3644>



Selected Answer

$$\begin{aligned}
 & (\exists x)(\forall y)[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)] \\
 &= \neg(\forall x)\neg(\forall y)[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)] \\
 & (\because (\exists x)F(x) = \neg\forall x\neg F(x)) \\
 &= \neg(\forall x)(\exists y)\neg[(a(x, y) \wedge b(x, y)) \wedge \neg c(x, y)] \\
 & (\because (\forall x)F(x) = \neg\exists x\neg F(x), \neg\neg F(x) = F(x)) \\
 &= \neg(\forall x)(\exists y)[\neg(a(x, y) \wedge b(x, y)) \vee c(x, y)] \\
 &= \neg(\forall x)(\exists y)[(a(x, y) \wedge b(x, y)) \rightarrow c(x, y)]
 \end{aligned}$$

(C) choice.

14 votes

-- Arjun Suresh (294k points)

### 3.1.8 First Order Logic: GATE2005-41 [top](#)

<http://gateoverflow.in/1166>



Selected Answer

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.

13 votes

-- Manali (2,8k points)

### 3.1.9 First Order Logic: GATE2005-IT-36 [top](#)

<http://gateoverflow.in/3783>



Selected Answer

Answer: B

Let P: Student is a girl.

and Q: Student is smart.

Option B says: IF for all student  $x$  if  $x$  is a girl then the student is smart THEN if the whole class comprises of girls then the

whole class comprises of smart students.

19 votes

-- Rajarshi Sarkar (35k points)

### 3.1.10 First Order Logic: GATE2006-26 [top](#)

<http://gateoverflow.in/989>



Selected Answer

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. Don't get confused by "and" between tigers and lions in the statement. This "and" doesn't mean that we will write " $\text{tiger}(x) \wedge \text{lion}(x)$ ", 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)

12 votes

-- Anu (10,6k points)

### 3.1.11 First Order Logic: GATE2006-IT-21 [top](#)

<http://gateoverflow.in/3560>



Selected Answer

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.

31 votes

-- Arjun Suresh (294k points)

### 3.1.12 First Order Logic: GATE2007-22 [top](#)

<http://gateoverflow.in/1120>



Selected Answer

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

14 votes

-- Manali (2,8k points)

### 3.1.13 First Order Logic: GATE2007-IT-21 [top](#)

<http://gateoverflow.in/3454>



Selected Answer

(A) is the answer

(A)

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  $x$ .

24 votes

-- Arjun Suresh (294k points)

### 3.1.14 First Order Logic: GATE2008-30 [top](#)

<http://gateoverflow.in/441>



Selected Answer

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

$\forall$

$x(\text{fs})$

1 22 votes

-- Arjun Suresh (294k points)

### 3.1.15 First Order Logic: GATE2008-IT-21 [top](#)

<http://gateoverflow.in/3282>



Selected Answer

- 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,

$$\text{RHS} \implies \text{LHS and LHS} \implies \text{RHS}.$$

- 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,

$$\text{RHS} \implies \text{LHS and LHS} \implies \text{RHS}.$$

- 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,

$$\text{RHS} \implies \text{LHS and LHS} \implies \text{RHS}.$$

- 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,

$$\text{RHS} \implies \text{LHS and LHS} \implies \text{RHS}.$$

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.

19 votes

-- Arjun Suresh (294k points)

$$[(\exists x, \alpha(x)) \rightarrow \beta] \rightarrow [\forall x, \alpha(x) \rightarrow \beta]$$

$$\text{LHS} \Rightarrow (\exists x, \alpha(x)) \rightarrow \beta$$

$(\sim \exists x, \alpha(x)) \vee \beta \rightarrow (\forall x, \sim \alpha(x)) \vee \beta \rightarrow (\forall x, (\sim \alpha(x) \vee \beta))$  (I can change scope of  $\forall x$  as B do not have x as free variable in it.)

$(\forall x, (\alpha(x) \rightarrow \beta))$  Proved !

C is correct

18 votes

-- Akash (43.8k points)

### 3.1.16 First Order Logic: GATE2008-IT-22 [top](#)



Selected Answer

$$[\forall x, \alpha \rightarrow (\exists y, \beta \rightarrow (\forall u, \exists v, y))] = [\forall x, \neg \alpha \vee (\exists y, \neg \beta \vee (\forall u, \exists v, y))]$$

Now, doing complement gives (complement of  $\forall$  is  $\exists$  and vice versa while propagating negation inwards as  $\forall x (P) = \neg \exists x (\neg P)$  and  $\exists x (P) = \neg \forall x (\neg P)$ )

$$[\exists x, \alpha \wedge (\forall y, \beta \wedge (\exists u, \forall v, \neg y))]$$

D choice

21 votes

-- Arjun Suresh (294k points)

### 3.1.17 First Order Logic: GATE2009-23 [top](#)



Selected Answer

The statement could be translated as, If  $x$  is either Gold or Silver,  
Answer is D. 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.

26 votes

-- Sona Praneeth Akula (4k points)

### 3.1.18 First Order Logic: GATE2009-26 [top](#)



Selected Answer

**Option B is correct. I and IV are equivalent.**

$$\neg \forall x (P(x)) = \exists x (\neg P(x)) \quad [\text{De morgan's Law}]$$

**Alternate approach:**

Let's take an **example**.

Let  $P(x)$  = Student  $x$  is pass.

I  $\rightarrow$  Not all students are pass. (which means "Some students are fail")

II  $\rightarrow$  There doesn't exist a student who is pass. (which means "Every student is fail")

III  $\rightarrow$  There doesn't exist a student who is not pass (which means "Every student is pass")

IV  $\rightarrow$  Some students are not pass. (which means "Some students are fail")

I and IV are equivalent.

4 votes

-- Soumya Jain (1.6k points)

I and IV are equal

12 votes

-- Bhagirathi Nayak (13.3k points)

### 3.1.19 First Order Logic: GATE2010-30 [top](#)

<http://gateoverflow.in/1158>

Selected Answer

$F(x, y, t) = \text{person } x \text{ can fool person } y \text{ at time } t.$

For the sake of simplicity propagate negation sign outward by applying de morgan's law.

$\forall x \exists y \exists t (\neg F(x, y, t)) = \neg \exists x \forall y \forall t (F(x, y, t))$  [By applying de morgan's law.]

Now converting  $\neg \exists x \forall y \forall t (F(x, y, t))$  in english is simple.

$\neg \exists x \forall y \forall t (F(x, y, t)) = \text{There doesn't exist a person who can fool everyone all the time.}$

Which means No one can fool everyone all the time.

So **option B is correct.**

8 votes

-- Soumya Jain (1.6k 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.

$$\forall x \exists y \exists t (\neg F(x, y, t)) = \neg (\neg \forall x \neg \exists y \neg \exists t) (\neg F(x, y, t)) = \neg (\neg \forall x \neg \exists y \neg \exists t (F(x, y, t))) = \neg (\exists x \forall y \forall t (F(x, y, t)))$$

33 votes

-- Bhagirathi Nayak (13.3k points)

### 3.1.20 First Order Logic: GATE2011\_30 [top](#)

<http://gateoverflow.in/2132>

Selected Answer

Answer is **A.**

$P(x) = (\neg(x = 1) \wedge \forall y (\exists z (x = y * z) \Rightarrow ((y = x) \vee (y = 1))))$  Statement: x is not equal to 1 and if there exists some z for all y such that product of y and

alternative approach ,

the formula

$$\exists x \forall y \forall z [x(y, z, x) \rightarrow ((y = 1) \vee (z = 1))]$$

expresses the statement "there exists a prime number" (the number 1 also satisfies this statement).

Note here that  $x(y, z, x)$  is equivalent to  $(x = y \times z)$ .

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>

20 votes

-- Sona Praneeth Akula (4k points)

### 3.1.21 First Order Logic: GATE2012\_13 [top](#)

<http://gateoverflow.in/45>

Selected Answer

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.

19 votes

-- Arjun Suresh (294k points)

### 3.1.22 First Order Logic: GATE2013\_27 [top](#)

<http://gateoverflow.in/1538>

Selected Answer

- 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

24 votes

-- Bhagirathi Nayak (13.3k points)

Best way to answer this kind of question...

 $F(x)=x$  is my friend $P(x)=x$  is perfect*"None of my friends are perfect" it can be written like this* $\forall x[F(x) \rightarrow \neg P(x)]$  $=\forall x[\neg F(x) \vee \neg P(x)]$  $=\forall x[\neg F(x) \wedge P(x)]$  $=\neg \exists x[F(x) \wedge P(x)]$ 

so answer is D

13 votes

-- vnc (6.2k points)

### 3.1.23 First Order Logic: GATE2013\_47 [top](#)

<http://gateoverflow.in/88>

Selected Answer

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:

$$A: \forall x(\exists z(\neg \beta) \rightarrow \forall y(\alpha))$$

$$\implies \forall x(\neg \exists z(\neg \beta) \vee \forall y(\alpha))$$

$$\begin{aligned} &\implies \forall x(\forall z(\beta) \vee \forall y(\alpha)) \\ &\implies \neg \exists x \neg (\forall z(\beta) \vee \forall y(\alpha)) \\ &\implies \neg \exists x(\neg \forall z(\beta) \wedge \neg \forall y(\alpha)) \end{aligned}$$

So, A is not matching with the logical statement in question.

B:  $\forall x(\forall z(\beta) \rightarrow \exists y(\neg \alpha))$

$$\begin{aligned} &\implies \forall x(\neg \forall z(\beta) \vee \exists y(\neg \alpha)) \\ &\implies \neg \exists x \neg (\neg \forall z(\beta) \vee \exists y(\neg \alpha)) \\ &\implies \neg \exists x(\forall z(\beta) \wedge \neg \exists y(\neg \alpha)) \\ &\implies \neg \exists x(\forall z(\beta) \wedge \forall y(\alpha)) \end{aligned}$$

Hence matches with the given statement.

C.  $\forall x(\forall y(\alpha) \rightarrow \exists z(\neg \beta))$

$$\begin{aligned} &\implies \forall x(\neg \forall y(\alpha) \vee \exists z(\neg \beta)) \\ &\implies \neg \exists x \neg (\neg \forall y(\alpha) \vee \exists z(\neg \beta)) \\ &\implies \neg \exists x(\forall y(\alpha) \wedge \neg \exists z(\neg \beta)) \\ &\implies \neg \exists x(\forall y(\alpha) \wedge \forall z(\beta)) \end{aligned}$$

Hence matches with the given statement.

D:  $\forall x(\exists y(\neg \alpha) \rightarrow \exists z(\beta))$

$$\begin{aligned} &\implies \forall x(\neg \exists y(\neg \alpha) \vee \exists z(\beta)) \\ &\implies \forall x(\forall y(\alpha) \vee \exists z(\beta)) \\ &\implies \neg \exists x \neg (\forall y(\alpha) \vee \exists z(\beta)) \\ &\implies \neg \exists x(\neg \forall y(\alpha) \wedge \neg \exists z(\beta)) \\ &\implies \neg \exists x(\neg \forall y(\alpha) \wedge \forall z(\neg \beta)) \end{aligned}$$

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

 21 votes

-- Arjun Suresh (294k points)

### 3.1.24 First Order Logic: GATE2014-1-1 [top](#)

<http://gateoverflow.in/769>



Selected Answer

"Not all that glitters is gold" can be expressed as :

$$\neg(\forall x(\text{glitters}(x) \rightarrow \text{gold}(x)))$$

(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.**

3 votes

-- Soumya Jain (1.6k points)

### 3.1.25 First Order Logic: GATE2014-3-53 [top](#)



Selected Answer

Not all rainy days are cold.

In other words it says "Some rainy days are cold" or "Some rainy days are not cold"

Given statement is

$$\begin{aligned} & \neg \forall d [R(d) \rightarrow C(d)] \\ \Leftrightarrow & \neg \forall d [\neg R(d) \vee C(d)] \\ \Leftrightarrow & \exists d [R(d) \wedge \neg C(d)] \\ \text{D)} \end{aligned}$$

13 votes

-- Srinath Jayachandran (3.7k 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

16 votes

-- Manali (2.8k points)

### 3.1.26 First Order Logic: GATE2015-2\_55 [top](#)



Selected Answer

Ans C.

$$(P \rightarrow Q) \leftrightarrow (\neg P \vee Q)$$

D is wrong as shown below.

Let  $S = \{2, 3, 4, 5\}$  and  $P(x, y)$  be  $x < y$ .

Now,  $P(2, 3)$  is true but  $P(3, 2)$ ,  $P(4, 2)$  etc are false and hence the implication also.

This is because the given formula is evaluated as:

$$\forall x \forall y (P(x, y) \rightarrow \forall x \forall y P(y, x))$$

For every  $(x, y)$  if  $P(x, y)$  is true then for every  $(x, y)$   $P(y, x)$  is true.

On the RHS,  $P(y, x)$  can be replaced with  $P(x, y)$  and then also the formula means the same. So, here precedence rule used is  $\rightarrow$  having more precedence than quantification which is against the convention used in Wikipedia. I guess all books only talk about conventions and there is no standard here. C option being so straight forward I guess, GATE didn't even consider this as an ambiguity. Also, it works only if  $x, y$  belongs to same domain.

The below one is a tautology provided  $x, y$  have the same domain.

$$(\forall x \forall y P(x, y)) \rightarrow (\forall x \forall y P(y, x))$$

If  $P(x, y)$  is true for all  $(x, y)$ , then  $P(y, x)$  is true for all  $(x, y)$ .

18 votes

-- Vikrant Singh (13.4k points)

### 3.1.27 First Order Logic: GATE2016-2-27 [top](#)



Selected Answer

Here D is not valid

Let me prove by example

What D is saying here is something like this

For all  $x$  ( $x$  is even no or  $x$  is odd no)  $\Rightarrow$  For all  $x$  ( $x$  is even no) or For all  $x$  ( $x$  is odd no) this is surely wrong. So

Ans  $\Rightarrow$  D

22 votes

-- Akash (43.8k points)

### 3.1.28 First Order Logic: GATE2017-1-02 [top](#)



Selected Answer

**Ans is B.**

1st Method:  $F : \forall x(\exists yR(x, y))$

Take option 4 :  $\neg\exists x(\forall y\neg R(x, y))$

$\forall x(\exists yR(x, y))$  ( Since we know  $\sim\forall x = \exists x$  And  $\sim\exists x = \forall x$  )

**F: For all girls there exist a boyfriend. (Given)**

( $x$  for girl &  $y$  for boys)

I: There exists some boys who have girlfriends. (**True**)

II: There exists some boys for which 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 F)

11 votes

-- Ahwan Mishra (5.3k points)

### 3.1.29 First Order Logic: TIFR2010-A-8 [top](#)



Selected Answer

a is TRUE as both LHS and RHS are equivalent- English would be for every  $x$ , and for every  $y$ ,  $P(x, y)$  is TRUE. Changing  $y$  and  $x$  wouldn't change the meaning.

b is TRUE as both LHS and RHS are equivalent- RHS is obtained by double negation of LHS.

c. Similar to a, both are equivalent.

d.

- LHS: For some  $x$ , for all  $y$ ,  $P(x, y)$  is TRUE.
- RHS: For all  $y$  and for some  $x$ ,  $P(x, y)$  is TRUE.

Both are not equivalent. LHS is stronger and implies RHS. For example, on the natural number set, we have  $x = 1$  such that for every  $y$ ,  $P(x \leq y)$  is TRUE. Clearly, this implies for all  $y$  there exists some  $x$  (here  $x$  could be different for different  $y$  but on LHS, it must be the same).

e.

- LHS: For all  $x$  and for some  $y$ ,  $P(x, y)$  is TRUE.
- RHS: For some  $y$  and for all  $x$ ,  $P(x, y)$  is TRUE.

As explained in d, these are not equivalent and here RHS is stronger than LHS, making the implication false. For example consider the " $\leq$ " relation on the integer set. LHS is true here as for every integer we have another integer which is greater. But RHS is false as there is no single integer (infinity is not an integer) which is greater than all other integers.

Hence, E). is not necessarily TRUE.

9 votes

-- Arjun Suresh (294k points)

### 3.1.30 First Order Logic: TIFR2012-A-2 [top](#)

<http://gateoverflow.in/20939>



Selected Answer

If Mr.  $M$  is guilty, then if we pick a witness, we know that the witness won't lie unless he is afraid. If the witness is afraid, it may lie or it may not lie (nothing is guaranteed).

However, unless we know what the victim said in the court (whether he said that Mr.  $M$  was guilty or not guilty), we can't say anything about Mr.  $M$ .

All we know is that we've a witness who is afraid, so he may or may not lie in the court. We haven't been told anything about what actually happened in the court proceeding.

So, we can't logically conclude anything about Mr.  $M$  being guilty or not guilty.

**Thus, options a and b are False.**

Furthermore, that witness who was afraid, he may or may not lie. Since he is afraid, we know that he "can" lie, but we're not guaranteed that he will lie.

**Thus, options d and e are False too.**

This leaves option c, and as we have seen earlier, we cannot conclude anything about Mr.  $M$  being guilty or not guilty.

**Hence, option c is the correct answer.**

Although not necessary, the logic equivalent of the given statement will be:

$$G \implies \neg \exists x : W(x) \wedge L(x) \wedge \neg A(x)$$

$$\equiv$$

$$G \implies \forall x : W(x) \implies$$

11 votes

-- Pragy Agarwal (19.5k points)

### 3.1.31 First Order Logic: TIFR2012-B-3 [top](#)

<http://gateoverflow.in/25046>



Selected Answer

Just translating to English:

- a. Every women who is a lawyer admires some women judge.
- b. If a person being women implies she is a lawyer then she admires some judge. OR If a person is not women or is a lawyer he/she admires some judge.
- c. Every women who is a lawyer admires every judge.
- d. There is some judge who is admired by every women lawyer.
- e. Every women lawyer admire some judge.

So, option E is the answer.

11 votes

-- Arjun Suresh (294k points)

### 3.1.32 First Order Logic: TIFR2016-B-4 [top](#)

<http://gateoverflow.in/97634>



Selected Answer

**Here is my Approach ....i am also getting (E) as the answer**

let A be {1,2} (say apple 1, apple 2)

there is atleast one element in A : satisfied

for every element x in A there is a y in A such that S(x,y) : Since nothing is told about the symmetry of the relation, we can have S(1,2) and S(2,1) : so,satisfied

So as of now, A = {1,2} and S={(1,2),(2,1)}

now we can go throught the options :

(A) S(x,x) is not possible ....i dont have that in S ....so satisfied ....and still finite A

(B) S(x,x) should be there.....well, i will make S={(1,2)(2,1),(1,1),(2,2)}....satisfied and still finite A

(C) take the same case as above ....satisfied and still finite A

(D) Now i cant have (1,1) and (2,2)

but even with S={(1,2).(2,1)} this condition is satisfied ....still finite A

(E) i cant do this with (1,2) and (2,1) ...because the trasitivity makes it (1,1) which should not be there ....and whatever elements i add the transitivity will lead me to (x,x) .....because any element added to A should occur atleast once in the left side of an ordered pair.....so only solution is infinite A ...

4 votes

-- Anand Vijayan (883 points)

### 3.1.33 First Order Logic: TIFR2017-B-11 [top](#)

<http://gateoverflow.in/95818>



Selected Answer

If  $x$  is a fly, then for all  $y$  which eats  $x$ ,  $y$  is a bat. This means only bats eat flies. Option E.

9 votes

-- Arjun Suresh (294k points)

## 3.2

### Logical Reasoning(10) [top](#)

#### 3.2.1 Logical Reasoning: CMI2013-A-07 [top](#)

<http://gateoverflow.in/46597>

Consider the following two statements.

1. There are infinitely many interesting whole numbers.
2. There are finitely many uninteresting whole numbers.

Which of the following is true?

- A. Statements 1 and 2 are equivalent.
- B. Statement 1 implies statement 2.
- C. Statement 2 implies statement 1.
- D. None of the above.

[cmi2013](#) [mathematical-logic](#) [logical-reasoning](#)

Answer

#### 3.2.2 Logical Reasoning: GATE2012\_1 [top](#)

<http://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 | mathematical-logic | easy | logical-reasoning

Answer

### 3.2.3 Logical Reasoning: GATE2015-2\_3 [top](#)

<http://gateoverflow.in/8049>

Consider the following two statements.

- S1: If a candidate is known to be corrupt, then he will not be elected
- S2: If a candidate is kind, he will be elected

Which one of the following statements follows from S1 and S2 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

gate2015-2 | mathematical-logic | normal | logical-reasoning

Answer

### 3.2.4 Logical Reasoning: GATE2015-3\_24 [top](#)

<http://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

gate2015-3 | mathematical-logic | difficult | logical-reasoning

Answer

### 3.2.5 Logical Reasoning: TIFR2010-A-4 [top](#)

<http://gateoverflow.in/10212>

If the bank receipt is forged, then Mr. M is liable. If Mr. M is liable, he will go bankrupt. If the bank will loan him money, he will not go bankrupt. The bank will loan him money.

Which of the following can be concluded from the above statements?

- a. Mr. M is liable
- b. The receipt is not forged
- c. Mr. M will go bankrupt
- d. The bank will go bankrupt

- e. None of the above

[tifr2010](#) [logical-reasoning](#) [mathematical-logic](#)

[Answer](#)

### 3.2.6 Logical Reasoning: TIFR2011-A-1 [top](#)

<http://gateoverflow.in/237>

If either wages or prices are raised, there will be inflation. If there is inflation, then either the government must regulate it or the people will suffer. If the people suffer, the government will be unpopular. Government will not be unpopular. Which of the following can be validly concluded from the above statements.

- A. People will not suffer
- B. If the inflation is not regulated, then wages are not raised
- C. Prices are not raised
- D. If the inflation is not regulated, then the prices are not raised
- E. Wages are not raised

[tifr2011](#) [mathematical-logic](#) [normal](#) [logical-reasoning](#)

[Answer](#)

### 3.2.7 Logical Reasoning: TIFR2011-A-12 [top](#)

<http://gateoverflow.in/2022>

The action for this problem takes place in an island of Knights and Knaves, where Knights always make true statements and Knaves always make false statements and everybody is either a Knight or a Knave. Two friends A and B lives in a house. The census taker (an outsider) knocks on the door and it is opened by A. The census taker says "I need information about you and your friend. Which if either is a Knight and which if either is a Knave?". "We are both Knaves" says A angrily and slams the door. What, if any thing can the census taker conclude?

- A. A is a Knight and B is a Knave.
- B. A is a Knave and B is a Knight.
- C. Both are Knaves.
- D. Both are Knights.
- E. No conclusion can be drawn.

[tifr2011](#) [mathematical-logic](#) [logical-reasoning](#)

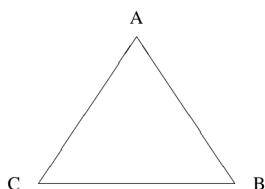
[Answer](#)

### 3.2.8 Logical Reasoning: TIFR2012-A-3 [top](#)

<http://gateoverflow.in/20981>

Long ago,in a planet far far away, there lived three races of intelligent inhabitants: the blues (who always tell the truth), the whites (who always lie), and the pinks (who, when asked a series of questions, start with a lie and then tell the truth and lie alternately). To three creatures, chosen from the planet and seated facing each other at A, B, and C (see figure), the following three questions are put:

- (i) What race is your left-hand neighbour?
- (ii) What race is your right-hand neighbour?
- (iii) What race are you?



Here are their answers:

- (A) (i) White (ii) Pink (iii) Blue
- (B) (i) Pink (ii) Pink (iii) Blue

(C) (i) White (ii) Blue (iii) Blue

What is the actual race of each of the three creatures?

- A.  $A$  is Pink,  $B$  is White,  $C$  is Blue.
- B.  $A$  is Blue,  $B$  is Pink,  $C$  is White.
- C.  $A$  is Pink,  $B$  is Blue,  $C$  is Pink.
- D.  $A$  is White,  $B$  is Pink,  $C$  is Blue.
- E. Cannot be determined from the above data.

[tifr2012](#) [mathematical-logic](#) [logical-reasoning](#)

[Answer](#)

### 3.2.9 Logical Reasoning: TIFR2013-A-3 [top](#)

<http://gateoverflow.in/25384>

Three candidates, Amar, Birendra and Chanchal stand for the local election. Opinion polls are conducted and show that fraction  $a$  of the voters prefer Amar to Birendra, fraction  $b$  prefer Birendra to Chanchal and fraction  $c$  prefer Chanchal to Amar. Which of the following is impossible?

- a.  $(a, b, c) = (0.51, 0.51, 0.51);$
- b.  $(a, b, c) = (0.61, 0.71, 0.67);$
- c.  $(a, b, c) = (0.68, 0.68, 0.68);$
- d.  $(a, b, c) = (0.49, 0.49, 0.49);$
- e. None of the above.

[tifr2013](#) [set-theory&algebra](#) [logical-reasoning](#)

[Answer](#)

### 3.2.10 Logical Reasoning: TIFR2014-A-8 [top](#)

<http://gateoverflow.in/25994>

All that glitters is gold. No gold is silver.

Claims:

- (1) No silver glitters.
- (2) Some gold glitters.

Then, which of the following is TRUE?

- a. Only claim 1 follows.
- b. Only claim 2 follows.
- c. Either claim 1 or claim 2 follows but not both.
- d. Neither claim 1 nor claim 2 follows.
- e. Both claim 1 and claim 2 follow.

[tifr2014](#) [mathematical-logic](#) [logical-reasoning](#)

[Answer](#)

## Answers: Logical Reasoning

### 3.2.1 Logical Reasoning: CMI2013-A-07 [top](#)

<http://gateoverflow.in/46597>



Selected Answer

As we know that there are infinite whole numbers.

Now if we say that all even whole numbers are interesting whole number then we will have **infinite interesting** whole numbers and **infinite uninteresting** whole numbers (odd whole number).

Now if we say that whole numbers between **1 to 100** are interesting whole number then we will have **finite**

**interesting** whole numbers and **infinite uninteresting** whole numbers (whole numbers excluding 1 to 100 ).

So from second example we can say that -

If there are finitely many uninteresting whole numbers, then there are infinitely many interesting whole numbers. But we can't say anything about the converse i.e., if there are infinitely many interesting whole numbers then there are finitely many uninteresting whole numbers.

Ans- C

4 votes

-- Dhananjay Kumar Sharma (25.2k points)

### 3.2.2 Logical Reasoning: GATE2012\_1 [top](#)

<http://gateoverflow.in/33>



Selected Answer

$I_1$  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.

18 votes

-- Arjun Suresh (2.94k points)

### 3.2.3 Logical Reasoning: GATE2015-2\_3 [top](#)

<http://gateoverflow.in/8049>



Selected Answer

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.

24 votes

-- Anoop Sonkar (4.8k points)

### 3.2.4 Logical Reasoning: GATE2015-3\_24 [top](#)

<http://gateoverflow.in/8427>



Selected Answer

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  $\neg A \wedge \neg B$  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.

27 votes

-- Arjun Suresh (294k points)

we do not know what is the person from whom those words are coming from, we 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 imply 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**

28 votes

-- Amar Vashishth (28.7k points)

### 3.2.5 Logical Reasoning: TIFR2010-A-4 [top](#)



Selected Answer

Let us denote sentences with variables F:Bank receipt is forged

L:Mr M is liable

B:He will go bankrupt

M:Bank loan him money

1.F->L

2.L->B

3.M->B'

4.M

From 3 and 4 modus ponens we get

5.B'

From 2 and 5 modus tollens we get

6.L'

From 1 and 6 modus tollens we get

F'

Ans is bank receipt is not forged

7 votes

-- Pooja Palod (32.4k points)

### 3.2.6 Logical Reasoning: TIFR2011-A-1 [top](#)

<http://gateoverflow.in/237>



Selected Answer

It is told in the question "If the people suffer, the government will be unpopular". And "government will not be unpopular" means, people will not suffer.

It is like  $A \rightarrow B$  is true and  $\sim B$  is given. So,  $\sim A$  must be true.

So, (a) is valid (always true).

Lets take the English meaning

Government will not be unpopular

- $\implies$  People will not suffer
- $\implies$  Either no inflation or government regulates it
- $\implies$  If no regulation then no inflation
- $\implies$  if no regulation then no wage or price rise

So, (b) and (d) are valid (always true) and (c) and (e) are not valid.

8 votes

-- Arjun Suresh (294k points)

### 3.2.7 Logical Reasoning: TIFR2011-A-12 [top](#)

<http://gateoverflow.in/20221>



Selected Answer

Option B should be the correct answer, that is A is a Knave & B is a Knight.

A must be either a Knight or a Knave.

Suppose A is a Knight, it means that the statement "We are both Knaves." must be true.

This is contradicting our assumption.

So the assumption that "A is a Knight" is not logically satisfiable simultaneously with the statement he made, which implies that A must be a Knave.

Now since A is a Knave, the statement made by him : "We are both Knaves." must be false.

The statement "We are both Knaves." will be false in any one of the following 3 conditions :

1. A is a Knight, B is a Knave.
2. A is a Knave, B is a Knight.
3. A is a Knight, B is a Knight.

But since we have already deduced that A is a Knave so in order to make the statement "We are both Knaves." false, we are only left with condition 2.

So B must be a Knight.

10 votes

-- Anurag Pandey (13.1k points)

### 3.2.8 Logical Reasoning: TIFR2012-A-3 [top](#)

<http://gateoverflow.in/20981>



Selected Answer

If A is Blue (honest), then

- Whatever A says about B and C must be True.
- A says that B is White(liar) and C is Pink(alternating). So, if A is Blue, B must be White and C must be Pink.
- B says that C is Pink. But B is a liar, and B agrees with A on the race of C (they must not agree). Thus, we reached a contradiction.

So, A can't be Blue.

If B is Blue (honest), then

- Whatever B says about A and C must be True.
- B says that A is Pink(alternating) and C is Pink(alternating). So, if B is Blue, A must be Pink and C must be Pink.
- Since A is pink, it must lie about B, say the truth about C and then lie about itself. Which it does.
- Since C is pink, it must lie about A, say the truth about B, and then lie about itself. Which it does.

**So we see that Blue B, Pink A and Pink C is a possible solution!**

**Thus, option C is correct.**

**However**, there is another option e, which says Cannot be determined from the above data.

So, what if there are multiple solutions that satisfy these constraints? If that is the case, option e will be correct. Sadly, there is no way of proving that no other solutions work except checking each one of them (using branch and bound to somewhat improve). Sadly, that will be lengthy.

Here is a Python3 program that finds all solutions to this problem: <http://ideone.com/7EFXCn>

8 votes

-- Pragy Agarwal (19.5k points)

### 3.2.9 Logical Reasoning: TIFR2013-A-3 [top](#)

<http://gateoverflow.in/2538>



Selected Answer

6 preference order for voter are possible:

ABC,ACB,BCA,BAC,CAB,CBA also Given that

$$a=ABC+ACB+CAB \quad (A \text{ prefer over } B) \quad (1)$$

$$b=BCA+BAC+ABC \quad (B \text{ prefer over } C) \quad (2)$$

$$c=CAB+CBA+BCA \quad (C \text{ prefer over } A) \quad (3)$$

Adding 1,2 and 3 we get

$$a+b+c=2(ABC+BCA+CAB)+ACB+BAC+CAB$$

Now we know that  $ABC+ACB+BAC+BCA+CAB+CBA=1$  therefore

$$[ABC+ACB+BAC+BCA+CAB+CBA] < [2(ABC+BCA+CAB)+ACB+BAC+CAB] < 2(ABC+ACB+BAC+BCA+CAB+CBA)$$

Hence we can say that value of  $a+b+c$  must be between 1 and 2

option c value greater than 2 hence correct answer is c

8 votes

-- Saurav Shrivastava (1.4k points)

### 3.2.10 Logical Reasoning: TIFR2014-A-8 [top](#)

<http://gateoverflow.in/2599>



Selected Answer

**The correct answer is option a) Only claim 1 follows.**



$\text{Glitters}(x) \implies \text{Gold}(x) \implies \neg \text{Silver}(x)$ . Hence, Claim 1 follows. If something Glitters, it cannot be Silver.

#### For claim 2:

The set of things that Glitter could be empty.

We can still assert that All that Glitters is Gold, because nothing Glitters in the first place.

So, in the case when nothing Glitters, there is no Gold that Glitters. Glitters is still a subset of Gold, but there is no element in the subset Glitters.



18 votes

-- Pragy Agarwal (19.5k points)

### 3.3

### Propositional Logic(36) top

#### 3.3.1 Propositional Logic: GATE 2016-1-1 top

<http://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 \_\_\_\_\_.

[gate2016-1](#) [mathematical-logic](#) [normal](#) [numerical-answers](#) [propositional-logic](#)
**Answer**

### 3.3.2 Propositional Logic: GATE 2016-2-01 [top](#)

<http://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 \_\_\_\_\_.

[gate2016-2](#) [mathematical-logic](#) [normal](#) [numerical-answers](#) [propositional-logic](#)
**Answer**

### 3.3.3 Propositional Logic: GATE1987-10e [top](#)

<http://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](#)
**Answer**

### 3.3.4 Propositional Logic: GATE1988-2vii [top](#)

<http://gateoverflow.in/83947>

Define the validity of a well-formed formula(wff)

[gate1988](#) [descriptive](#) [mathematical-logic](#) [propositional-logic](#)
**Answer**

### 3.3.5 Propositional Logic: GATE1989-3-v [top](#)

<http://gateoverflow.in/87128>

Answer the following:

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](#)
**Answer**

### 3.3.6 Propositional Logic: GATE1990-3-x [top](#)

<http://gateoverflow.in/84861>

Choose the correct alternatives (More than one may be correct).

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](#)
**Answer**

### 3.3.7 Propositional Logic: GATE1991\_03,xii [top](#)

<http://gateoverflow.in/528>

Choose the correct alternatives (more than one may be correct) and write the corresponding letters only:

If  $F_1$ ,  $F_2$  and  $F_3$  are propositional formulae such that  $F_1 \wedge F_2 \rightarrow F_3$  and  $F_1 \wedge F_2 \rightarrow \neg F_3$  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](#)

[Answer](#)

### 3.3.8 Propositional Logic: GATE1992\_02,xvi [top](#)

<http://gateoverflow.in/574>

Choose the correct alternatives (more than one may be correct) and write the corresponding letters only:

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](#)

[Answer](#)

### 3.3.9 Propositional Logic: GATE1993\_18 [top](#)

<http://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](#)

[Answer](#)

### 3.3.10 Propositional Logic: GATE1993\_8.2 [top](#)

<http://gateoverflow.in/2300>

The proposition  $p \wedge (\neg p \vee q)$  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](#)

### 3.3.11 Propositional Logic: GATE1994\_3.13 [top](#)

<http://gateoverflow.in/2499>

Let  $p$  and  $q$  be propositions. Using only the Truth Table, decide whether

$$p \iff q \text{ does not imply } p \rightarrow \neg q$$

is **True** or **False**.

[gate1994](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

[Answer](#)

### 3.3.12 Propositional Logic: GATE1995\_13 [top](#)

<http://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](#)

[Answer](#)

### 3.3.13 Propositional Logic: GATE1995\_2.19 [top](#)

<http://gateoverflow.in/2631>

If the proposition  $\neg p \rightarrow v$  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

- a) True
- b) Multiple Values
- c) False
- d) Cannot be determined

[gate1995](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

[Answer](#)

### 3.3.14 Propositional Logic: GATE1996\_2.3 [top](#)

<http://gateoverflow.in/2732>

Which of the following is false? Read  $\wedge$  as AND,  $\vee$  as OR,  $\sim$  as NOT,  $\rightarrow$  as one way implication and  $\leftrightarrow$  as two way implication

- A.  $((x \rightarrow y) \wedge x) \rightarrow y$
- B.  $((\sim x \rightarrow y) \wedge (\sim x \rightarrow \sim y)) \rightarrow x$
- C.  $(x \rightarrow (x \vee y))$
- D.  $((x \vee y) \leftrightarrow (\sim x \rightarrow \sim y))$

[gate1996](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

[Answer](#)

### 3.3.15 Propositional Logic: GATE1997\_3.2 [top](#)

<http://gateoverflow.in/2233>

Which of the following propositions is a tautology?

- A.  $(p \vee q) \rightarrow p$
- B.  $p \vee (q \rightarrow p)$
- C.  $p \vee (p \rightarrow q)$
- D.  $p \rightarrow (p \rightarrow q)$

[gate1997](#) [mathematical-logic](#) [easy](#) [propositional-logic](#)

[Answer](#)

### 3.3.16 Propositional Logic: GATE1998\_1.5 [top](#)

<http://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](#)

### 3.3.17 Propositional Logic: GATE1999\_14 [top](#)

<http://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](#)

[Answer](#)

### 3.3.18 Propositional Logic: GATE2000-2.7 [top](#)

<http://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](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

[Answer](#)

### 3.3.19 Propositional Logic: GATE2001-1.3 [top](#)

<http://gateoverflow.in/696>

Consider two well-formed formulas in propositional logic

$$F1 : P \Rightarrow \neg P \quad F2 : (P \Rightarrow \neg P) \vee (\neg P \Rightarrow P)$$

Which one of the following statements is correct?

- A. F1 is satisfiable, F2 is valid  
 B. F1 unsatisfiable, F2 is satisfiable  
 C. F1 is unsatisfiable, F2 is valid  
 D. F1 and F2 are both satisfiable

[gate2001](#) [mathematical-logic](#) [easy](#) [propositional-logic](#)

[Answer](#)

### 3.3.20 Propositional Logic: GATE2002-1.8 [top](#)

<http://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](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

**Answer****3.3.21 Propositional Logic: GATE2002-5b** [top](#)<http://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).

$$A \leftrightarrow (A \vee A)$$

$$(A \vee B) \rightarrow B$$

$$A \wedge (\neg(A \vee B))$$

[gate2002](#) [mathematical-logic](#) [easy](#) [descriptive](#) [propositional-logic](#)
**Answer****3.3.22 Propositional Logic: GATE2003-72** [top](#)<http://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](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)
**Answer****3.3.23 Propositional Logic: GATE2004-70** [top](#)<http://gateoverflow.in/1064>

The following propositional statement is  $(P \Rightarrow (Q \vee R)) \Rightarrow ((P \wedge Q) \Rightarrow R)$

- A. satisfiable but not valid
- B. valid
- C. a contradiction
- D. None of the above

[gate2004](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)
**Answer****3.3.24 Propositional Logic: GATE2004-IT-31** [top](#)<http://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?

P and Q only

P and R only

P and S only

P, Q, R and S

[gate2004-it](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)
**Answer****3.3.25 Propositional Logic: GATE2005-40** [top](#)<http://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?

$$X \equiv Y$$

$$X \rightarrow Y$$

$$Y \rightarrow X$$

$$\neg Y \rightarrow X$$

[gate2005](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

[Answer](#)

### 3.3.26 Propositional Logic: GATE2006-27 [top](#)

<http://gateoverflow.in/990>

Consider the following propositional statements:

$$P1 : ((A \wedge B) \rightarrow C) \equiv ((A \rightarrow C) \wedge (B \rightarrow C))$$

$$P2 : ((A \vee B) \rightarrow C) \equiv ((A \rightarrow C) \vee (B \rightarrow C))$$

Which one of the following is true?

- A. P1 is a tautology, but not P2
- B. P2 is a tautology, but not P1
- C. P1 and P2 are both tautologies
- D. Both P1 and P2 are not tautologies

[gate2006](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)

[Answer](#)

### 3.3.27 Propositional Logic: GATE2008-31 [top](#)

<http://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](#) [normal](#) [mathematical-logic](#) [propositional-logic](#)

[Answer](#)

### 3.3.28 Propositional Logic: GATE2009-24 [top](#)

<http://gateoverflow.in/801>

The binary operation  $\square$  is defined as follows

<b>P</b>	<b>Q</b>	<b><math>P \square Q</math></b>
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](#) [mathematical-logic](#) [easy](#) [propositional-logic](#)
[Answer](#)

### 3.3.29 Propositional Logic: GATE2014-1-53 [top](#)

<http://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.  $(\sim(p \leftrightarrow q) \wedge r) \wedge (p \wedge q \wedge \sim r)$

[gate2014-1](#) [mathematical-logic](#) [normal](#) [propositional-logic](#)
[Answer](#)

### 3.3.30 Propositional Logic: GATE2014-2-53 [top](#)

<http://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.  $a \rightarrow (b \rightarrow a)$

[gate2014-2](#) [mathematical-logic](#) [propositional-logic](#) [normal](#)
[Answer](#)

### 3.3.31 Propositional Logic: GATE2014-3-1 [top](#)

<http://gateoverflow.in/2039>

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.

[gate2014-3](#) [mathematical-logic](#) [easy](#) [propositional-logic](#)
[Answer](#)

### 3.3.32 Propositional Logic: GATE2015-1-14 [top](#)

<http://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.  $(\neg p \wedge \neg q) \vee (p \wedge q)$

[gate2015-1](#) [mathematical-logic](#) [easy](#) [propositional-logic](#)
[Answer](#)

### 3.3.33 Propositional Logic: GATE2017-1-01 [top](#)

<http://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

[gate2017-1](#) | [mathematical-logic](#) | [propositional-logic](#) | [easy](#)

[Answer](#)

### 3.3.34 Propositional Logic: GATE2017-1-29 [top](#)

<http://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.

[gate2017-1](#) | [mathematical-logic](#) | [propositional-logic](#)

[Answer](#)

### 3.3.35 Propositional Logic: GATE2017-2-11 [top](#)

<http://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.  $(\neg p \wedge r) \vee (r \rightarrow (p \wedge q))$

[gate2017-2](#) | [mathematical-logic](#) | [propositional-logic](#)

[Answer](#)

### 3.3.36 Propositional Logic: TIFR2015-A-5 [top](#)

<http://gateoverflow.in/29454>

What is logically equivalent to "If Kareena and Parineeti go to the shopping mall then it is raining":

- a. If Kareena and Parineeti do not go to the shopping mall then it is not raining.
- b. If Kareena and Parineeti do not go to the shopping mall then it is raining.
- c. If it is raining then Kareena and Parineeti go to the shopping mall.
- d. If it is not raining then Kareena and Parineeti do not go to the shopping mall.
- e. None of the above.

[tifr2015](#) | [mathematical-logic](#) | [propositional-logic](#)

[Answer](#)

## Answers: Propositional Logic

### 3.3.1 Propositional Logic: GATE 2016-1-1 [top](#)

<http://gateoverflow.in/39663>



Selected Answer

$$\begin{aligned} & \sim((p \rightarrow q) \wedge (\sim r \vee \sim s)) \\ &= (\sim(\sim p \vee q)) \vee (\sim(\sim r \vee \sim s)) \\ &= (p \wedge \sim q) \vee (r \wedge s) \end{aligned}$$

Which can be read as ( $x \in \{8, 9, 10, 11, 12\}$  AND  $x$  is not a composite number) OR ( $x$  is a perfect square AND  $x$  is a prime number)

Now for

- $x$  is a perfect square and  $x$  is a prime number.
- it can never be true as every square has atleast 3 factors, 1,  $x$  and  $x^2$ .

So second condition can never be true..

That 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.. Hence,

ANSWER 11.

31 votes

-- Abhilash Panicker (8.8k points)

### 3.3.2 Propositional Logic: GATE 2016-2-01 [top](#)

<http://gateoverflow.in/39568>



Selected Answer

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  $(P \wedge (P \Rightarrow Q)) \Leftrightarrow A$  (notational for convenience). Then for options (i), (ii), (iii), (iv), (v). If  $(A \Rightarrow \text{option})$  is a tautology then  $P \wedge (P \Rightarrow Q)$  logically implies that option x else  $P \wedge (P \Rightarrow Q)$  does not logically implies that option x.

P	Q	A	Option(i)	Option(ii)	Option(iii)	Option(iv)	Option(v)
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	T	T	T	T

$\alpha$

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.

60 votes

-- Anurag Pandey (13.1k points)

### 3.3.3 Propositional Logic: GATE1987-10e [top](#)

<http://gateoverflow.in/82457>



Selected Answer

**P<sub>1</sub>** : P**P<sub>2</sub>**:  $(P \rightarrow Q) \vee (P \wedge (R \rightarrow Q))$ 

$$\begin{aligned} \text{so } P_1 \wedge P_2 &= [P \cdot [(P' + Q) + (PR' + PQ)]] \\ &= [P \cdot [P' + Q + PR' + PQ]] \\ &= [PR' + PQ] \\ &= P(R \rightarrow Q) \end{aligned}$$

7 votes

-- Prashant Singh (49.2k points)

**3.3.4 Propositional Logic: GATE1988-2vii** [top](#)<http://gateoverflow.in/93947>

Selected Answer

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.

2 votes

-- Kantikumar (3.4k points)

**3.3.5 Propositional Logic: GATE1989-3-v** [top](#)<http://gateoverflow.in/87128>

Selected Answer

1.  $P \rightarrow Q = P' + Q$
2.  $\neg Q \rightarrow \neg P = Q + P'$
3.  $\neg P \vee Q = P' + Q$   
so A,B,C are equivalent .

2 votes

-- kunal (20.8k points)

**3.3.6 Propositional Logic: GATE1990-3-x** [top](#)<http://gateoverflow.in/84861>

Selected Answer

Ans) A

For reason follow pics

$\rightarrow$  To make a formula valid it must be true for all cases (In-tology)

Q)  $\frac{(P \Rightarrow Q) \wedge (Q \Rightarrow R)}{T \quad F}$  : to make it invalid

assume:

$$\frac{T \Rightarrow R}{T \quad F} : F$$

Now,

$$\frac{(P \Rightarrow Q) \wedge (Q \Rightarrow R)}{T \quad T}$$

We know  $P = T ; R = F$

$$\frac{(T \Rightarrow Q) \wedge (Q \Rightarrow F)}{T \quad T} \rightarrow Q \neq F ; \text{ it should be } T \quad Q \neq T ; \text{ it should be } F$$

since value of Q is ambiguous gives it tells us that our original assumption of  $P = T ; R = F \Rightarrow P \Rightarrow R = F$  is wrong.

$T \Rightarrow F$  is not possible. Thus its invalid.

Q)  $\frac{(P \Rightarrow Q) \Rightarrow (P \Rightarrow \neg Q)}{T \quad F}$  : to make it invalid the case must hold

so,  $\neg P \Rightarrow \neg Q$  : for this to be true

$$\therefore P = F ; Q = T \quad \text{which makes } P \Rightarrow Q = T$$

so  $T \Rightarrow F$  does hold. Thus invalid.

Q)  $\frac{P \wedge (\neg P \vee \neg Q)}{T \quad F} \Rightarrow Q$  : to make it invalid

to make it true  $P : \cancel{1} T$

so again  $T \Rightarrow F$  does not hold. Thus invalid.

Q)  $\frac{(P \Rightarrow R) \vee (Q \Rightarrow R)}{T \quad F} \Rightarrow \frac{(P \vee Q) \Rightarrow R}{F}$  : to make it invalid

or,

$$\frac{(P \Rightarrow F) \vee (Q \Rightarrow F)}{T \quad F} \quad \left[ \because R = F \right]$$

assume  $P = T$  which makes the value  $T \Rightarrow F$  (LHS)  $\times F$  (RHS)

so again  $T \Rightarrow F$  holds. Thus invalid.

Ans - option A)

2 votes

-- Tuhin Dutta (1.2k points)

### 3.3.7 Propositional Logic: GATE1991\_03,xii top

<http://gateoverflow.in/528>

Selected Answer

answer = option B

False  $\rightarrow$  anything = True, always

12 votes

-- Amar Vashishth (28.7k points)

### 3.3.8 Propositional Logic: GATE1992\_02,xvi top

<http://gateoverflow.in/574>

Selected Answer

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.

8 votes

-- Rajarshi Sarkar (35k points)

### 3.3.9 Propositional Logic: GATE1993\_18 [top](#)

<http://gateoverflow.in/2315>



Selected Answer

$$A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A)$$

$$= A(A' + B + C)(A' + B')$$

$$= AB'(A' + B + C)$$

$$= AB'C$$

C is logical consequence of a formula X if,  
 $X \rightarrow C$  is true

$$\text{here } X = A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A) \\ = AB'C$$

$$\text{cheaking , } AB'C \rightarrow C$$

$$= (AB'C)' + C$$

$$= A' + B + C' + C$$

$$= 1$$

C is logical consequence of  $A \wedge (A \rightarrow (B \vee C)) \wedge (B \rightarrow \neg A)$ ..

9 votes

-- Digvijay (47k points)

### 3.3.10 Propositional Logic: GATE1993\_8.2 [top](#)

<http://gateoverflow.in/2300>



Selected Answer

OPTION (B)

9 votes

-- Manali (2.8k points)

### 3.3.11 Propositional Logic: GATE1994\_3.13 [top](#)

<http://gateoverflow.in/2499>



Selected Answer

$p$	$q$	$p \leftrightarrow q$	$p \rightarrow \neg q$	$(p \leftrightarrow q) \rightarrow (p \rightarrow \neg q)$
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.

12 votes

-- Arjun Suresh (294k points)

### 3.3.12 Propositional Logic: GATE1995\_13 [top](#)

<http://gateoverflow.in/2649>



Selected Answer

$$(p \vee \neg q \vee r) \wedge (p \vee \neg q \vee \neg r) \wedge (p \vee q \vee r) \wedge (\neg p \vee q \vee r)$$

7 votes

-- Anu (10.6k points)

### 3.3.13 Propositional Logic: GATE1995\_2.19 [top](#)

**Cannot be determined.**

From the axiom  $\neg p \rightarrow v$ , we can conclude that  $p + v$ .

So,  $p$  can be True or False, i.e. nothing can be said about its value.

$$\neg p \vee (p \rightarrow q)$$

$$\equiv \neg p \vee (\neg p \vee q)$$

$$\equiv \neg p \vee q$$

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.

22 votes

-- Pragy Agarwal (19.5k points)

### 3.3.14 Propositional Logic: GATE1996\_2.3 [top](#)



Selected Answer

OPTION D... when  $x = F$  &  $y = F$

9 votes

-- Manali (2.8k points)

### 3.3.15 Propositional Logic: GATE1997\_3.2 [top](#)



Selected Answer

$$C) P \text{ OR } (P \rightarrow Q) = P \text{ OR } (\text{NOT } P \text{ OR } Q)$$

$$= (P \text{ OR } \text{NOT } P) \text{ OR } Q \quad \text{Associativity rule}$$

$$= T \text{ OR } Q$$

$$= T$$

11 votes

-- Manali (2.8k points)

### 3.3.16 Propositional Logic: GATE1998\_1.5 [top](#)



Selected Answer

I stay only if you go **is equivalent to** If I stay then you go.

A only if B  $\Rightarrow A \rightarrow B$

A = "I stay" **and** B = "You go"

converse( A->B) = B->A

" If you go then I stay "

Answer is A

12 votes

-- Manali (2.8k points)

### 3.3.17 Propositional Logic: GATE1999\_14 [top](#)



Selected Answer

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.

$$(A \vee B) = T \vee B = T$$

5 votes

-- Arjun Suresh (294k points)

### 3.3.18 Propositional Logic: GATE2000-2.7 [top](#)



Selected Answer

Given that,  $a \Leftrightarrow b \vee \sim b$

It is equivalent to  $a \Leftrightarrow \text{TRUE}$

$$\therefore (a \wedge b) \rightarrow ((a \wedge c) \vee d)$$

$$\text{wkt, } 1 \wedge x = x$$

$$\therefore (a \wedge b) = 1 \wedge b = b$$

$$\text{similarly, } 1 \wedge c = c$$

We now have,  $b \rightarrow (c \vee d)$

Which can be written as,

$$\sim b \vee c \vee d$$

We also know that  $b \Leftrightarrow c$

$$\therefore \sim b \vee c = \text{TRUE}$$

$$\therefore \text{TRUE} \vee d = \text{TRUE}$$

And hence answer is option a

17 votes

-- Gate\_15\_isHere (639 points)

### 3.3.19 Propositional Logic: GATE2001-1.3 [top](#)



Selected Answer

$$F1: P \Rightarrow \neg P$$

$$= \neg P \vee \neg P$$

$= \neg P$  can be true when P is false ( Atleast one T hence satisfiable)

$$F2: (P \Rightarrow \neg P) \vee (\neg P \Rightarrow P)$$

$$= \neg P \vee (P \vee P)$$

$$= \neg P \vee P$$

$$= T$$

VALID

Option A

16 votes

-- Manali (2.8k points)

### 3.3.20 Propositional Logic: GATE2002-1.8 [top](#)



Selected Answer

```
while ( not z ) {
    if (X) then
        Y
}
or
unless( z ) {
    if (X) then
        Y
}
```

this is what it means in programming. if you want to execute statement Y then X must be True and Z False, which is equivalent to  $(X \text{ AND } \neg Z) \rightarrow Y$

option A

34 votes

-- Vikrant Singh (13.4k points)

### 3.3.21 Propositional Logic: GATE2002-5b [top](#)



Selected Answer

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

16 votes

-- Arjun Suresh (294k points)

### 3.3.22 Propositional Logic: GATE2003-72 [top](#)

TAKING OPTION (A)

$((P \vee R) \wedge (Q \vee \neg R)) \Rightarrow (P \vee Q)$  is logically valid.

$$((P + R) \cdot (Q + \neg R))' + (P + Q)$$

$$((P' R') + (Q' R)) + (P + Q)$$

$$P + R' + Q + R$$

$= 1 + P + Q = 1$  SO TAUTOLOGY MEANS VALID. True

Option B

$(P \vee Q) \Rightarrow ((P \vee R) \wedge (Q \vee \neg R))$  is logically valid

$$(P + Q)' + ((P + R)) \cdot (Q + \neg R))$$

$P'Q' + PQ + PR' + QR$  WHICH IS CONTINGENCY SO ONLY SATISFIABLE.

So option B is false.

14 votes

-- Prashant Singh (49.2k points)

### 3.3.23 Propositional Logic: GATE2004-70 [top](#)

<http://gateoverflow.in/1064>



Selected Answer

Answer a

It is false when  $P = T, Q = T, R = F$

It is true (satisfiable) when  $P = T, Q = T, R = T$

10 votes

-- Anu (10.6k points)

### 3.3.24 Propositional Logic: GATE2004-IT-31 [top](#)

<http://gateoverflow.in/3674>



Selected Answer

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.

$$\begin{array}{ll}
 \text{P: } & \neg p \vee q \\
 & \neg q \vee s \\
 & p \vee x \\
 \hline
 & s \vee q \\
 \text{and, } & \neg s \rightarrow q \checkmark
 \end{array}
 \quad
 \begin{array}{ll}
 \text{Q: } & \neg p \\
 & \neg q \\
 & \neg p \vee (\neg q \vee s) \\
 \hline
 & \neg p \vee \neg q \\
 & \neg p \neq \neg q
 \end{array}$$
  

$$\begin{array}{ll}
 \text{R: } & \neg (q \wedge r) \vee p = \neg q \vee \neg r \vee p \\
 & \neg q \vee p \\
 & \neg p \vee \neg r \\
 \hline
 & \neg p \vee \neg r \neq q
 \end{array}$$
  

$$\begin{array}{ll}
 \text{S: } & \neg p \vee q \\
 & \neg q \vee r \\
 \hline
 & q \equiv r \checkmark
 \end{array}
 \quad \text{ANSWER = PBS.}$$

14 votes

-- Amar Vashishth (28.7k points)

### 3.3.25 Propositional Logic: GATE2005-40 [top](#)

<http://gateoverflow.in/1165>



Selected Answer

$$\begin{aligned} X &= (P \vee Q) \rightarrow R \\ &= \sim(P \vee Q) \vee R \\ &= (\sim P \wedge \sim Q) \vee R \\ &= (\sim P \vee R) \wedge (\sim Q \vee R) \\ &= (P \rightarrow R) \wedge (Q \rightarrow R) \end{aligned}$$

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.

15 votes

-- Arjun Suresh (294k points)

### 3.3.26 Propositional Logic: GATE2006-27 [top](#)

<http://gateoverflow.in/990>



Selected Answer

(D) Both P1 and P2 are not tautologies.

P1: If A is true and B is false, LHS of P1 is true but RHS becomes false. Hence not tautology.

P2: 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 P2 can be simplified as follows:

$$((AvB) \rightarrow C) = (\sim(AvB) \vee C) = (\sim A \wedge \sim B) \vee C = (\sim A \vee C) \wedge (\sim B \vee C) = (A \rightarrow C) \wedge (B \rightarrow C)$$

9 votes

-- Arjun Suresh (294k points)

### 3.3.27 Propositional Logic: GATE2008-31 [top](#)

<http://gateoverflow.in/442>



Selected Answer

I and II are present in each option so need to check.

For III and IV

$$\begin{aligned} (P \wedge Q) \vee (P \wedge \sim Q) &= P \wedge (Q \vee \sim Q) \quad (\text{By distributive law}) \\ &= P \wedge T \\ &= P \end{aligned}$$

For III.

$$P \vee (\sim P \wedge \sim Q) = P \vee \sim Q \quad (\text{By Absorption Law})$$

For IV.

$$P \vee (\neg P \wedge Q) = P \vee Q \quad (\text{By Absorption Law})$$

So Option B is correct.

I, II, III are logically equivalent.

1 votes

-- Soumya Jain (1.6k points)

(B) Only I, II and III. Draw truth table to check, evaluating individual expression will consume lot of time with no guaranteed answer.

12 votes

-- Keith Kr (6.3k points)

### 3.3.28 Propositional Logic: GATE2009-24 [top](#)

<http://gateoverflow.in/801>



Selected Answer

Answer is B because the truth values for option B is same as that of P "or" Q.

The given truth table is for  $Q \Rightarrow P$  which is  $\bar{Q} + P$ .

Now, with A option we get  $\bar{Q} + P = P + Q$

14 votes

-- chetna (465 points)

### 3.3.29 Propositional Logic: GATE2014-1-53 [top](#)



Selected Answer

- 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  $\sim r$  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"

11 votes

-- Manu Thakur (6k points)

### 3.3.30 Propositional Logic: GATE2014-2-53 [top](#)



Selected Answer

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  $\neg b \rightarrow (a \wedge c)$  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..

14 votes

-- Pooja Palod (32.4k points)

### 3.3.31 Propositional Logic: GATE2014-3-1 [top](#)



Selected 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 :  $B \rightarrow \neg A \iff \neg B \vee \neg A \iff \neg A \vee \neg B$  (Disjunction is commutative)

Hence  $P \iff Q$  ( P is equivalent to Q, which means P implies Q ,and Q implies P )

19 votes

-- Srinath Jayachandran (3.7k points)

### 3.3.32 Propositional Logic: GATE2015-1-14 [top](#)



Selected Answer

$p \leftrightarrow q$   
 $= (p \rightarrow q) \wedge (q \rightarrow p)$   
 $= (\neg p \vee q) \wedge (q \rightarrow p) \quad (\text{As } p \rightarrow q = \neg p \vee q)$   
 $= (\neg p \vee q) \wedge (\neg q \vee p)$   
 $= (\neg p \wedge \neg q) \vee (p \wedge q)$

So, answer C

19 votes

-- Priya\_das (775 points)

### 3.3.33 Propositional Logic: GATE2017-1-01 [top](#)



Selected Answer

$\sim P \rightarrow \sim Q$  it can also be written as  $P \vee \sim Q$  so statement 3 is correct

now taking the contrapositive of  $\sim P \rightarrow \sim Q$  we get  $Q \rightarrow P$  hence statement 2 is correct

So the answer is

OPTION (D)

7 votes

-- sriv\_shubham (2.7k points)

### 3.3.34 Propositional Logic: GATE2017-1-29 [top](#)



Selected Answer

given  $(P \rightarrow Q) \rightarrow R$  is false..hence 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

$\sim(R \rightarrow P) \vee Q$

Since, R is False. Therefore,  $R \rightarrow P$  is true and  $\sim(R \rightarrow P)$  is False. So, it becomes False  $\vee Q$ .

..which is TRUE whenever Q is TRUE

hence option (D)

7 votes

-- sriv\_shubham (2.7k points)

### 3.3.35 Propositional Logic: GATE2017-2-11 [top](#)



Selected Answer

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  $\neg r \rightarrow (p \wedge q)$  and NOT  $(p \wedge q) \rightarrow \neg r$ . 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. So, p only if q can be written as if p then q.

So, ANDing clause 1. and 2. we have  $(\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q)) (\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q))$  [option A is correct].

1 votes

-- Prateek Kumar (507 points)

### 3.3.36 Propositional Logic: TIFR2015-A-5 [top](#)



Selected Answer

**Answer will be (D)**

"If Kareena and Parineeti go to the shopping mall then it is raining"

**Let Kareena and Parineeti go to the shopping mall =p**

**it is raining = q**

Now the statement told that **p→q**

a. If Kareena and Parineeti do not go to the shopping mall then it is not raining.

i.e.  $\sim p \rightarrow \sim q$

So, it is not matching with the previous implication

b. If Kareena and Parineeti do not go to the shopping mall then it is raining.

that means  $\sim p \rightarrow q$

it is also not matching

c. If it is raining then Kareena and Parineeti go to the shopping mall.

that means  $q \rightarrow p$ . So, it is also false

d. If it is not raining then Kareena and Parineeti do not go to the shopping mall.

i.e.  $\sim q \rightarrow \sim p = q \vee \sim p = p \rightarrow q$

So, correct option is (D)

13 votes

-- srestha (58.3k points)

# 4 Discrete Mathematics: Set Theory & Algebra (176) top

## 4.1 Binary Operation(8) top

### 4.1.1 Binary Operation: GATE1989-1-v top

<http://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 \_\_\_\_\_.

descriptive gate1989 set-theory&algebra binary-operation

Answer

### 4.1.2 Binary Operation: GATE1994\_2.2 top

<http://gateoverflow.in/2469>

On the set  $N$  of non-negative integers, the binary operation \_\_\_\_\_ is associative and non-commutative.

gate1994 set-theory&algebra normal binary-operation

Answer

### 4.1.3 Binary Operation: GATE2003-38 top

<http://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

- A. 0
- B. 1
- C. 2
- D. 3

gate2003 set-theory&algebra normal binary-operation

Answer

### 4.1.4 Binary Operation: GATE2006-28 top

<http://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 | set-theory&algebra | binary-operation

Answer

#### 4.1.5 Binary Operation: GATE2006-IT-2 [top](#)

<http://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

#### 4.1.6 Binary Operation: GATE2013\_1 [top](#)

<http://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 | set-theory&algebra | easy | binary-operation

Answer

#### 4.1.7 Binary Operation: GATE2015-1\_28 [top](#)

<http://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

[gate2015-1](#) | [set-theory&algebra](#) | [easy](#) | [binary-operation](#)

[Answer](#)

### 4.1.8 Binary Operation: GATE2015-3\_2 [top](#)

<http://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.

$$(S1) (P \# Q) \# R = P \# (Q \# R)$$

$$(S2) Q \# R = (R \# Q)$$

Which are the following is/are true for the Boolean variables P, Q and R?

- A. Only S1 is true
- B. Only S2 is true
- C. Both S1 and S2 are true
- D. Neither S1 nor S2 are true

[gate2015-3](#) | [set-theory&algebra](#) | [binary-operation](#) | [normal](#)

[Answer](#)

## Answers: Binary Operation

### 4.1.1 Binary Operation: GATE1989-1-v [top](#)

<http://gateoverflow.in/87051>



Selected Answer

Given , the cardinality of set = n

So consequently ,

No of entries in operation table(Cayley table) =  $n^2$

And hence if we consider lower triangular or upper triangular half , we have :  $(n^2 + n) / 2$

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 =  $n^{(n^2 + n)/2}$

So 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 =  $n^{(n^2 + n)/2}$**

6 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

### 4.1.2 Binary Operation: GATE1994\_2.2 [top](#)

<http://gateoverflow.in/2469>



Selected Answer

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  $b * a = b$ .

16 votes

-- Happy Mittal (10.9k points)

### 4.1.3 Binary Operation: GATE2003-38 [top](#)



Selected Answer

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 solution is 2

10 votes

-- Praveen Saini (53.5k points)

### 4.1.4 Binary Operation: GATE2006-28 [top](#)



Selected Answer

This question is easier to Answer With Boolean Algebra ->

A op B=  $B \rightarrow A$ , i.e.  $\sim B \vee A$ .

now

Lets look at Option D

$\sim (\sim A \text{ op } B) \Rightarrow \sim (B \rightarrow \sim A) \Rightarrow \sim (\sim B \vee \sim A) \Rightarrow B \wedge A$

So Answer is D.

Other options ->

A)  $\sim B \vee \sim A$

B)  $\sim B \wedge \sim A$

C)  $\sim B \wedge A$

<http://gateoverflow.in/991>

8 votes

-- Akash (43.8k points)

#### 4.1.5 Binary Operation: GATE2006-IT-2 [top](#)

<http://gateoverflow.in/3539>



Answer: A

- I. Identity element is 3.
- II. Identity element is 1.
- III. There is no identity element. ( $x^y \neq y^x$ , when  $x \neq y$ )

17 votes

-- Rajarshi Sarkar (35k points)

#### 4.1.6 Binary Operation: GATE2013\_1 [top](#)

<http://gateoverflow.in/59>



Answer is (A) Commutative but not associative.

$y \oplus x = y^2 + x^2 = x \oplus y$ . Hence, commutative.

$$(x \oplus y) \oplus z = (x^2 + y^2) \oplus z = (x^2 + y^2)^2 + z^2$$
$$x \oplus (y \oplus z) = x \oplus (y^2 + z^2) = x^2 + (y^2 + z^2)^2$$

So,  $((x \oplus y) \oplus z) \neq (x \oplus (y \oplus z))$ , hence not associative.

17 votes

-- Arjun Suresh (294k points)

#### 4.1.7 Binary Operation: GATE2015-1\_28 [top](#)

<http://gateoverflow.in/8226>



option A : as it is XOR operation

12 votes

-- GATERush (1.2k points)

#### 4.1.8 Binary Operation: GATE2015-3\_2 [top](#)

<http://gateoverflow.in/8393>



Answer=B

$$(P \# Q) \# R = (P' + Q') \# R$$

$$= P.Q + R'$$

whereas

$$P \# (Q \# R) = P' + (Q \# R)'$$

$$= P' + (Q' + R)'$$

$$= P' + QR$$

13 votes

-- overtomano (1.2k points)

## 4.2

### Counting(1) [top](#)

## 4.2.1 Counting: GATE2005-44 [top](#)

<http://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

$$a \equiv c \pmod{3} \text{ and } b \equiv d \pmod{5}$$

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

[gate2005](#) [set-theory&algebra](#) [normal](#) [counting](#)

[Answer](#)

## Answers: Counting

## 4.2.1 Counting: GATE2005-44 [top](#)

<http://gateoverflow.in/1170>



Selected Answer

order pair 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 combination.(Pigeon Hole principle)  
total  $15+1 = 16$  combination

12 votes

-- Digvijay (47k points)

## 4.3

## Fields(1) [top](#)

## 4.3.1 Fields: GATE2008-IT-26 [top](#)

<http://gateoverflow.in/3316>

Consider the field  $C$  of complex numbers with addition and multiplication. Which of the following form(s) a subfield of  $C$  with addition and multiplication?

- **S1:** the set of real numbers
- **S2:**  $\{(a + ib) \mid a \text{ and } b \text{ are rational numbers}\}$
- **S3:**  $\{a + ib \mid (a^2 + b^2) \leq 1\}$
- **S4:**  $\{ia \mid a \text{ is real}\}$

- A. only S1
- B. S1 and S3
- C. S2 and S3
- D. S1 and S2

[gate2008-it](#) [set-theory&algebra](#) [normal](#) [fields](#)

[Answer](#)

## Answers: Fields

## 4.3.1 Fields: GATE2008-IT-26 [top](#)

<http://gateoverflow.in/3316>



Selected Answer

A field is an algebraic structure over two operations  $+$  and  $*$  if :

1. It is closed under both  $+$  and  $*$ .
2.  $+$  and  $*$  are both commutative and associative. ( $+$  and  $*$  in this question are already commutative and associative, so

no need to check).

3. Existence of additive identity(0) and multiplicative identity(1)
4. Existence of additive and multiplicative inverses for each non-zero element.
5. Distributive property of \* over + (This is also satisfied in question)

So for each option, we have to check only properties 1, 3, and 4.

(S1) : set of all real numbers

1. Closed : Yes, real+real = real, real\*real=real
3. Additive and multiplicative identity : Yes, 0 and 1 are real numbers

4. Additive and multiplicative inverse for each non-zero element : Yes, for any real number  $a$ , additive inverse is  $-a$ , which is also a real number, and multiplicative inverse is  $1/a$ , which is also a real number.

(S2) :  $\{(a + ib) \mid a \text{ and } b \text{ are rational numbers}\}$

1. Closed : Yes, rational+rational=rational, rational\*rational=rational
3. Additive and multiplicative identity : Yes,  $0+0i$  (additive identity) and  $1+0i$  (multiplicative identity) belong to given set.
4. Additive and multiplicative inverse for each non-zero element : Additive inverse is  $-a-ib$ , which belongs to given set. Multiplicative identity is  $\frac{1}{a+ib} = \frac{a-ib}{a^2+b^2} = \frac{a}{a^2+b^2} + i\frac{-b}{a^2+b^2}$ , which also belongs to given set.

(S3) :  $\{a + ib \mid (a^2 + b^2) \leq 1\}$

1. Closed : No, for example :  $(0.3+0.4i) + (0.7 + 0.6i) = 1 + i$ . Here both complex numbers which were added were in the given set, but resultant complex number is not.

(S4) :  $\{ia \mid a \text{ is real}\}$

Here this set doesn't contain 1 (multiplicative identity)

So (S1) and (S2) are subfields of C. So option D) is correct.

14 votes

-- Happy Mittal (10.9k points)

## 4.4

## Functions(34) top

### 4.4.1 Functions: GATE 2016-1-28 top

<http://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 \_\_\_\_\_.

[gate2016-1](#) [set-theory&algebra](#) [functions](#) [normal](#) [numerical-answers](#)

[Answer](#)

### 4.4.2 Functions: GATE1987-9b top

<http://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](#)

[Answer](#)

### 4.4.3 Functions: GATE1988-13ii top

<http://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](#)

### 4.4.4 Functions: GATE1989-13c top

<http://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

[Answer](#)

#### 4.4.5 Functions: GATE1993\_8.6 [top](#)

<http://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](#)

#### 4.4.6 Functions: GATE1996\_1.3 [top](#)

<http://gateoverflow.in/2707>

Suppose X and Y are sets and  $|X|$  and  $|Y|$  are their respective cardinalities. 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](#)

#### 4.4.7 Functions: GATE1996\_2.1 [top](#)

<http://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](#)

#### 4.4.8 Functions: GATE1997-13 [top](#)

<http://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  $m \geq n \geq 1$ .

- a. How many functions are members of  $F$ ?
- b. How many functions  $f$  in  $F$  satisfy the property  $f(i) = 1$  for some  $i, 1 \leq i \leq n$ ?
- c. How many functions  $f$  in  $F$  satisfy the property  $f(i) < f(j)$  for all  $1 \leq i \leq j \leq n$ ?

[gate1997](#) [set-theory&algebra](#) [functions](#) [normal](#)
**Answer**

### 4.4.9 Functions: GATE1998\_1.8 [top](#)

<http://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](#) [permutations-and-combinations](#) [functions](#) [easy](#)
**Answer**

### 4.4.10 Functions: GATE2001-2.3 [top](#)

<http://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.

- S1 :  $f(E \cup F) = f(E) \cup f(F)$
- S2 :  $f(E \cap F) = f(E) \cap f(F)$

Which of the following is true about S1 and S2?

- A. Only S1 is correct
- B. Only S2 is correct
- C. Both S1 and S2 are correct
- D. None of S1 and S2 is correct

[gate2001](#) [set-theory&algebra](#) [functions](#) [normal](#)
**Answer**

### 4.4.11 Functions: GATE2003-37 [top](#)

<http://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](#) [set-theory&algebra](#) [functions](#) [normal](#)
**Answer**

### 4.4.12 Functions: GATE2003-39 [top](#)

<http://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  $h(\langle s_1 \dots s_n \rangle) = \prod_{i=1}^n P_i^{f(s_i)}$

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](#) | [set-theory&algebra](#) | [functions](#) | [normal](#)

[Answer](#)

#### 4.4.13 Functions: GATE2005-43 [top](#)

<http://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 be onto
- C.  $g$  should be onto but  $f$  need not be onto
- D. both  $f$  and  $g$  need not be onto

[gate2005](#) | [set-theory&algebra](#) | [functions](#) | [normal](#)

[Answer](#)

#### 4.4.14 Functions: GATE2005-IT-31 [top](#)

<http://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  $\Rightarrow h$  is onto
- B.  $h$  is onto  $\Rightarrow f$  is onto
- C.  $h$  is onto  $\Rightarrow g$  is onto
- D.  $h$  is onto  $\Rightarrow f$  and  $g$  are onto

[gate2005-it](#) | [set-theory&algebra](#) | [functions](#) | [normal](#)

[Answer](#)

#### 4.4.15 Functions: GATE2006-2 [top](#)

<http://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](#) | [set-theory&algebra](#) | [normal](#) | [functions](#)

[Answer](#)

#### 4.4.16 Functions: GATE2006-25 [top](#)

<http://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](#) | [set-theory&algebra](#) | [normal](#) | [functions](#)

[Answer](#)

### 4.4.17 Functions: GATE2006-IT-6 [top](#)

<http://gateoverflow.in/3545>

Given a boolean function  $f(x_1, x_2, \dots, x_n)$ , which of the following equations is NOT true

- A.  $f(x_1, x_2, \dots, x_n) = x_1'f(x_1, x_2, \dots, x_n) + x_1f(x_1, x_2, \dots, x_n)$
- B.  $f(x_1, x_2, \dots, x_n) = x_2f(x_1, x_2, \dots, x_n) + x_2'f(x_1, x_2, \dots, x_n)$
- C.  $f(x_1, x_2, \dots, x_n) = x_n'f(x_1, x_2, \dots, 0) + x_nf(x_1, x_2, \dots, 1)$
- 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](#)

### 4.4.18 Functions: GATE2007-3 [top](#)

<http://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](#) [permutations-and-combinations](#) [functions](#) [normal](#)

[Answer](#)

### 4.4.19 Functions: GATE2012\_37 [top](#)

<http://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](#) [set-theory&algebra](#) [functions](#) [normal](#)

[Answer](#)

### 4.4.20 Functions: GATE2014-1-50 [top](#)

<http://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 \_\_\_\_\_.

[gate2014-1](#) [set-theory&algebra](#) [functions](#) [permutations-and-combinations](#) [numerical-answers](#)

[Answer](#)

### 4.4.21 Functions: GATE2014-3-2 [top](#)

<http://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  $Y$ ,  $f^{-1}(S \cap T) = f^{-1}(S) \cap f^{-1}(T)$

[gate2014-3](#) [set-theory&algebra](#) [functions](#) [normal](#)

[Answer](#)

### 4.4.22 Functions: GATE2014-3-49 [top](#)

<http://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

[gate2014-3](#) | [set-theory&algebra](#) | [functions](#) | [normal](#)

[Answer](#)

### 4.4.23 Functions: GATE2015-1\_39 [top](#)

<http://gateoverflow.in/8294>

Consider the operations

$$f(X, Y, Z) = X'YZ + XY' + Y'Z' \text{ and } g(X, Y, Z) = X'YZ + X'YZ' + XY$$

Which one of the following is correct?

- A. Both  $\{f\}$  and  $\{g\}$  are functionally complete
- B. Only  $\{f\}$  is functionally complete
- C. Only  $\{g\}$  is functionally complete
- D. Neither  $\{f\}$  nor  $\{g\}$  is functionally complete

[gate2015-1](#) | [set-theory&algebra](#) | [functions](#) | [difficult](#)

[Answer](#)

### 4.4.24 Functions: GATE2015-1\_5 [top](#)

<http://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.  $\frac{-1}{x}$
- C.  $\frac{g(x)}{h(x)}$
- D.  $\frac{x}{(1-x)^2}$

[gate2015-1](#) | [set-theory&algebra](#) | [functions](#) | [normal](#)

[Answer](#)

### 4.4.25 Functions: GATE2015-2\_40 [top](#)

<http://gateoverflow.in/8212>

The number of onto functions (surjective functions) from set  $X = \{1, 2, 3, 4\}$  to set  $Y = \{a, b, c\}$  is \_\_\_\_\_.

[gate2015-2](#) | [set-theory&algebra](#) | [functions](#) | [normal](#) | [numerical-answers](#)

[Answer](#)

### 4.4.26 Functions: GATE2015-2\_54 [top](#)

<http://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 \_\_\_\_\_.

[gate2015-2](#) | [set-theory&algebra](#) | [functions](#) | [normal](#) | [numerical-answers](#)

[Answer](#)

### 4.4.27 Functions: GATE2015-2\_GA\_3 [top](#)

<http://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

[gate2015-2](#) | [set-theory&algebra](#) | [functions](#) | [normal](#)

[Answer](#)

#### 4.4.28 Functions: GATE2015-2\_GA\_9 [top](#)

<http://gateoverflow.in/8040>

If  $p, q, r, s$  are distinct integers such that:

$$f(p, q, r, s) = \max(p, q, r, s)$$

$$g(p, q, r, s) = \min(p, q, r, s)$$

$h(p, q, r, s) = \text{remainder of } (p \times q) / (r \times s) \text{ if } (p \times q) > (r \times s)$   
 or remainder of  $(r \times s) / (p \times q)$  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  $fgh(2, 5, 7, 3), 4, 6, 8$ ?

[gate2015-2](#) | [set-theory&algebra](#) | [functions](#) | [normal](#) | [numerical-answers](#)

[Answer](#)

#### 4.4.29 Functions: ISI2017\_MMA [top](#)

<http://gateoverflow.in/132738>

Let  $S \subseteq \mathbb{R}$ .

Consider the statement:

"There exists a continuous function  $f: S \rightarrow S$  such that  $f(x) \neq x$  for all  $x$  belongs to  $S$ ."

This statement is false if  $S$  equals

- A) [2,3]
- B) (2,3]
- C) [-3,-2] union [2,3]
- D) (-infinity to +infinity)

I think the answer should be D because in -infinity to +infinity,  $f(x)$  will definitely be equal to  $x$  at some point but we want this to not happen as said in the question. Am I correct?

[isi2017](#) | [functions](#)

[Answer](#)

#### 4.4.30 Functions: TIFR2013-B-16 [top](#)

<http://gateoverflow.in/25859>

Consider a function  $T_{k,n} : \{0,1\}^n \rightarrow \{0,1\}$  which returns 1 if at least  $k$  of its  $n$  inputs are 1. Formally,  $T_{k,n}(x) = 1$  if  $\sum_1^n x_i \geq k$ . Let  $y \in \{0,1\}^n$  be such that  $y$  has exactly  $k$  ones. Then, the function  $T_{k,n-1}(y_1, y_2, \dots, y_{i-1}, y_{i+1}, \dots, y_n)$  (where  $y_i$  is omitted) is equivalent to

- a.  $T_{k-1,n}(y)$
- b.  $T_{k,n}(y)$
- c.  $y_i$
- d.  $\neg y_i$
- e. None of the above.

[tifr2013](#) | [set-theory&algebra](#) | [functions](#)

[Answer](#)

#### 4.4.31 Functions: TIFR2014-B-17 [top](#)

<http://gateoverflow.in/27344>

Let  $f : \{0, 1\}^n \rightarrow \{0, 1\}$  be a boolean function computed by a logical circuit comprising just binary AND and binary OR gates (assume that the circuit does not have any feedback). Let  $\text{PARITY} : \{0, 1\}^n \rightarrow \{0, 1\}$  be the boolean function that outputs 1 if the total number of input bits set to 1 is odd. Similarly, let  $\text{MAJORITY}$  be the boolean function that outputs 1 if the number of input bits that are set to 1 is at least as large as the number of input bits that are set to 0. Then, which of the following is NOT possible?

- a.  $f(0, 0, \dots, 0) = f(1, 1, \dots, 1) = 0$ .
- b.  $f(0, 0, \dots, 0) = f(1, 1, \dots, 1) = 1$
- c.  $f$  is the MAJORITY function.
- d.  $f$  is the PARITY function.
- e.  $f$  outputs 1 at exactly one assignment of the input bits.

[tifr2014](#) [set-theory&algebra](#) [functions](#)

[Answer](#)

#### 4.4.32 Functions: TIFR2014-B-18 [top](#)

<http://gateoverflow.in/27351>

Let  $k$  be an integer at least 4 and let  $[k] = \{1, 2, \dots, k\}$ . Let  $f : [k]^4 \rightarrow \{0, 1\}$  be defined as follows:  $f(y_1, y_2, y_3, y_4) = 1$  if and only if the  $y_i$ 's are all distinct. For each choice  $z = (z_1, z_2, z_3) \in [k]^3$ , let  $g_z : [k] \rightarrow \{0, 1\}$  be defined by  $g_z(Y) = f(Y, z_1, z_2, z_3)$ . Let  $N$  be the number of distinct functions  $g_z$  that are obtained as  $z$  varies in  $\{1, 2, \dots, k\}^3$ , that is,  $N = |\{g_z : z \in \{1, 2, \dots, k\}^3\}|$ . What is  $N$ ?

- a.  $k^3 + 1$
- b.  $2^{\binom{k}{3}}$
- c.  $\binom{k}{3}$
- d.  $\binom{k}{3} + 1$
- e.  $4^{\binom{k}{3}}$

[tifr2014](#) [set-theory&algebra](#) [functions](#)

[Answer](#)

#### 4.4.33 Functions: TIFR2017-A-10 [top](#)

<http://gateoverflow.in/95272>

For a set  $A$  define  $\mathcal{P}(A)$  to be the set of all subsets of  $A$ . For example, if  $A = \{1, 2\}$  then  $\mathcal{P}(A) = \{\emptyset, \{1, 2\}, \{1\}, \{2\}\}$ . Let  $A \rightarrow \mathcal{P}(A)$  be a function and  $A$  is not empty. Which of the following must be TRUE?

- A.  $f$  cannot be one-to-one (injective)
- B.  $f$  cannot be onto (surjective)
- C.  $f$  is both one-to-one and onto (bijective)
- D. there is no such  $f$  possible
- E. if such a function  $f$  exists, then  $A$  is infinite

[tifr2017](#) [set-theory&algebra](#) [sets](#) [functions](#) [easy](#)

[Answer](#)

#### 4.4.34 Functions: TIFR2017-A-11 [top](#)

<http://gateoverflow.in/95289>

Let  $f \circ g$  denote function composition such that  $(f \circ g)(x) = f(g(x))$ . Let  $f : A \rightarrow B$  such that for all  $g : B \rightarrow A$  and  $h : B \rightarrow A$  we have  $f \circ g = f \circ h \Rightarrow g = h$ . Which of the following must be true?

- A.  $f$  is onto (surjective)
- B.  $f$  is one-to-one (injective)
- C.  $f$  is both one-to-one and onto (bijective)
- D. the range of  $f$  is finite
- E. the domain of  $f$  is finite

[tifr2017](#) [set-theory&algebra](#) [functions](#)

[Answer](#)

## Answers: Functions

### 4.4.1 Functions: GATE 2016-1-28 [top](#)

<http://gateoverflow.in/39717>



Answer is 2  
Its Saying we have 2 domains  
 $N^+ \rightarrow N^+$

1. So  $F(1) = F(6) = F(3) = F(8) = F(4) = F(2) = F(1)$ ...It Repeats... Now  $F(7) = F(12) = F(6)$ ...Again repeats both above are same...Since  $F(6)$  matches in both so same both belongs to same value.We are not getting  $F(5)$  above
2. Now  $F(5) = F(10) = F(5)$ ..Repeats ...We can see we have different value for multiples of 5 and other natural numbers.

17 votes

-- Deepesh Kataria (1.8k points)

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  $x$ . It will have 2 different values.

23 votes

-- Kumar Shikhar Deep (1.1k points)

### 4.4.2 Functions: GATE1987-9b [top](#)

<http://gateoverflow.in/82437>



There are  $n!$  one to one function possible with  $n$  elements to itself.. I.e.  $P(n) = n!$

5 votes

-- Prashant Singh (49.2k points)

### 4.4.3 Functions: GATE1988-13ii [top](#)

<http://gateoverflow.in/94634>

let set s={1,2,3,4}

now see 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  $f(1)=1$  &  $f(2)=1$  if it happened then at least one element remain unmapped in codomain,which resultant f not to be onto but it is given that f is onto.so every element in codomain have exactly one element in domain.so one of mapping be like  $f(1)=2$ ,  $f(2)=3$ , $f(3)=4$ , $f(4)=1$  which certainly prove that f is an one one function also.

NOTE:if s is infinite then this result may not always be true.

8 votes

-- junaid ahmad (3.4k points)

### 4.4.4 Functions: GATE1989-13c [top](#)

<http://gateoverflow.in/83178>



single valued are the function which has the domain single element map to only one element in Range.

so i tink  $n^m$  are the total number of the Single valued function are there.

1 votes

-- Arpit Dhuriya (3k points)

#### 4.4.5 Functions: GATE1993\_8.6 [top](#)

<http://gateoverflow.in/2304>



Selected Answer

Answer: B

##### Theorem 4

For any finite sets A and B, the number of one-to-one functions from A to B is  $\frac{|B|!}{(|B|-|A|)!} = P(|B|, |A|)$

**Proof.** Let  $A = \{a_1, a_2, \dots, a_n\}$  and  $B = \{b_1, b_2, \dots, b_m\}$ . A one-to-one function  $f$  assigns each element  $a_i$  of  $A$  a distinct element  $b_j = f(a_i)$  of  $B$ ; for  $a_1$  there are  $m$  choices, for  $a_2$  there are  $m - 1$  choices, ..., for  $a_n$  there are  $(m - (n - 1))$  choices.

Hence by the rule of product, we have

$$\underbrace{m(m-1)\dots(m-(n-1))}_n = \frac{m!}{(m-n)!} = \frac{|B|!}{(|B|-|A|)!} = P(|B|, |A|)$$

injective functions from  $A$  to  $B$ .  $\square$

Ref: Page 33 of <http://www.cs.toronto.edu/~stacho/macm101-2.pdf>

8 votes

-- Rajarshi Sarkar (35k points)

#### 4.4.6 Functions: GATE1996\_1.3 [top](#)

<http://gateoverflow.in/2707>



Selected Answer

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.

14 votes

-- Arjun Suresh (294k points)

#### 4.4.7 Functions: GATE1996\_2.1 [top](#)

<http://gateoverflow.in/2730>



Selected Answer

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,

$$x = \frac{z_1+z_2}{2} \text{ and } y = \frac{z_1-z_2}{2}$$

$$\text{So, } f\left(\frac{z_1}{2}, \frac{z_2}{2}\right) = \left(\frac{z_1+z_2}{2}, \frac{z_1-z_2}{2}\right) = (x, y) \implies f^{-1}(x, y) = \left(\frac{z_1}{2}, \frac{z_2}{2}\right) = \left\{\frac{x+y}{2}, \frac{x-y}{2}\right\}$$

11 votes

-- neha pawar (4.4k points)

simply taking the 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.

13 votes

-- Kumar Shikhar Deep (1.1k points)

#### 4.4.8 Functions: GATE1997-13 [top](#)

<http://gateoverflow.in/2273>



Selected Answer

(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.

11 votes

-- Arjun Suresh (294k points)

#### 4.4.9 Functions: GATE1998\_1.8 top

<http://gateoverflow.in/1645>

Selected Answer

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.

13 votes

-- Digvijay (47k points)

#### 4.4.10 Functions: GATE2001-2.3 top

<http://gateoverflow.in/721>

Selected Answer

Here Answer is A .

S1 is always True.

S2 is false Consider case where E & F do not intersect, i.e. Intersection is empty set. In that case ,  $F(E)$  and  $F(F)$  might have some common element.

8 votes

-- Akash (43.8k points)

Say  $E=\{1,2\}$

$F=\{3,4\}$

$f(1)=a$

$f(2)=b$

$f(3)=b$

$f(4)=d$

$$f(E \cup F) = f(1,2,3,4) = a,b,d$$

$$f(E) \cup f(F) = f(1,2) \cup f(3,4) = (a,b) \cup (b,d) = a,b,d$$

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, S2 is not true

13 votes

-- srestha (58.3k points)

#### 4.4.11 Functions: GATE2003-37 [top](#)

<http://gateoverflow.in/927>



Selected Answer

$f : A \rightarrow B$  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  $n(B) \geq n(A)$ .

$g : 2^A \rightarrow 2^B, g(C) = \{f(x) | x \in C\}$ , 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  $n(2^A)$ .

$h : 2^B \rightarrow 2^A, h(D) = \{x | x \in A, f(x) \in D\}$  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), then we would have got  $g(h(D)) = D$ .

18 votes

-- Mari Ganesh Kumar (2.2k points)

#### 4.4.12 Functions: GATE2003-39 [top](#)

<http://gateoverflow.in/930>



Selected Answer

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  $h$ .

10 votes

-- Arjun Suresh (294k points)

### 4.4.13 Functions: GATE2005-43 [top](#)

<http://gateoverflow.in/1168>



Selected Answer

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.

16 votes

-- Arjun Suresh (294k points)

### 4.4.14 Functions: GATE2005-IT-31 [top](#)

<http://gateoverflow.in/3777>



Selected Answer

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  $\rightarrow$  option (C).

13 votes

-- Arjun Suresh (294k points)

### 4.4.15 Functions: GATE2006-2 [top](#)

<http://gateoverflow.in/881>



Selected Answer

D is Correct.

$E = 2^{XY}$  Which is the total number of subsets of  $W$ .

Now, the mapping for a function from  $A$  to  $B$  with  $N$  and  $M$  elements respectively... we have  $M^N$ .

Here,

$$E^Z = 2^{XY}(Z) = 2^{XYZ}$$

16 votes

-- Snehil Joshi (367 points)

### 4.4.16 Functions: GATE2006-25 [top](#)

<http://gateoverflow.in/988>



Selected Answer

Total elements in  $S = m$

Total number of subsets of size 3 each can be  $mC_3$ .

Now suppose take 1st element 1. Out of  $mC_3$  subsets, 1 wont be there in  $(m-1)C_3$  subsets.

So 1 will be there in  $mC_3 - (m-1)C_3 = (m-1)(m-2)/2$  subsets.

$$\sum f(i) = \sum (m-1)(m-2)/2 = m(m-1)(m-2)/2$$

We know  $mC_3 = n$  (No of X subset) therefore  $m(m-1)(m-2)/2 = 3n$ . (B)

120 votes

-- Madhur Rawat (2.6k points)

#### 4.4.17 Functions: GATE2006-IT-6 [top](#)

<http://gateoverflow.in/3545>



Selected Answer

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:  $f(0) + f(1) = 0 + 1 = \text{always } 1$

11 votes

-- Rajarshi Sarkar (35k points)

**A,B,C** are true.

Because in all these three cases we could a boolean variable and its compliment is added to same function.

ie : if  $x = 1$  then  $x' = 0$  and viceversa.

$$1.f(x) + 0.f(x) = f(x)$$

**Hence D is false.**

12 votes

-- siraj p s (97 points)

#### 4.4.18 Functions: GATE2007-3 [top](#)

<http://gateoverflow.in/1202>



Selected Answer

answer - C

size of domain = number of different combinations of inputs =  $2^1$

size of codomain = 2 ( {0,1} )

number of functions = (size of co-domain)<sup>(size of domain)</sup>

16 votes

-- ankitrokdeonsns (9.1k points)

#### 4.4.19 Functions: GATE2012\_37 [top](#)

<http://gateoverflow.in/1759>



Selected Answer

No onto (or surjective) functions are there from an  $n$ -element ( $n \geq 2$ ) set to a 2-element set  $\Rightarrow$  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) =  $2^n - 2$  (C))

**alternate**

[http://gateoverflow.in/8212/gate2015-2\\_40](http://gateoverflow.in/8212/gate2015-2_40)

12 votes

-- Akash (43.8k points)

$2^n - 2$  in words (total functions - 2 functions where all elements maps exactly one element)

12 votes

-- Bhagirathi Nayak (13.3k points)

#### 4.4.20 Functions: GATE2014-1-50 [top](#)

<http://gateoverflow.in/1930>



Selected Answer

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,  $\log_2 \log_2 N = 2^4 = 16$ .

30 votes

-- Arjun Suresh (294k points)

#### 4.4.21 Functions: GATE2014-3-2 [top](#)

<http://gateoverflow.in/2038>



Selected Answer

D)

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)

$$|f(A \cup B)| = |f(\{a, b, c\})| = |\{1\}| = 1 \\ |f(A)| + |f(B)| = 1 + 1 = 2, \text{ LHS } \neq \text{ RHS.}$$

B)

$$f(A \cap B) = f(\{\}) = \{\} \\ f(A) \cap f(B) = \{1\} \cap \{1\} = \{1\}$$

LHS  $\neq$  RHS

C)

$$|f(A \cap B)| = |f(\{\})| = |\{\}| = 0 \\ \min\{|f(A)|, |f(B)|\} = \min(1, 1) = 1 \\ \text{LHS } \neq \text{ RHS}$$

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.

23 votes

-- Srinath Jayachandran (3.7k points)

#### 4.4.22 Functions: GATE2014-3-49 [top](#)

<http://gateoverflow.in/2083>



Selected Answer

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  $\Rightarrow$  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.

28 votes

-- Arjun Suresh (294k points)

#### 4.4.23 Functions: GATE2015-1\_39 [top](#)

<http://gateoverflow.in/8294>



Selected Answer

$g$  is preserving 0 as when all inputs are zero, output is always 0 and so  $g$  cannot be functionally complete.

$f$  is not preserving 0.

$f$  is not preserving 1. (when all inputs are 1, output is 0).

$f$  is not linear as in  $XY'$  only one (odd) input ( $X = 1, Y = Z = 0$ ) needs to be 1 and in  $X'YZ$  two inputs (even) ( $X = 0, Y = Z = 1$ ) need to be 1.

$f$  is not monotone as changing  $Y$  from 0 to 1, can take  $f$  from 1 to 0.

$f$  is not self dual as  $f(X, Y, Z) \neq \sim f(\sim X, \sim Y, \sim Z)$

So,  $f$  satisfies all 5 conditions required for functional completeness and hence B is the answer.

<http://cs.ucsb.edu/~victor/ta/cs40/posts-criterion.pdf>

42 votes

-- Arjun Suresh (294k points)

#### 4.4.24 Functions: GATE2015-1\_5 [top](#)

<http://gateoverflow.in/8025>



Selected Answer

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)

14 votes

-- GateMaster Prime (1.6k points)

#### 4.4.25 Functions: GATE2015-2\_40 [top](#)

<http://gateoverflow.in/8212>



Selected Answer

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) ,  
should be hold "  $m \geq n$ "

then number of onto function

$$= n^m -^n C_1(n-1)^m +^n C_2(n-2)^m -^n C_3(n-3)^m + \dots \text{and so on till} \\ ^n C_n(n-n)^m +, -, \text{ alternative}$$

$$= \sum_{i=0}^n (-1)^i nC_i (n-i)^m$$

here  $m=4$  and  $n=3$  (here above condition valid)

then

$$\text{number of onto function} \\ = 3^4 -^3 C_1(3-1)^4 +^3 C_2(3-2)^4 -^3 C_3(3-3)^4$$

$$= 81 - 3*16 + 3*1 - 1*0$$

$$= 36$$

ref@ <http://www.cse.iitd.ac.in/~mittal/stirling.html>

22 votes

-- Arjun Suresh (294k points)

Alternatively which is equivalent to put 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 .

$$\text{So Total no. of ways} = \binom{4}{2} \times \binom{2}{1} \times \binom{1}{1} \times 3 = 36$$

20 votes

-- Jagdish Singh (491 points)

#### 4.4.26 Functions: GATE2015-2\_54 [top](#)

<http://gateoverflow.in/8257>



Selected Answer

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

$$= 20 * 19 / (20 * 20) = 0.95$$

21 votes

-- Vikrant Singh (13.4k points)

#### 4.4.27 Functions: GATE2015-2\_GA\_3 [top](#)

<http://gateoverflow.in/8030>



Selected Answer

Answer: C

Put the value of x of all the options in  $f(x)$  and find value of  $f(x)$ .

11 votes

-- Rajarshi Sarkar (35k points)

**4.4.28 Functions: GATE2015-2\_GA\_9** [top](#)<http://gateoverflow.in/8040>

Selected Answer

It is given that  $h(p,q,r,s) = \text{remainder of } (p \times q)/(r \times s) \text{ if } (p \times q) > (r \times s) \text{ or remainder of } (r \times s)/(p \times q) \text{ if } (r \times s) > (p \times q).$

$h(2,5,7,3) = \text{remainder of } (7 \times 3)/(2 \times 5), \because (7 \times 3) > (2 \times 5)$

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:

$fg(1,4,6,8) = 8 \times 1, \because \max(1,4,6,8) = 8 \text{ & } \min(1,4,6,8) = 1$

Thus,  $fg(1,4,6,8) = 8$

Answer: 8

15 votes

-- Shyam Singh (1.5k points)

**4.4.29 Functions: ISI2017 MMA** [top](#)<http://gateoverflow.in/132738>

Selected Answer

good question.

yes u r correct . because we do not know the equation of function hence we can not predict at what point it is discontinuous. but we can definitely say that open interval (-infinity to +infinity) will include all possible number ,hence whatever will the function be , at some point it may violate the given condition . therefore option D is correct one

1 votes

-- Niraj Singh (1.8k points)

**4.4.30 Functions: TIFR2013-B-16** [top](#)<http://gateoverflow.in/2589>

ANS : D

as number of y's exactly k and yi is missing . if  $y_i = 1$  then result becomes 0 , because number of 1s are less than k now.

if  $y_i = 0$  then result becomes 1. as number of 1s remain same. removal of which won't effect final value.

3 votes

-- pramod (3.3k points)

**4.4.31 Functions: TIFR2014-B-17** [top](#)<http://gateoverflow.in/27344>

Note : NOT is absent in function f.

for two boolean variables, p1=1,p2=1, neither p1ANDp2 nor p1ORp2 is 0. ie, f(1,1) is never 0.

for i = 1 to n. f(p\_i) is a function of AND,OR operations on p\_i. if all p\_i=1, then f can never be 0;

similarly if all p\_i=0, f can never be 1;

Therefore A,B are not possible.

for j < n, if all p\_j=0 and p\_{n-j}=1, then f(p\_j, p\_{n-j}) = majority if each 0 is AND with each 1. The remaining 1's or 0's are OR with the result.

Hence MAJORITY can be computed from f.

Option C is possible.

To check odd number of 1's, for PARITY function, we have to get the result 0 for even number of 1's which is not possible with just AND and OR operations, how might we combine(since NOT is absent in f);

D is not possible.

For option E, we check by symmetry. When the inputs are complemented among 0's and 1's, can f change to f'? f is not always fixed for a particular input,. example, f(0,1) = 0OR1=1 0AND1=0,hence f can take multiple values for same input. Therefore E is also not right.

The only possible answer is C .Hence A,B,D,E are not possible.

2 votes

-- Vikranth Inti (523 points)

#### 4.4.32 Functions: TIFR2014-B-18 [top](#)

<http://gateoverflow.in/27351>



Selected Answer

The function  $g_z(Y)$  is defined as  $[k] \rightarrow \{0,1\}$  where  $[k]$  is the set of positive integers till  $k$ . That is, given a triplet  $(z_1, z_2, z_3)$ ,  $Y$  can take any value from 1 to  $k$ . If  $Y$  happens to be any of  $z_1, z_2, z_3$ ,  $g_z(Y) = 0$  due to the definition of  $f$  and  $g_z$ . Now even for different  $z$ ,  $g_z$  may be the same. Otherwise, the answer would have been how many ways we can form a triplet  $z$  - which gives  $k^3$  and for each  $z$  we get a function  $g_z$ .

For all unique combinations of  $z_1, z_2, z_3$  are unique, we are guaranteed that we get a distinct function  $g_z$ . This is clear from the definition of  $g_z$ . For example, suppose  $k = 4$ . The triplets are

$\{(1,2,3)\}$   
 $\{(1,2,4)\}$   
 $\{(1,3,4)\}$   
 $\{(2,3,4)\}$

For the triplet  $(1,2,3)$ ,  $Y$  can be made in 4 ways as  $(1,2,3,1), (1,2,3,2), (1,2,3,3)$  and  $(1,2,3,4)$ . Now, as per definition of  $g_z$ , we get  $g_{(1,2,3)} = \{\{1 \rightarrow 0\}, \{2 \rightarrow 0\}, \{3 \rightarrow 0\}, \{4 \rightarrow 1\}\}$ .

Similarly, for the next three triplets,  $g_z$  are different as in second only 3 maps to 1, in third one only 2 maps to 1 and in fourth one only 1 maps to 1.

So, in general, for any given  $k$ , we have  ${}^k C_3$  ways of forming distinct triplets and each of them guarantees a unique function  $g_z$  where exactly  $k-3$  elements map to 1 and 3 elements map to 0. Now, if any of the elements in the triplet are same, then the function becomes  $\{\{1 \rightarrow 0\}, \{2 \rightarrow 0\}, \dots, \{k \rightarrow 0\}\}$ , (all  $k$  elements mapping to 0) and this remains the same for any triplet. So, total number of possible functions are

$${}^k C_3 + 1$$

2 votes

-- Arjun Suresh (294k points)

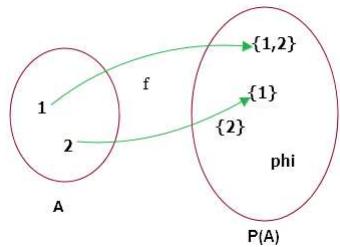
#### 4.4.33 Functions: TIFR2017-A-10 [top](#)

<http://gateoverflow.in/95272>



Selected Answer

Even if it can be **one-to-one** in the following way,



But, It cannot be onto,because, the number of elements in domain ( $A$ ) < the number of elements in co-domain ( $P(A)$ ). For a function to be **onto**, the domain should be able to cover all elements of co-domain with each element of the domain having exactly one image in co-domain.  
so option(B)

10 votes

-- Motamarri Anusha (11.6k points)

#### 4.4.34 Functions: TIFR2017-A-11 [top](#)



Selected Answer

$f : A \rightarrow B$  is injective if and only if, given any functions  $g, h : B \rightarrow A$  whenever  $f \circ g = f \circ h$ ,  $f \circ g = f \circ h$ , then  $g = h$ .

Refer to properties of Injective functions: [https://en.wikipedia.org/wiki/Injective\\_function](https://en.wikipedia.org/wiki/Injective_function)

Let us prove  $(\forall g, h : f(g(x)) = f(h(x)) \rightarrow g(x) = h(x)) \rightarrow f$  is one-to-one is true.

This is equivalent to,  $f$  is not one-to-one  $\rightarrow (\exists g, h : f(g(x)) = f(h(x)) \wedge g(x) \neq h(x))$

Let us assume LHS is true, i.e.  $f$  is not one-to-one.

Then there exists some  $c, d \in A$  such that,

$$f(c) = f(d) = a, \text{ where } a \text{ is an arbitrary element which belongs to } B$$

Let  $g$  and  $h$  be some functions out of all possible functions from  $B$  to  $A$  such that  $g \neq h$ ,

$$\text{i.e. } g(x) = c \text{ and } h(x) = d \quad \exists c, d \in A \text{ and } \exists x \in B$$

$\therefore f(g(x)) = f(c) = a$  and  $f(h(x)) = f(d) = a$  and  $g(x) \neq h(x)$ , i.e. RHS is also true.

Thus, whenever  $\forall g, h : f \circ g = f \circ h \rightarrow g = h$  is true,  $f$  is one-to-one.

Domain of  $f$  need not be finite. Let  $f : A \rightarrow B$  be identity function and  $A$  and  $B$  be infinite sets. Assume that  $f \circ g = f \circ h$  is true,

then  $f(g(x)) = f(h(x)) \rightarrow g(x) = h(x)$  will be true  $\forall g, h$  since  $f$  is an identity function. So, even if domain of  $f$  is not finite, the condition holds true.

4 votes

-- Silpa (671 points)

#### 4.5

#### Generating Functions(1) [top](#)

##### 4.5.1 Generating Functions: GATE2005-50 [top](#)

<http://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 set-theory&algebra normal generating-functions

[Answer](#)

## Answers: Generating Functions

### 4.5.1 Generating Functions: GATE2005-50 [top](#)



Selected Answer

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

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  $g(1) = 2, g(2) = 3 \Rightarrow g(i) = i + 1$

8 votes

-- Manish Joshi (25.2k points)

## 4.6

### Groups(22) [top](#)

### 4.6.1 Groups: GATE1990-2-x [top](#)

<http://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 groups

[Answer](#)

### 4.6.2 Groups: GATE1992-14a [top](#)

<http://gateoverflow.in/593>

If  
 $G$  is a group of even order, then show that there exists an element  
 $a \neq e$ ,  
 $e$ , the identity in  
 $G$ , such that  
 $a^2 = e$ .

gate1992 set-theory&algebra groups normal

[Answer](#)

### 4.6.3 Groups: GATE1992-14b [top](#)

<http://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](#) [groups](#) [normal](#)

[Answer](#)

#### 4.6.4 Groups: GATE1993\_28 [top](#)

<http://gateoverflow.in/2324>

Let  $(\{p, q\}, *)$  be a semigroup where  $p * p = q$ . Show that:

- a.  $p * q = q * p$  and
- b.  $q * q = q$

[gate1993](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

#### 4.6.5 Groups: GATE1994\_1.10 [top](#)

<http://gateoverflow.in/2451>

Some group  $(G, o)$  is known to be abelian. Then, which one of the following is true for  $G$ ?

- A.  $g = g^{-1}$  for every  $g \in G$
- B.  $g = g^2$  for every  $g \in G$
- C.  $(goh)^2 = g^2oh^2$  for every  $g, h \in G$
- D.  $G$  is of finite order

[gate1994](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

#### 4.6.6 Groups: GATE1995\_2.17 [top](#)

<http://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.  $A$  is closed under  $*$  but  $\langle A, *\rangle$  is not a semigroup.
- B.  $\langle A, *\rangle$  is a semigroup but not a monoid.
- C.  $\langle A, *\rangle$  is a monoid but not a group.
- D.  $\langle A, *\rangle$  is a group but not an abelian group.

[gate1995](#) [set-theory&algebra](#) [groups](#)

[Answer](#)

#### 4.6.7 Groups: GATE1995\_21 [top](#)

<http://gateoverflow.in/2659>

Let  $G_1$  and  $G_2$  be subgroups of a group  $G$ .

- a. Show that  $G_1 \cap G_2$  is also a subgroup of  $G$ .
- b. Is  $G_1 \cup G_2$  always a subgroup of  $G$ ?

[gate1995](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

## 4.6.8 Groups: GATE1996\_1.4 [top](#)

<http://gateoverflow.in/2708>

Which of the following statements is false?

- A. The set of rational numbers is an abelian group under addition
- B. The set of integers is an abelian group under addition
- C. The set of rational numbers form an abelian group under multiplication
- D. The set of real numbers excluding zero is an abelian group under multiplication

[gate1996](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

## 4.6.9 Groups: GATE1997\_3.1 [top](#)

<http://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](#) [groups](#) [normal](#)

[Answer](#)

## 4.6.10 Groups: GATE1998\_12 [top](#)

<http://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](#) [groups](#) [descriptive](#)

[Answer](#)

## 4.6.11 Groups: GATE2000-4 [top](#)

<http://gateoverflow.in/675>

Let  $S = \{0, 1, 2, 3, 4, 5, 6, 7\}$  and  $\otimes$  denote multiplication modulo 8, that is,  $x \otimes y = (xy) \bmod 8$

Prove that  $(\{0, 1\}, \otimes)$  is not a group.

Write 3 distinct groups  $(G, \otimes)$  where  $G \subset S$  and  $G$  has 2 elements.

[gate2000](#) [set-theory&algebra](#) [descriptive](#) [groups](#)

[Answer](#)

## 4.6.12 Groups: GATE2002-1.6 [top](#)

<http://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](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

### 4.6.13 Groups: GATE2003-7 [top](#)

<http://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](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

### 4.6.14 Groups: GATE2004-72 [top](#)

<http://gateoverflow.in/1068>

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](#) [set-theory&algebra](#) [groups](#) [normal](#)

[Answer](#)

### 4.6.15 Groups: GATE2005-13 [top](#)

<http://gateoverflow.in/1168>

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:

- 3 and 13
- 2 and 11
- 4 and 13
- 8 and 14

[gate2005](#) [set-theory&algebra](#) [normal](#) [groups](#)

[Answer](#)

### 4.6.16 Groups: GATE2005-46 [top](#)

<http://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](#) [set-theory&algebra](#) [groups](#) [normal](#)

**Answer****4.6.17 Groups: GATE2006-3** [top](#)<http://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](#) [set-theory&algebra](#) [groups](#) [normal](#)**Answer****4.6.18 Groups: GATE2007-21** [top](#)<http://gateoverflow.in/1219>

How many different non-isomorphic Abelian groups of order 4 are there?

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

[gate2007](#) [groups](#) [normal](#)**Answer****4.6.19 Groups: GATE2009-1** [top](#)<http://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](#) [set-theory&algebra](#) [easy](#) [groups](#)**Answer****4.6.20 Groups: GATE2009-22** [top](#)<http://gateoverflow.in/799>

For the composition table of a cyclic group shown below:

*	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>
<b>a</b>	a	b	c	d
<b>b</b>	b	a	d	c
<b>c</b>	c	d	b	a
<b>d</b>	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](#) [set-theory&algebra](#) [normal](#) [groups](#)**Answer****4.6.21 Groups: GATE2014-3-3** [top](#)<http://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 \_\_\_\_\_.

[gate2014-3](#) | [set-theory&algebra](#) | [groups](#) | [numerical-answers](#) | [normal](#)

[Answer](#)

## 4.6.22 Groups: GATE2014-3-50 [top](#)

<http://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 \_\_\_\_\_.

[gate2014-3](#) | [set-theory&algebra](#) | [groups](#) | [numerical-answers](#) | [normal](#)

[Answer](#)

## Answers: Groups

### 4.6.1 Groups: GATE1990-2-x [top](#)

<http://gateoverflow.in/84039>



Selected Answer

group-----> left inverse

semigroup -----> associative

monoid -----> identity

abelian group -----> commutative

4 votes

-- **kunal** (20.8k points)

### 4.6.2 Groups: GATE1992-14a [top](#)

<http://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)  $a$ .

Further rewriting meaning: the inverse of any element is not that element itself, it is someone else.

But I want to somehow show that at least one element has inverse as its own. I am trying a method let's 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 atleast 1 element as its own inverse.

Let  $|G| = 2n$ . Then we take out the identity and have  $2n-1$  elements to choose from.

Step1: select an element, if it is its own inverse then I am done.

Step2 (otherwise) : if inverse of  $a$  is not  $a$  and its  $b$ . then throw  $a$  and  $b$  out. (because if ' $a$ ' inverse is ' $b$ ' then ' $b$ ' inverse also ' $a$ ', and inverse of an element is unique.)

(Notice we always throw one pair)

In worst case I will end up throwing each element but one element will left as it is, because total number of elements are odd ( $2n-1$ ) and we always throw a pair of two (even).

Now question is, What is 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 !

6 votes

-- Sachin Mittal (7.1k points)

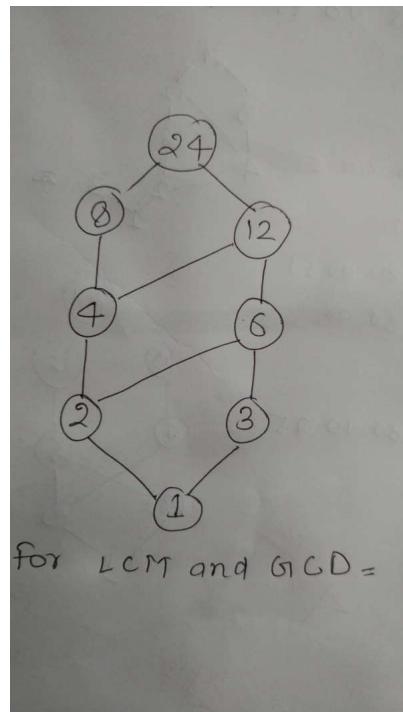
### 4.6.3 Groups: GATE1992-14b [top](#)

<http://gateoverflow.in/4358>



Selected Answer

ans is lattice .



6 votes

-- Prashant Singh (49.2k points)

### 4.6.4 Groups: GATE1993\_28 [top](#)

<http://gateoverflow.in/2324>

$$\begin{aligned} p*p &= q \\ p*p*p &= p*q \quad //\text{left operations with } p \\ (p*p)*p &= p*q \quad //\text{associative property} \\ q*p &= p*q \quad //p*p=q \end{aligned}$$

m not getting 2nd part.

4 votes

-- Digvijay (47k points)

### 4.6.5 Groups: GATE1994\_1.10 [top](#)

<http://gateoverflow.in/2451>



Selected Answer

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,

$$(go h)^2 = (go h)o(go h) = (go h)o(go h) = ((go h)o g)o h = (ho(gog))o h = (ho g^2)o h = (g^2 o h)o h = g^2 o(h o h) = g^2 o h^2$$

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.

Order of a group is the number of elements in it. Integer is an infinite set, so D is also false.

ref @ <http://math.stackexchange.com/questions/40996/prove-that-if-abi-abn-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>

15 votes

-- Arjun Suresh (294k points)

## 4.6.6 Groups: GATE1995\_2.17 [top](#)

<http://gateoverflow.in/2629>



Selected Answer

Answer: D

As the matrices are non singular so their determinant is  $\neq 0$ . Hence, the inverse matrix can be found.

But for a group to be abelian it should follow commutativity. As, matrix multiplication is not commutative so  $\langle A, * \rangle$  is a group but not an abelian group.

EDIT:

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 is possible to have  $AB = C$ , the easiest way to see this using determinant

$$\begin{aligned} AB &= C \\ \Rightarrow \det(AB) &= \det(C) \\ \det(AB) &= 0 [\because \det(C)=0 \text{ as } C \text{ is singular}] \\ \Rightarrow |A| \cdot |B| &= 0 \\ \Rightarrow |A| &= 0 \text{ or } |B| = 0 \end{aligned}$$

Which is contradiction as  $A$  and  $B$  both are non singular.

10 votes

-- Rajarshi Sarkar (35k points)

## 4.6.7 Groups: GATE1995\_21 [top](#)

<http://gateoverflow.in/2659>



Selected Answer

$G = \{1, 3, 5, 7\}$  is a group wrt  $\otimes_8$  Opeartion bcz all elements are less than 8 and co-prime to 8.

Let  $G_1 = \{1, 3\}$   $G_2 = \{1, 5\}$

each are sub-group of G having identity element 1. we can make composition table and cross verify.

a)  $G_1 \cap G_2 = \{1\}$  is a subgroup containing only identity element.(Trivial Subgroup).

b)  $G_1 \cup G_2 = \{1, 3, 5\}$  which is not a subgroup.

Reason when we draw composition table  $3*5=15 \text{ mod } 8=7$  which is not present in this subgroup so not satisfying closure property. Hence not a subgroup.

4 votes

-- Rajesh Pradhan (18.6k points)

#### 4.6.8 Groups: GATE1996\_1.4 [top](#)

<http://gateoverflow.in/2708>



Selected Answer

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.

5 votes

-- Rajarshi Sarkar (35k points)

#### 4.6.9 Groups: GATE1997\_3.1 [top](#)

<http://gateoverflow.in/2232>



Selected Answer

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)

13 votes

-- Sourav Roy (3.6k points)

#### 4.6.10 Groups: GATE1998\_12 [top](#)

<http://gateoverflow.in/1726>



Selected Answer

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  $(a * b) * a = c \Rightarrow (a * b) * a * a = c * a \Rightarrow a * b * a = c * a \Rightarrow c * a = a.$

Similarly,  $a * (a * b * a) = a * c \Rightarrow a * a * (b * a) = a * c \Rightarrow a * (b * a) = a * c \Rightarrow a * c = a = c * a.$

So,  $c = a.$

c. Let  $(a * b) * c = d. \Rightarrow (a * b) * c * c = d * c \Rightarrow a * b * c = d * c \Rightarrow d * c = d.$

Similarly,  $a * (a * b * c) = a * d \Rightarrow a * a * (b * c) = a * d \Rightarrow a * (b * c) = a * d \Rightarrow a * d = d.$

Thus  
 $d * c = a * d = d$

Now  
 $c * d * c = c * a * d = c * d \Rightarrow c = c * a * d = c * d$

and

$d * c * a = a * d * a = d * a \Rightarrow d * c * a = a = d * a$

So,

$a * c = (d * a) * (c * d) = d * (a * c) * d = d.$

Thus,  
 $a * b * c = a * c.$

5 votes

-- Arjun Suresh (294k points)

#### 4.6.11 Groups: GATE2000-4 [top](#)

<http://gateoverflow.in/675>



Selected Answer

A	$\begin{array}{c cc} \oplus & 0 & 1 \\ \hline 0 & 0 & 0 \\ 1 & 0 & 1 \end{array}$	$\begin{array}{c cc} \oplus & 1 & 3 \\ \hline 1 & 1 & 3 \\ 3 & 3 & 1 \end{array}$	$\begin{array}{c cc} \oplus & 1 & 5 \\ \hline 1 & 1 & 5 \\ 5 & 5 & 1 \end{array}$	$\begin{array}{c cc} \oplus & 1 & 7 \\ \hline 1 & 1 & 7 \\ 7 & 7 & 1 \end{array}$
---	-----------------------------------------------------------------------------------	-----------------------------------------------------------------------------------	-----------------------------------------------------------------------------------	-----------------------------------------------------------------------------------

A) 1 is the identity element. inverse doesn't exist for zero. so it is not a group

7 votes

-- Anu (10,6k points)

#### 4.6.12 Groups: GATE2002-1.6 [top](#)

<http://gateoverflow.in/810>



Selected Answer

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.

11 votes

-- Rajarshi Sarkar (35k points)

### 4.6.13 Groups: GATE2003-7 top

<http://gateoverflow.in/898>



Selected Answer

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 and hence, ans should be (a).

17 votes

-- Madhur Rawat (2.6k points)

### 4.6.14 Groups: GATE2004-72 top

<http://gateoverflow.in/1068>



Selected Answer

From First row you can conclude that e is the identity element.

=> Using the above fact, from second row you can conclude that a and c are inverses of each other.

=> In fourth row:

First element :  $c * e = c$  (e is identity)

Second element :  $c * a = e$  (inverse)

Option 4 matches this.

7 votes

-- Mojo Jojo (4.2k points)

### 4.6.15 Groups: GATE2005-13 top

<http://gateoverflow.in/1163>



Selected Answer

Option c.

Identity element here is 1.

$$4 * 4 \bmod 15 = 1$$

$$7 * 13 \bmod 15 = 1.$$

9 votes

-- anshu (3.2k points)

### 4.6.16 Groups: GATE2005-46 top

<http://gateoverflow.in/1171>



Selected Answer

Given Information -  $\rightarrow$  Matrix is upper triangular. It's 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 &  $|AB| = |A||B| =$  Non zero as  $|A|, |B|$  are non zero)
2. Associative (Matrix multiplication is associative).
3. Identity  $\rightarrow$  Identity Matrix In
4. Inverse, as determinant is non zero there exist inverse for every matrix.

So it is group.

13 votes

-- Akash (43.8k points)

### 4.6.17 Groups: GATE2006-3 [top](#)

<http://gateoverflow.in/882>



Selected Answer

Answer: C

3 has an inverse, which is 7. As,  $3 \cdot 7 \bmod 10 = 1$ .

9 votes

-- Rajarshi Sarkar (35k points)

### 4.6.18 Groups: GATE2007-21 [top](#)

<http://gateoverflow.in/1219>



Selected Answer

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)

14 votes

-- Digvijay (47k points)

### 4.6.19 Groups: GATE2009-1 [top](#)

<http://gateoverflow.in/785>



Selected Answer

Grupoid- closure property Semigroup- closure,associative Monoid-closure,associative,identity Group-closure,associative,identity,inverse Abelian group- group property+commutative So ans should be A..

14 votes

-- SONU (2.4k points)

### 4.6.20 Groups: GATE2009-22 [top](#)

<http://gateoverflow.in/799>



Selected Answer

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 can't generate any other element except a, so a is not a generator.

Now for b,  $b * b = b$ . Then  $(b * b) * b = b * b = b$ , and so on. Here again we see that we can only generate a and b on repeated application of b on itself. So it is not a generator.

Now for c,  $c * c = c$ . Then  $(c * c) * c = c * c = c$ . Then  $(c * c * c) * c = c * c = c$ . So we see that we have generated all elements of group. So c is a generator.

For d,  $d * d = d$ . Then  $(d * d) * d = d * d = d$ . Then  $(d * d * d) * d = d * d = d$ . So we have generated all elements of group from d, so d is a generator.

So c and d are generators. So 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)

14 votes

-- Anu (10.6k points)

### 4.6.21 Groups: GATE2014-3-3 [top](#)

<http://gateoverflow.in/2037>



Selected Answer

Lagranges 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 given the size of L is atleast 4(1 and 3 eliminated) and not equal to G(15 eliminated), the only size left is 5.

Size of L is 5.

29 votes

-- Srinath Jayachandran (3.7k points)

## 4.6.22 Groups: GATE2014-3-50 top

<http://gateoverflow.in/2084>



Selected Answer

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  $x$ .

$x * o$ , 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.)

$x * y * o$ , obviously u cant 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. :)

17 votes

-- Sachin Mittal (7.1k points)

Exp:  $x * x = e \Rightarrow x$  is its own inverse  
 $y * y = e \Rightarrow y$  is its own inverse  
 $(x * y) * (x * y) = e \Rightarrow (x * y)$  is its own inverse  
 $(y * x) * (y * x) = e \Rightarrow (y * x)$  is its own inverse  
also  $x * x * e = e * e$  can be rewritten as follows  
 $x * y * y * x = e * y * y * e = e$  [;  $y * y = e$ ]  
 $(x * y) * (y * x) = e$  shows that  $(x * y)$  and  $(y * x)$   
Are each other's inverse and we already know that  
 $(x * y)$  and  $(y * x)$  are inverse of its own.  
As per (G<sub>\*</sub>) to be group any element should have  
only one inverse element (unique)  
This process  $x * y = y * x$  (is one element)  
So the elements of such group are 4 which are  $\{x, y, e, x * y\}$

And so the answer is 4.

14 votes

-- Gate Keeda (19.1k points)

## 4.7

## Inequality(1) top

### 4.7.1 Inequality: GATE1987-1-xxi [top](#)

<http://gateoverflow.in/80377>

If  $a, b$ , and  $c$  are constants, which of the following is a linear inequality?

- A.  $ax + bcy = 0$
- B.  $ax^2 + cy^2 = 21$
- C.  $abx + a^2y \geq 15$
- D.  $xy + ax \geq 20$

[gate1987](#) [set-theory&algebra](#) [inequality](#)

[Answer](#)

## Answers: Inequality

### 4.7.1 Inequality: GATE1987-1-xxi [top](#)

<http://gateoverflow.in/80377>



Selected Answer

Linear inequalities with 2 variables are of the form  $Px + Qy \leq K$  or  $Px + Qy \geq K$  for some constants P and Q.

- 1) is an equality.
- 2) is not linear since the power of x and y are not 1.
- 3) it is a linear inequality.
- 4) not linear.

So correct answer is C)

2 votes

-- air1 (3.3k points)

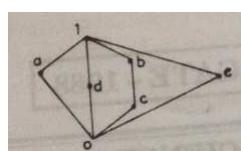
## 4.8

### Lattice(9) [top](#)

### 4.8.1 Lattice: GATE1988-1vii [top](#)

<http://gateoverflow.in/91351>

The complement(s) of the element 'a' in the lattice shown in below figure is (are) \_\_\_\_\_



[gate1988](#) [descriptive](#) [lattice](#) [set-theory&algebra](#)

[Answer](#)

### 4.8.2 Lattice: GATE1994\_2.9 [top](#)

<http://gateoverflow.in/2476>

The Hasse diagrams of all the lattices with up to four elements are \_\_\_\_\_ (write all the relevant Hasse diagrams)

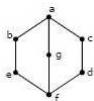
[gate1994](#) [set-theory&algebra](#) [lattice](#) [normal](#)

[Answer](#)

### 4.8.3 Lattice: GATE1997\_3.3 [top](#)

<http://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](#)

#### 4.8.4 Lattice: GATE2002-4 [top](#)

<http://gateoverflow.in/851>

$S = \{(1,2), (2,1)\}$  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  $(\square(S), \subseteq)$

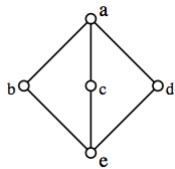
gate2002 set-theory&algebra normal lattice descriptive

[Answer](#)

#### 4.8.5 Lattice: GATE2005-9 [top](#)

<http://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

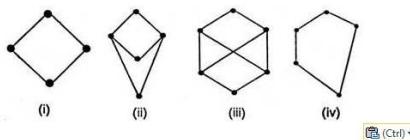
gate2005 set-theory&algebra lattice normal

[Answer](#)

#### 4.8.6 Lattice: GATE2008-IT-28 [top](#)

<http://gateoverflow.in/3318>

Consider the following Hasse diagrams.



(Ctrl) +

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

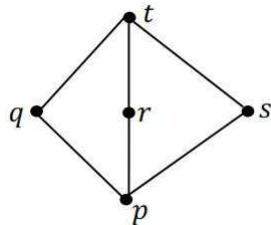
[gate2008-it](#) [set-theory&algebra](#) [lattice](#) [normal](#)

Answer

### 4.8.7 Lattice: GATE2015-1\_34 [top](#)

<http://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.  $\frac{1}{5} < p_r < 1$

[gate2015-1](#) [set-theory&algebra](#) [normal](#) [lattice](#)

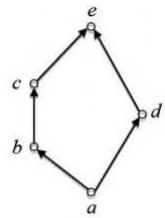
Answer

### 4.8.8 Lattice: GATE2017-2-21 [top](#)

<http://gateoverflow.in/110278>

Consider the set  $X = \{a, b, c, d, e\}$  under partial ordering. The Hasse diagram of the partial order  $(X, R)$  is shown below.

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 \_\_\_\_\_

[gate2017-2](#) [discrete-mathematics](#) [lattice](#) [numerical-answers](#)

Answer

### 4.8.9 Lattice: TIFR2012-B-4 [top](#)

<http://gateoverflow.in/25090>

Let  $\wedge, \vee$  denote the meet and join operations of lattice. A lattice is called distributive if for all  $x, y, z$ ,

$$x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$$

It is called complete if meet and join exist for every subset. It is called modular if for all  $x, y, z$

$$z \leq x \Rightarrow x \wedge (y \vee z) = (x \wedge y) \vee z$$

The positive integers under divisibility ordering i.e.  $p \leq q$  if  $p$  divides  $q$  forms a.

- a. Complete lattice.

- b. Modular, but not distributive lattice.
- c. Distributive lattice.
- d. Lattice but not a complete lattice.
- e. Under the given ordering positive integers do not form a lattice.

[tifr2012](#) [set-theory&algebra](#) [lattice](#)

[Answer](#)

## Answers: Lattice

### 4.8.1 Lattice: GATE1988-1vii [top](#)

<http://gateoverflow.in/91351>



Selected Answer

$\text{lub}(a,e) = \text{lub}(a,b) = \text{lub}(a,c) = \text{lub}(a,d) = I$  (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 complements of a.

1 upvote

-- Ashwani Kumar (3.2k points)

### 4.8.2 Lattice: GATE1994\_2.9 [top](#)

<http://gateoverflow.in/2476>



Selected Answer

1. Diamond structure
2. Straight line structure

1 upvote

-- Digvijay (47k points)

### 4.8.3 Lattice: GATE1997\_3.3 [top](#)

<http://gateoverflow.in/2234>



Selected Answer

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.

1 upvote

-- Rajarshi Sarkar (35k points)

### 4.8.4 Lattice: GATE2002-4 [top](#)

<http://gateoverflow.in/857>



Selected Answer

$S = \{(1,2), (2,1)\} \rightarrow$  This relation is Irreflexive, Symmetric, Not Transitive, Not Reflexive, Not Asymmetric, Not antisymmetric.

Equivalence Relation  $\rightarrow$  Symmetric, Transitive, Reflexive.

It is not transitive & Reflexive.

So Reflexive closure of S = { (1,1),(2,2),(3,3),(1,2),(2,1) }

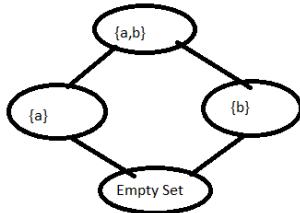
After taking transitive closure relation does not change.

Answer S = { (1,1),(2,2),(3,3),(1,2),(2,1) }

$S = \{a, b\}$

$P(S) = \{\{\}, \{a\}, \{b\}, \{a, b\}\}$

Related Hasse Diagram



6 votes

-- Akash (43.8k points)

#### 4.8.5 Lattice: GATE2005-9 [top](#)

<http://gateoverflow.in/1158>



Selected Answer

Option b , a lattice has lub and glb but to be distributive it should have unique complement.

10 votes

-- anshu (3.2k points)

#### 4.8.6 Lattice: GATE2008-IT-28 [top](#)

<http://gateoverflow.in/3318>



Selected Answer

ans is (A)

hasse diagram is lattice when every pair of element have least upper bound and greatest lower bound.in fig 2 and 3 every element will not have least upper bound and greatest lower bound so they are not lattice.

15 votes

-- neha pawar (4.4k points)

#### 4.8.7 Lattice: GATE2015-1\_34 [top](#)

<http://gateoverflow.in/8281>



Selected Answer

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 all findings make option A, B, C as FALSE.

Hence, answer = **option D**

1 26 votes

-- Arjun Suresh (294k points)

### 4.8.8 Lattice: GATE2017-2-21 [top](#)

<http://gateoverflow.in/110278>



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

1 20 votes

-- Prashant Singh (49.2k points)

### 4.8.9 Lattice: TIFR2012-B-4 [top](#)

<http://gateoverflow.in/25090>

Lattice with gcd as meet and lcm as join.

it is distributive

$$\begin{aligned} \gcd(a, \text{lcm}(b, c)) &= \text{lcm}(\gcd(a, b), \gcd(a, c)) \\ \text{lcm}(a, \gcd(b, c)) &= \gcd(\text{lcm}(a, b), \text{lcm}(a, c)). \end{aligned}$$

it is complete semi-meet lattice as there is no upper bound it is not complete semi-join lattice.

ANS: C

1 2 votes

-- pramod (3.3k points)

## 4.9

### Lines Curves(1) [top](#)

#### 4.9.1 Lines Curves: GATE2007-IT-80 [top](#)

<http://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  $n(n - 1)/2$  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 of  $P_a$  and  $P_b$  is minimum
- D. None of the above

gate2007-it lines-curves

Answer

### Answers: Lines Curves

#### 4.9.1 Lines Curves: GATE2007-IT-80 [top](#)

<http://gateoverflow.in/3532>

Answer: C

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

For gradient to be maximum  $x_2 - x_1$  should be minimum.

3 votes

-- Rajarshi Sarkar (35k points)

**4.10****Mathematical Induction(2)** [top](#)**4.10.1 Mathematical Induction: GATE1995\_23** [top](#)<http://gateoverflow.in/2661>Prove using mathematical induction for  $n \geq 5, 2^n > n^2$ [gate1995](#) [set-theory&algebra](#) [proof](#) [mathematical-induction](#)[Answer](#)**4.10.2 Mathematical Induction: GATE2000-3** [top](#)<http://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](#) [set-theory&algebra](#) [mathematical-induction](#) [descriptive](#)[Answer](#)**Answers: Mathematical Induction****4.10.1 Mathematical Induction: GATE1995\_23** [top](#)<http://gateoverflow.in/2661>

Selected Answer

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) $RHS = (n+1)^2 = n^2 + 2n + 1 < LHS$ , hence proved.

9 votes

-- Arjun Suresh (294k points)

**4.10.2 Mathematical Induction: GATE2000-3** [top](#)<http://gateoverflow.in/674>

Selected Answer

 $s_3 = 1 + \min(s_1, s_2) = 1 + \min(1, 1) = 2 = \lceil \frac{3}{2} \rceil$ .

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)

7 votes

-- Arjun Suresh (294k points)

**4.11****Number Theory(9)** [top](#)

### 4.11.1 Number Theory: GATE1991-15,a [top](#)

<http://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

Answer

### 4.11.2 Number Theory: GATE1995\_7 [top](#)

<http://gateoverflow.in/2642>

- Determine the number of divisors of 600.
- Compute without using power series expansion  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$

gate1995 normal number-theory

Answer

### 4.11.3 Number Theory: GATE2005-IT-34 [top](#)

<http://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  $n$ .

- $p(q - 1)$
- $pq$
- $(p^2 - 1)(q - 1)$
- $p(p - 1)(q - 1)$

gate2005-it set-theory&algebra normal number-theory

Answer

### 4.11.4 Number Theory: GATE2007-IT-16 [top](#)

<http://gateoverflow.in/3449>

The minimum positive integer  $p$  such that  $3^p$  modulo 17 = 1 is

- 5
- 8
- 12
- 16

gate2007-it set-theory&algebra normal number-theory

Answer

### 4.11.5 Number Theory: GATE2008-IT-24 [top](#)

<http://gateoverflow.in/3285>

The exponent of 11 in the prime factorization of  $300!$  is

- 27
- 28
- 29
- 30

gate2008-it set-theory&algebra normal number-theory

Answer

### 4.11.6 Number Theory: GATE2014-2-49 [top](#)

<http://gateoverflow.in/2015>

The number of distinct positive integral factors of 2014 is \_\_\_\_\_

gate2014-2 set-theory&algebra easy numerical-answers number-theory

Answer

### 4.11.7 Number Theory: GATE2015-2\_9 [top](#)

<http://gateoverflow.in/8058>

The number of divisors of 2100 is \_\_\_\_.

gate2015-2 | set-theory&algebra | number-theory | easy | numerical-answers

[Answer](#)

### 4.11.8 Number Theory: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123882>

Q11 If  $\alpha_1, \alpha_2, \dots, \alpha_n$  are the positive numbers then

$$\frac{\alpha_1}{\alpha_2} + \frac{\alpha_2}{\alpha_3} + \dots + \frac{\alpha_{n-1}}{\alpha_n} + \frac{\alpha_n}{\alpha_1}$$

is always

- A)  $\geq n$
- B)  $\leq n$
- C)  $\leq n^{\frac{1}{2}}$
- D) None of the above

isi2004 | set-theory&algebra | number-theory

[Answer](#)

### 4.11.9 Number Theory: ISI 2016 [top](#)

<http://gateoverflow.in/45216>

Find the number of positive integers  $n$  for which  $n^2+96$  is a perfect square.

isi-2016 | set-theory&algebra | number-theory

[Answer](#)

## Answers: Number Theory

### 4.11.1 Number Theory: GATE1991-15,a [top](#)

<http://gateoverflow.in/542>

$x$  &  $y$  can be expressed as

$$x = 2^{a_1} \cdot 3^{a_2} \cdots P^{a_n}$$

$$y = 2^{b_1} \cdot 3^{b_2} \cdots P^{b_n}$$

where  $a_i$  &  $b_i \geq 0$  for  $1 \leq i \leq n$ , and  $P$  is a prime number.

$$x * y = 2^{a_1+b_1} \cdot 3^{a_2+b_2} \cdots P^{a_n+b_n}$$

$$\text{LCM}(x,y) = 2^{\max(a_1+b_1)} \cdot 3^{\max(a_2+b_2)} \cdots P^{\max(a_n+b_n)}$$

$$\text{HCF}(x,y) = 2^{\min(a_1+b_1)} \cdot 3^{\min(a_2+b_2)} \cdots P^{\min(a_n+b_n)}$$

$$\text{Since, } \max(a_i + b_i) + \min(a_i + b_i) = a_i + b_i$$

$$\text{So, } \text{LCM}(x,y) * \text{HCF}(x,y) = 2^{a_1+b_1} \cdot 3^{a_2+b_2} \cdots P^{a_n+b_n} = x * y$$

Proved!

3 votes

-- ZAHID WAKEEL (273 points)

### 4.11.2 Number Theory: GATE1995\_7 [top](#)

<http://gateoverflow.in/2642>

Answer for Part A)

Prime factorization of 600 =  $2^3 * 3 * 5^2$

Total no of divisors =  $(3+1)(1+1)(2+1) = 4 * 2 * 3 = 24$  Divisors

Here we are choosing either 0, 1, 2 or 3 2's so  $3 + 1 = 4$  choices for 2 & So on for all .

In case we do not choose any of above factor, we get 1 as divisor !

5 votes

-- Akash (43.8k points)

### 4.11.3 Number Theory: GATE2005-IT-34 [top](#)

<http://gateoverflow.in/3780>



Selected Answer

$n = p^2q$ , where p and q are prime.

So, number of multiple of p in n = pq

Number of multiples of q in n =  $p^2$

Number of multiples of pq in n = p

Since prime factorisation of n consists of only p and q,  $\text{gcd}(m, n)$  will be a multiple of these or 1. So, number of possible m such that  $\text{gcd}(m, n)$  is 1 will be n - number of multiples of either p or q.

$$= n - p^2 - pq + p$$

$$= p^2q - p^2 - pq + p$$

$$= p(pq - p - q + 1)$$

$$= p(p-1)(q-1)$$

10 votes

-- Arjun Suresh (294k points)

### 4.11.4 Number Theory: GATE2007-IT-16 [top](#)

<http://gateoverflow.in/3449>



Selected Answer

D) fermat's little theorem

6 votes

-- Shaun Patel (6.9k points)

### 4.11.5 Number Theory: GATE2008-IT-24 [top](#)

<http://gateoverflow.in/3285>



Selected Answer

$300!$  is  $1 * 2 * 3 * \dots * 300$

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.

15 votes

-- Happy Mittal (10.9k points)

### 4.11.6 Number Theory: GATE2014-2-49 [top](#)

<http://gateoverflow.in/2015>



Selected Answer

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.)

12 votes

-- Arjun Suresh (294k points)

### 4.11.7 Number Theory: GATE2015-2\_9 [top](#)

<http://gateoverflow.in/8058>



Selected Answer

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)

14 votes

-- Rajarshi Sarkar (35k points)

### 4.11.8 Number Theory: ISI 2004 MIII [top](#)

<http://gateoverflow.in/12388>



Selected Answer

Given ,

$a_1, a_2, \dots, a_n$  are the positive numbers ,

So  $(a_1 / a_2), (a_2 / a_3)$  etc will be also positive numbers..

Hence applying A.M.  $\geq$  G.M ,

$$\begin{aligned} & \left( \frac{(a_1 / a_2)}{n} + \frac{(a_2 / a_3)}{n} + \dots + \frac{(a_n / a_1)}{n} \right)^{1/n} \geq \left( \frac{(a_1 / a_2)}{n} \cdot \frac{(a_2 / a_3)}{n} \cdots \frac{(a_n / a_1)}{n} \right)^{1/n} \\ \Rightarrow & \left( \frac{(a_1 / a_2)}{n} + \frac{(a_2 / a_3)}{n} + \dots + \frac{(a_n / a_1)}{n} \right)^{1/n} \geq n \cdot \left( \frac{(a_1 / a_2)}{n} \cdot \frac{(a_2 / a_3)}{n} \cdots \frac{(a_n / a_1)}{n} \right)^{1/n} \\ \Rightarrow & \left( \frac{(a_1 / a_2)}{n} + \frac{(a_2 / a_3)}{n} + \dots + \frac{(a_n / a_1)}{n} \right)^{1/n} \geq n^{1/n} \\ \Rightarrow & \left( \frac{(a_1 / a_2)}{n} + \frac{(a_2 / a_3)}{n} + \dots + \frac{(a_n / a_1)}{n} \right)^{1/n} \geq n \end{aligned}$$

**Hence A) is the correct answer..**

6 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

### 4.11.9 Number Theory: ISI 2016 [top](#)

<http://gateoverflow.in/45218>



Selected Answer

$$\begin{aligned} n^2 + 96 &= x^2 \\ x^2 - n^2 &= 96 \\ (x-n)(x+n) &= 96 \end{aligned}$$

Since, x and n both should be positive integer.  $(x-n)$  and  $(x+n)$  will be divisors of 96.

By observation,  $(x-n)$  should be smaller than  $(x+n)$  because x and n are positive integers.  
 $(x-n) = k_1 \rightarrow x = n+k_1$

$$\begin{aligned} (x+n) &= k_2 \\ \rightarrow n+k_1+n &= k_2 \\ \rightarrow 2n+k_1 &= k_2 \\ \rightarrow 2n &= k_2-k_1 \\ \rightarrow \\ n &= \left(\frac{k_2-k_1}{2}\right) \end{aligned}$$

As we have seen from above,  
 $n = \left(\frac{k_2-k_1}{2}\right)$

Therefore, for  $n$  to be a positive integer,  $k_2-k_1$  should be even. **That is, both should be odd or both should be even.**

There are 6 pairs of divisors when multiplied becomes  $96 = (1, 96), (2, 48), (3, 32), (4, 24), (6, 16), (8, 12)$ .

Therefore, there are **only 4** such possibilities. Phew!

6 votes

-- Shyam Singh (1.4k points)

## 4.12

## Partial Order(13) [top](#)

### 4.12.1 Partial Order: GATE1991\_01,xiv [top](#)

<http://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

Answer

### 4.12.2 Partial Order: GATE1993\_8.5 [top](#)

<http://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

### 4.12.3 Partial Order: GATE1996\_1.2 [top](#)

<http://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

### 4.12.4 Partial Order: GATE1997\_6.1 [top](#)

<http://gateoverflow.in/2257>

A partial order  $\leq$  is defined on the set  $S = \{x, a_1, a_2, \dots, a_n, y\}$  as  $x \leq a_i$  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

#### 4.12.5 Partial Order: GATE1998\_11 [top](#)

<http://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

Answer

#### 4.12.6 Partial Order: GATE2003-31 [top](#)

<http://gateoverflow.in/921>

Let  $(S, \leq)$  be a partial order with two minimal elements a and b, and a maximum element c. Let  $P: S \rightarrow \{\text{True, False}\}$  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 set-theory&algebra partial-order normal

Answer

#### 4.12.7 Partial Order: GATE2004-73 [top](#)

<http://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 set-theory&algebra partial-order normal

Answer

#### 4.12.8 Partial Order: GATE2007-26 [top](#)

<http://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  $S: \pi_1 = \{\overline{abcd}\}, \pi_2 = \{\overline{ab}, \overline{cd}\}, \pi_3 = \{\overline{abc}, \overline{d}\}, \pi_4 = \{\overline{a}, \overline{b}, \overline{c}, \overline{d}\}$ . 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:

gate2007 set-theory&algebra normal partial-order

Answer

### 4.12.9 Partial Order: GATE2007-IT-23 [top](#)

<http://gateoverflow.in/3458>

A partial order  $P$  is defined on the set of natural numbers as follows. Here  $x/y$  denotes integer division.

- i.  $(0, 0) \in P$ .
- ii.  $(a, b) \in P$  if and only if  $a \% 10 \leq b \% 10$  and  $(a/10, b/10) \in P$ .

Consider the following ordered pairs:

- i.  $(101, 22)$
- ii.  $(22, 101)$
- iii.  $(145, 265)$
- iv.  $(0, 153)$

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

### 4.12.10 Partial Order: TIFR2012-B-5 [top](#)

<http://gateoverflow.in/25092>

Let  $R$  be a binary relation over a set  $S$ . The binary relation  $R$  is called an equivalence relation if it is reflexive transitive and symmetric. The relation is called partial order if it is reflexive, transitive and anti symmetric. (Notation: Let  $aRb$  denote that order pair  $(a, b) \in R$ .) The relation  $R$  is called a well-order if  $R$  is a partial order and there does not exist an infinite descending chain (with respect to  $R$ ) within  $S$ . An infinite sequence  $x_1, x_2, \dots$  of elements of  $S$  is called an infinite descending chain if for all  $i$  we have  $x_{i+1}Rx_i$  and  $x_i \neq x_{i+1}$ .

Take  $S = \mathbb{N} \times \mathbb{N}$  and let the binary relation  $\sqsubseteq$  over  $S$  be such that  $(i_1, j_1) \sqsubseteq (i_2, j_2)$  if and only if either  $(i_1 < i_2)$  or  $((i_1 = i_2) \wedge (j_1 \leq j_2))$ . Which statement is true of  $\sqsubseteq$ ?

- a.  $\sqsubseteq$  is an equivalence relation but not a well order.
- b.  $\sqsubseteq$  is a partial order but not a well order.
- c.  $\sqsubseteq$  is a partial order and a well order.
- d.  $\sqsubseteq$  is an equivalence relation and a well order.
- e.  $\sqsubseteq$  is neither a partial order nor an equivalence relation.

tifr2012 set-theory&algebra partial-order

Answer

### 4.12.11 Partial Order: TIFR2013-B-4 [top](#)

<http://gateoverflow.in/25664>

A set  $S$  together with partial order  $\ll$  is called a well order if it has no infinite descending chains, i.e. there is no infinite sequence  $x_1, x_2, \dots$  of elements from  $S$  such that  $x_{i+1} \ll x_i$  and  $x_{i+1} \neq x_i$  for all  $i$ .

Consider the set of all words (finite sequence of letters  $a - z$ ), denoted by  $W$ , in dictionary order.

- a. Between “aa” and “az” there are only 24 words.
- b. Between “aa” and “az” there are only  $2^{24}$  words.
- c.  $W$  is not a partial order.
- d.  $W$  is a partial order but not a well order.
- e.  $W$  is a well order.

tifr2013 set-theory&algebra partial-order

Answer

### 4.12.12 Partial Order: TIFR2014-B-15 [top](#)

<http://gateoverflow.in/27322>

Consider the set  $N^*$  of finite sequences of natural numbers with  $x \leq_p y$  denoting that sequence  $x$  is a prefix of sequence  $y$ . Then, which of the following is true?

- $N^*$  is uncountable.
- $\leq_p$  is a total order.
- Every non-empty subset of  $N^*$  has a least upper bound.
- Every non-empty subset of  $N^*$  has a greatest lower bound.
- Every non-empty finite subset of  $N^*$  has a least upper bound.

tifr2014 | set-theory&algebra | partial-order

Answer

### 4.12.13 Partial Order: TIFR2014-B-16 [top](#)

<http://gateoverflow.in/27341>

Consider the ordering relation  $x | y \subseteq N \times N$  over natural numbers  $N$  such that  $x | y$  if there exists  $z \in N$  such that  $x \bullet z = y$ . A set is called lattice if every finite subset has a least upper bound and greatest lower bound. It is called a complete lattice if every subset has a least upper bound and greatest lower bound. Then,

- $|$  is an equivalence relation.
- Every subset of  $N$  has an upper bound under  $|$ .
- $|$  is a total order.
- $(N, |)$  is a complete lattice.
- $(N, |)$  is a lattice but not a complete lattice.

tifr2014 | set-theory&algebra | partial-order

Answer

## Answers: Partial Order

### 4.12.1 Partial Order: GATE1991\_01,xiv [top](#)

<http://gateoverflow.in/509>



Selected Answer

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.

7 votes

-- Rajarshi Sarkar (35k points)

### 4.12.2 Partial Order: GATE1993\_8.5 [top](#)

<http://gateoverflow.in/2303>



Selected Answer

relation less than is :

- not Reflexive
- Irreflexive
- not symmetric
- Asymmetric
- Anti symmetric

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' bt still Antisymmetric.  
as  $\{(1,1) (1,2)\}$

not Asymmetric and Irreflexive = Antisymmetric  
Option E

9 votes

-- Digvijay (47k points)

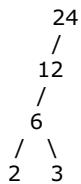
### 4.12.3 Partial Order: GATE1996\_1.2 [top](#)

<http://gateoverflow.in/2706>



Answer: B

Hasse Diagram is:



8 votes

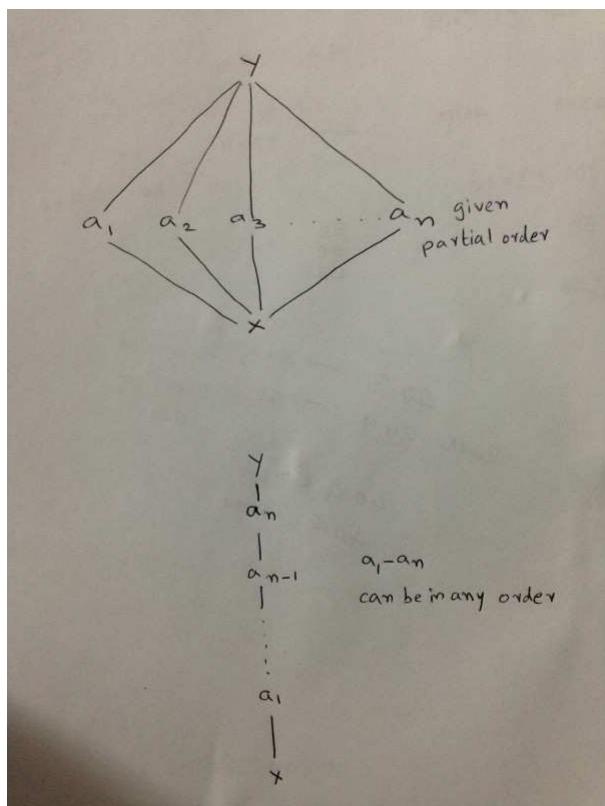
-- Rajarshi Sarkar (35k points)

#### 4.12.4 Partial Order: GATE1997\_6.1 [top](#)

<http://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.

15 votes

-- Arjun Suresh (294k points)

#### 4.12.5 Partial Order: GATE1998\_11 [top](#)

<http://gateoverflow.in/1725>

- (a) the ordered pairs of the equivalence relations induced = { (a,a) (a,b) (a,c) (b,a) (b,b) (b,c) (c,a) (c,b) (c,c) (d,d) }

ps : equivalence relations = each partition power set - phi

3 votes

-- Nitin Sharma (1.8k points)

#### 4.12.6 Partial Order: GATE2003-31 [top](#)

<http://gateoverflow.in/821>



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)

11 votes

-- Arjun Suresh (294k points)

#### 4.12.7 Partial Order: GATE2004-73 [top](#)

<http://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  $\{\{1,3,5\}, \{1,2,4\}\}$ , 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. So option (A) is correct.

13 votes

-- Rajarshi Sarkar (35k points)

#### 4.12.8 Partial Order: GATE2007-26 [top](#)

<http://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)

16 votes

-- Akash (43.8k points)

### 4.12.9 Partial Order: GATE2007-IT-23 [top](#)



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  $1 < 2$

and

(iv) (0, 153)  $\Rightarrow 0 < 3$  and no need to examine further

16 votes

-- Vikrant Singh (13.4k points)

### 4.12.10 Partial Order: TIFR2012-B-5 [top](#)

Answer -> C

$S = (i_1 j_1) \sqsubseteq (i_2 j_2)$  iff  $(i_1 < i_2)$  or  $((i_1 = i_2) \wedge (j_1 \leq j_2))$

1.  $(m, n) R (m, n)$  ?

yes, here  $m < n$ , so we go at second criteria.

Now  $m=n$  &  $n=n$ . So This is reflexive.

2. Antisymmetric

$(1, 2) R (2, 3)$

Is  $(2, 3) R (1, 2)$ ? No as  $2 < 1$ .

If you see the definition, it is clear that other than diagonal element no other element is related to itself. So antisymmetric.

3. Transitive ->

$(1, 2) R (2, 3)$  &  $(2, 3) R (2, 4)$  (It is easy to prove)

$(1, 2) R (2, 4)$ ? Yes. It can be seen easily from following property

$S = (i_1 j_1) \sqsubseteq (i_2 j_2)$  iff  $(i_1 < i_2)$  or  $((i_1 = i_2) \wedge (j_1 \leq j_2))$ .

Not going to prove this formally.

4. It is Not reflexive  $(1, 2) R (2, 3)$  but  $(2, 3) \sim R (3, 2)$

5. This is well ordered. We do not have infinite descending chain. As we have least element  $(0, 0)$  our chain stops there.

Ref :-

[https://en.wikipedia.org/wiki/Infinite\\_descending\\_chain](https://en.wikipedia.org/wiki/Infinite_descending_chain)

<https://books.google.co.in/books?id=OR5KAAAAQBAJ&pg=PA17&lpg=PA17&dq=does+natural+no+have+infinite+descending+chain&source=bl&ots=dDJdZ26vW35YMNbgkR5twmKDMwL2bo&hl=en&sa=X&ved=0ahUKEwje9of1-rfJAhUSC44KHRqGDI4Q6AEIKjAC#v=onepage&q=does%20natural%20no%20have%20infinite%20descending%20chain&f=false>

[https://en.wikipedia.org/wiki/Well-order#Examples\\_and\\_counterexamples](https://en.wikipedia.org/wiki/Well-order#Examples_and_counterexamples)

2 votes

-- Akash (43.8k points)

**4.12.11 Partial Order: TIFR2013-B-4** [top](#)<http://gateoverflow.in/25664>

Answer -> E)well order

Minimal Element is 'a', it is less than all elements !

a) False, after aa, we can have ab. Then aba,abb,abc.. Not limited to 24

b) False. after aa, we can have ab,aba,abc.. In fact  $ab(a-z)^*$ . Not limited to  $2^{24}$

C)False. Why not partial order ? Dictionary order is partial order ! It is Reflexive, Antisymmetric & Transitive. Even definition of wikipedia says it is !

D) False.Dictionary order is well order .

Defination of Dictionary order -> Ref -> [https://en.wikipedia.org/wiki/Lexicographical\\_order](https://en.wikipedia.org/wiki/Lexicographical_order)

Given two partially ordered sets A and B, the lexicographical order on the Cartesian product  $A \times B$  is defined as

$(a,b) \leq (a',b')$  if and only if  $a < a'$  or  $(a = a' \text{ and } b \leq b')$ .

The result is a partial order. If A and B are each totally ordered, then the result is a total order as well. The lexicographical order of two totally ordered sets is thus a linear extension of their product order.

✍ 5 votes

-- Akash (43.8k points)

**4.12.12 Partial Order: TIFR2014-B-15** [top](#)<http://gateoverflow.in/27322>

Selected Answer

Consider any sequence like "43,9,8,2" - it can have many (infinite) least upper bounds like "43,9,8,2,5", "43,9,8,2,1" ... but can have only 1 greatest lower bound - "43,9,8" because we are using prefix relation. So, option D is true.

✍ 5 votes

-- Arjun Suresh (294k points)

**4.12.13 Partial Order: TIFR2014-B-16** [top](#)<http://gateoverflow.in/27341>

Selected Answer

i think ans will be E)

as every subset of this will not have LUB and GLB .

✍ 3 votes

-- Pranay Datta (9.7k points)

**4.13****Permutations And Combinations(1)** [top](#)**4.13.1 Permutations And Combinations: GATE2000-5** [top](#)<http://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](#) [permutations-and-combinations](#) [normal](#) [descriptive](#)

Answer

**Answers: Permutations And Combinations**

### 4.13.1 Permutations And Combinations: GATE2000-5 [top](#)



Selected Answer

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

Exactly one element occurs exactly twice:

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 you only have to select two elements out of  $n$  in  ${}^nC_2$

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.

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

7 votes

-- Pranay Datta (9.7k points)

### 4.14

### Polynomials(8) [top](#)

#### 4.14.1 Polynomials: GATE1995\_2.8 [top](#)

<http://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](#) [set-theory&algebra](#) [normal](#) [polynomials](#)

Answer

#### 4.14.2 Polynomials: GATE1997-4.4 [top](#)

<http://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

- A. 1
- B. 2
- C. 3
- D. 4

[gate1997](#) [set-theory&algebra](#) [normal](#) [polynomials](#)

Answer

#### 4.14.3 Polynomials: GATE2000-2.4 [top](#)

<http://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](#) [set-theory&algebra](#) [normal](#) [polynomials](#)

[Answer](#)

#### 4.14.4 Polynomials: GATE2014-2-5 [top](#)

<http://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.  $f(0) + f(4) < 0$

[gate2014-2](#) [set-theory&algebra](#) [polynomials](#) [numerical-answers](#) [normal](#)

[Answer](#)

#### 4.14.5 Polynomials: GATE2017-2-24 [top](#)

<http://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  $b = \underline{\hspace{2cm}}$

[gate2017-2](#) [polynomials](#) [numerical-answers](#)

[Answer](#)

#### 4.14.6 Polynomials: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123770>

Q7 The equation  $x^6 - 5x^4 + 16x^2 - 72x + 9 = 0$  has

- A) Exactly two distinct real roots
- B) Exactly three distinct real roots
- C) Exactly four distinct real roots
- D) six different real roots

[isi2004](#) [polynomials](#)

[Answer](#)

#### 4.14.7 Polynomials: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123818>

Q9 The equation'

$$\frac{1}{3} + \frac{1}{2}s^2 + \frac{1}{6}s^3 = s$$

has

- A) exactly three solution in  $[0,1]$
- B) exactly one solution in  $[0,1]$
- C) exactly two solution in  $[0,1]$
- D) no solution in  $[0,1]$

[isi2004](#) [polynomials](#)

[Answer](#)

#### 4.14.8 Polynomials: TIFR2012-A-12 [top](#)

<http://gateoverflow.in/25035>

For the polynomial  $p(x) = 8x^{10} - 7x^3 + x - 1$  consider the following statements (which may be true or false)

- i. It has a root between [0, 1].
- ii. It has a root between [0, -1].
- iii. It has no roots outside (-1, 1).

Which of the above statements are true?

- A. Only (i).
- B. Only (i) and (ii).
- C. Only (i) and (iii).
- D. Only (ii) and (iii).
- E. All of (i), (ii) and (iii).

[tifr2012](#) [set-theory&algebra](#) [polynomials](#)

[Answer](#)

## Answers: Polynomials

### 4.14.1 Polynomials: GATE1995\_2.8 [top](#)

<http://gateoverflow.in/2620>



Selected Answer

ans is C,

just put values of C in place of x. it will satisfy the equation.

16 votes

-- jayendra (8.1k points)

### 4.14.2 Polynomials: GATE1997-4.4 [top](#)

<http://gateoverflow.in/2245>



Selected Answer

Lets take  $p(x) = ax + b$   
Now,  $p(0) = 5 \Rightarrow b = 5$ .

$p(1) = 4 \Rightarrow a + b = 4, a = -1$

$p(2) = 9 \Rightarrow 4a + b = 9 \Rightarrow -4 + 5 = 9$ , which is false. So, degree 1 is not possible.

Let  $p(x) = ax^2 + bx + c$

$p(0) = 5 \Rightarrow c = 5$

$p(1) = 4 \Rightarrow a + b + c = 4 \Rightarrow a + b = -1 \rightarrow (1)$

$p(2) = 9 \Rightarrow 4a + 2b + c = 9 \Rightarrow 2a + b = 2 \rightarrow (2)$

$(2) - (1) \Rightarrow a = 3, b = -1 - 3 = -4$

$p(3) = 20 \Rightarrow 9a + 3b + c = 20, 27 - 12 + 5 = 20$ , equation holds.

So, degree 2 also will suffice.

16 votes

-- Arjun Suresh (294k points)

### 4.14.3 Polynomials: GATE2000-2.4 [top](#)

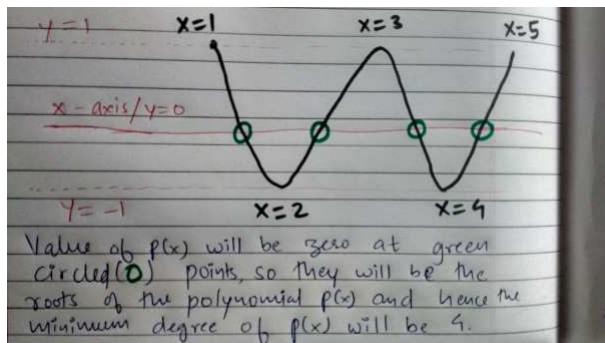
<http://gateoverflow.in/651>



Selected Answer

yes, option D is the correct answer.

Here is how  $p(x)$  should look like:



15 votes

-- Anurag Pandey (13.1k points)

#### 4.14.4 Polynomials: GATE2014-2-5 [top](#)

<http://gateoverflow.in/1957>



Selected Answer

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  $f(0)f(4) < 0$ .

24 votes

-- Happy Mittal (10.9k points)

#### 4.14.5 Polynomials: GATE2017-2-24 [top](#)

<http://gateoverflow.in/11815>



Selected Answer

Let  $ax^2 + bx + c = 0$  be a quadratic equation, then

Sum of roots =  $\frac{-b}{a}$  and product of roots =  $\frac{c}{a}$

$$(5)_b + (6)_b = (13)_b \Rightarrow b = 8$$

$$\text{and } (5)_b * (6)_b = (36)_b \text{ means } 30 = 3b + 6. \text{ So, } b = 8$$

11 votes

-- Manish Joshi (25.2k points)

#### 4.14.6 Polynomials: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123770>



Selected Answer

$$P(x) = x^6 - 5x^4 + 16x^2 - 72x + 9$$

- $P(0) = 9$
- $P(-1) = -ve$
- $P(4) = +ve$

Hence, atleast 2 real roots can be clearly seen, but what about other 4 roots left?

That's why we check  $P''(x)$ ,

$$P'(x) = 6x^5 - 20x^3 + 32x - 72$$

$$P''(x) = 30x^4 - 60x^2 + 32 > 0 \text{ for any real value of } x.$$

comparing this with a quadratic eq taking  $x^2$  as  $y$  we get  $30y^2 - 60y + 32$ . The discriminant ( $b^2 - 4ac$ ) is negative implying  $P''(x)$  has no real roots

Hence by Rolle's theorem  $P'(x)$  can have at most 1 real root and  $P(x)$  can have at most 2 real roots. Because if a function  $f(x)$  has 2 roots  $x_1$  and  $x_2$  then there exists a point  $x \in [x_1, x_2]$  where the curve becomes flat i.e its the root of  $f'(x)$  meaning  $f(x)$  has max 2 roots

=> Exactly two distinct real roots

**Option A**

1 upvote

-- Heisenberg (1.7k points)

### 4.14.7 Polynomials: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123818>

Selected Answer

$s^3 + 3s^2 - 6s + 2 = 0$   
 $(s-1)(s^2 + 4s + 2) = 0$   
 $s_1 = 1$        $s_2, s_3 = \frac{-4 \pm \sqrt{16+8}}{2}$   
 $= -2 \pm \sqrt{6}$   
 $s_2 = -2 - \sqrt{6} \quad s_3 = -2 + \sqrt{6}$   
 $\approx -4.4 \quad \approx .44$   
 $s_1, s_3 \in [-1, 1] \quad \text{so exactly two soln.}$

c is ans.

1 upvote

-- 2018 (5.2k points)

### 4.14.8 Polynomials: TIFR2012-A-12 [top](#)

<http://gateoverflow.in/25035>

At  $f(0)$  it is negative, at  $f(1)$  it is positive, and at  $f(-1)$  it is positive, which means there will be roots between  $(0, 1)$  and  $(-1, 0)$ . Any values below -1 and above 1 will always yield positive values for  $f(x)$ , which means no roots available.

1 upvote

-- Shaun Patel (6.9k points)

## 4.15

### Relations(31) [top](#)

#### 4.15.1 Relations: GATE 2016-2-26 [top](#)

<http://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.

[Answer](#)

## 4.15.2 Relations: GATE1987-2d [top](#)

<http://gateoverflow.in/80583>

State whether the following statements are TRUE or FALSE:

The union of two equivalence relations is also an equivalence relation.

[gate1987](#) [discrete-mathematics](#) [relations](#)[Answer](#)

## 4.15.3 Relations: GATE1987-9a [top](#)

<http://gateoverflow.in/82438>

How many binary relations are there on a set  $A$  with  $n$  elements?

[gate1987](#) [set-theory&algebra](#) [relations](#)[Answer](#)

## 4.15.4 Relations: GATE1989-1-iv [top](#)

<http://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](#)

## 4.15.5 Relations: GATE1994\_2.3 [top](#)

<http://gateoverflow.in/2470>

Amongst the properties {reflexivity, symmetry, anti-symmetry, transitivity} the relation  $R = \{(x,y) \in N^2 | x \neq y\}$  satisfies \_\_\_\_\_

[gate1994](#) [set-theory&algebra](#) [normal](#) [relations](#)[Answer](#)

## 4.15.6 Relations: GATE1995\_1.19 [top](#)

<http://gateoverflow.in/2608>

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](#)

## 4.15.7 Relations: GATE1996\_2.2 [top](#)

<http://gateoverflow.in/2731>

Let  $R$  be a non-empty relation on a collection of sets defined by  $ARB$  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](#)

### 4.15.8 Relations: GATE1996\_8 [top](#)

<http://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  $f(3) = g(3)$ .

- Find the number of equivalence classes defined by  $\sim$ .
- Find the number of elements in each equivalence class.

[gate1996](#) [set-theory&algebra](#) [relations](#) [functions](#) [normal](#)

[Answer](#)

### 4.15.9 Relations: GATE1997\_14 [top](#)

<http://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](#)

[Answer](#)

### 4.15.10 Relations: GATE1997\_6.3 [top](#)

<http://gateoverflow.in/2259>

The number of equivalence relations of the set  $\{1, 2, 3, 4\}$  is

- A. 15
- B. 16
- C. 24
- D. 4

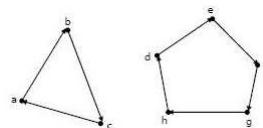
[gate1997](#) [set-theory&algebra](#) [relations](#) [normal](#)

[Answer](#)

### 4.15.11 Relations: GATE1998-10 [top](#)

<http://gateoverflow.in/1724>

- Prove by induction that the expression for the number of diagonals in a polygon of  $n$  sides is  $\frac{n(n-3)}{2}$
- 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](#) [set-theory&algebra](#) [descriptive](#) [relations](#)

[Answer](#)

### 4.15.12 Relations: GATE1998\_1.6 [top](#)

<http://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&amp;algebra relations easy

**Answer****4.15.13 Relations: GATE1998\_1.7** [top](#)<http://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&amp;algebra relations normal

**Answer****4.15.14 Relations: GATE1998\_2.3** [top](#)<http://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. reflective, symmetric and transitive
- B. neither reflective, nor irreflexive but transitive
- C. irreflexive, symmetric and transitive
- D. irreflexive and antisymmetric

gate1998 set-theory&amp;algebra easy relations

**Answer****4.15.15 Relations: GATE1999\_1.2** [top](#)<http://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&amp;algebra relations permutations-and-combinations easy

**Answer****4.15.16 Relations: GATE1999\_2.3** [top](#)<http://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](#)

Answer

### 4.15.17 Relations: GATE1999\_3 [top](#)

<http://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".

- b. Give an example of a relation  $R$  which is symmetric and transitive but not reflexive.

[gate1999](#) [set-theory&algebra](#) [relations](#) [normal](#)

Answer

### 4.15.18 Relations: GATE2000-2.5 [top](#)

<http://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?

- A.  $R$  is not an equivalence relation
- B.  $R$  is an equivalence relation having 1 equivalence class
- C.  $R$  is an equivalence relation having 2 equivalence classes
- D.  $R$  is an equivalence relation having 3 equivalence classes

[gate2000](#) [set-theory&algebra](#) [relations](#) [normal](#)

Answer

### 4.15.19 Relations: GATE2001-1.2 [top](#)

<http://gateoverflow.in/695>

Consider the following relations:

- R1  $(a, b)$  iff  $(a + b)$  is even over the set of integers
- R2  $(a, b)$  iff  $(a + b)$  is odd over the set of integers
- R3  $(a, b)$  iff  $a \cdot b > 0$  over the set of non-zero rational numbers
- R4  $(a, b)$  iff  $|a - b| \leq 2$  over the set of natural numbers

Which of the following statements is correct?

- A. R1 and R2 are equivalence relations, R3 and R4 are not
- B. R1 and R3 are equivalence relations, R2 and R4 are not
- C. R1 and R4 are equivalence relations, R2 and R3 are not
- D. R1, R2, R3 and R4 all are equivalence relations

[gate2001](#) [set-theory&algebra](#) [normal](#) [relations](#)

Answer

### 4.15.20 Relations: GATE2002-2.17 [top](#)

<http://gateoverflow.in/847>

The binary relation  $S = \emptyset$  (empty set) on a set  $A = \{1, 2, 3\}$  is

- A. Neither reflexive nor symmetric
- B. Symmetric and reflexive
- C. Transitive and reflexive
- D. Transitive and symmetric

[gate2002](#) [set-theory&algebra](#) [normal](#) [relations](#)

[Answer](#)

### 4.15.21 Relations: GATE2002-3 [top](#)

<http://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

- A. Give the expression for  $N_r$ , in terms of n.
- B. Give the expression for  $N_f$ , terms of n.
- C. Which is larger for all possible  $n$ ,  $N_r$  or  $N_f$

[gate2002](#) [set-theory&algebra](#) [normal](#) [descriptive](#) [relations](#)

[Answer](#)

### 4.15.22 Relations: GATE2004-24 [top](#)

<http://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](#) [set-theory&algebra](#) [easy](#) [relations](#)

[Answer](#)

### 4.15.23 Relations: GATE2004-IT-4 [top](#)

<http://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  $R_1R_2$  from A to C?

- A.  $R_1R_2 = \{(1, 2), (1, 4), (3, 3), (5, 4), (7, 3)\}$
- B.  $R_1R_2 = \{(1, 2), (1, 3), (3, 2), (5, 2), (7, 3)\}$
- C.  $R_1R_2 = \{(1, 2), (3, 2), (3, 4), (5, 4), (7, 2)\}$
- D.  $R_1R_2 = \{(3, 2), (3, 4), (5, 1), (5, 3), (7, 1)\}$

[gate2004-it](#) [set-theory&algebra](#) [relations](#) [normal](#)

[Answer](#)

### 4.15.24 Relations: GATE2005-42 [top](#)

<http://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](#) [set-theory&algebra](#) [normal](#) [relations](#)

[Answer](#)

### 4.15.25 Relations: GATE2005-7 [top](#)

<http://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](#) [set-theory&algebra](#) [normal](#) [relations](#)

[Answer](#)

### 4.15.26 Relations: GATE2006-4 [top](#)

<http://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](#) [set-theory&algebra](#) [normal](#) [relations](#)

[Answer](#)

### 4.15.27 Relations: GATE2007-2 [top](#)

<http://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](#) [set-theory&algebra](#) [normal](#) [relations](#)

[Answer](#)

### 4.15.28 Relations: GATE2009-4 [top](#)

<http://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](#) [set-theory&algebra](#) [easy](#) [relations](#)

[Answer](#)

### 4.15.29 Relations: GATE2010-3 [top](#)

<http://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 | set-theory&algebra | easy | relations

[Answer](#)

### 4.15.30 Relations: GATE2015-2\_16 [top](#)

<http://gateoverflow.in/8089>

Let  $R$  be the relation on the set of positive integers such that  $aRb$  if and only if  $a$  and  $b$  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

gate2015-2 | set-theory&algebra | relations | normal

[Answer](#)

### 4.15.31 Relations: GATE2015-3\_41 [top](#)

<http://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

gate2015-3 | set-theory&algebra | relations | normal

[Answer](#)

## Answers: Relations

### 4.15.1 Relations: GATE 2016-2-26 [top](#)

<http://gateoverflow.in/39603>



Selected Answer

B) Reflexive, but not transitive.

its " $a \leq c$  OR  $b \leq d$ ",

**NOT**

" $a \leq c$  AND  $b \leq d$ "

(2,5) R (6, 3) R (1, 4),  
but NOT (2,5) R (1, 4)

22 votes

-- Ashish Deshmukh (1.5k points)

### 4.15.2 Relations: GATE1987-2d [top](#)

<http://gateoverflow.in/80583>



Selected Answer

No union of two equivalence relation may not be 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 :  $R = \{(1, 2), (3, 4)\} \dots S = \{(2, 3)\}$

Union =  $\{(1, 2), (3, 4), (2, 3)\}$  which is not transitive i.e.  $(1, 3)$  and  $(2, 4)$  is missing.

so False is answer.

6 votes

-- Prashant Singh (49.2k points)

### 4.15.3 Relations: GATE1987-9a [top](#)

<http://gateoverflow.in/82436>



Selected Answer

Total number of binary relation from  $n$  element set to itself is  $2^{n^2}$ . I.e.  $n^2$  entries with two choice take it or not.

7 votes

-- Prashant Singh (49.2k points)

### 4.15.4 Relations: GATE1989-1-iv [top](#)

<http://gateoverflow.in/87048>

The transitive closure of the relation  $\{(1,2),(2,3),(3,4),(5,4)\} = \{(1,2),(2,3),(1,3),(3,4),(2,4),(1,4),(5,4)\}$

6 votes

-- Prashant Singh (49.2k points)

### 4.15.5 Relations: GATE1994\_2.3 [top](#)

<http://gateoverflow.in/2470>



Selected Answer

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.

12 votes

-- Rajarshi Sarkar (35k points)

### 4.15.6 Relations: GATE1995\_1.19 [top](#)

<http://gateoverflow.in/2606>



Selected Answer

Answer 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. ( $(3, 3)$  is not there.)

4 votes

-- Anu (10.6k points)

### 4.15.7 Relations: GATE1996\_2.2 [top](#)

<http://gateoverflow.in/2731>



Selected Answer

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 non 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 trasitive or reflexive

D is false because  $R$  is symmetric

1 9 votes

-- akash (1.2k points)

#### 4.15.8 Relations: GATE1996\_8 [top](#)

<http://gateoverflow.in/2760>



Selected Answer

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.

1 12 votes

-- Arjun Suresh (294k points)

#### 4.15.9 Relations: GATE1997\_14 [top](#)

<http://gateoverflow.in/2274>



Selected Answer

1. since it is given that relation R is reflexive and transitive...and the new defined relation is the definition of symmetric only

so it is reflexive, symmetric and transitive => equivalence.

2

partial order<sup>l</sup> 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  $a \leq b$  and  $b \leq c$ , then  $a \leq c$  (transitivity).

1 5 votes

-- asutosh kumar Biswal (10.2k points)

#### 4.15.10 Relations: GATE1997\_6.3 [top](#)

<http://gateoverflow.in/2259>



Selected Answer

No of Equivalence Relations are given by BELL number.

The  $n$ th of these numbers,  $B_n$ , counts 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)

1 -> Equivalence relation with 1 element

1 2 -> Equivalence relation with 2 element

2 3 5 -> Equivalence relation with 3 element

5 7 10 15 -> Equivalence relation with 4 element

13 votes

-- Akash (43.8k points)

Ways of selecting any of the following elements out of 4 : (i) 1 element : C(4,1) (ii) 2 elements : C(4,2) (iii) 3 elements : C(4,3) (iv) 4 elements : C(4,4)

1

Total partitions = C(4,1) + C(4,2) + C(4,3) + C(4,4) = 15

20 votes

-- shekhar chauhan (42.9k points)

### 4.15.11 Relations: GATE1998-10 [top](#)

<http://gateoverflow.in/1724>



part A

Statement:

$$\text{no\_of\_diagonal} = D(n) = \frac{n(n-3)}{2}$$

**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 Dagonals in for (k+1) sided polygon = diagonal from k sided polygon +  $k - 2 + 1$

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

=>  $D(k+1)$  holds.

Since both the basis and the inductive step have been performed, by mathematical induction, the statement  $D(n)$  holds for all natural numbers  $n > 3$

4 votes

-- Debashish Deka (51.4k points)

### 4.15.12 Relations: GATE1998\_1.6 [top](#)

<http://gateoverflow.in/1643>



Ans 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.

8 votes

-- Keith Kr (6.3k points)

**4.15.13 Relations: GATE1998\_1.7** [top](#)<http://gateoverflow.in/1644>

Selected Answer

Answer: C

R1 intersection R2 is equivalence relation..

R1 union R2 is not equivalence relation because transitivity needn't hold. For example, (a, b) can be in R1 and (b, c) be in R2 and (a, c) not in either R1 or R2.

12 votes

-- Digvijay (47k points)

**4.15.14 Relations: GATE1998\_2.3** [top](#)<http://gateoverflow.in/1675>

Selected Answer

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.

14 votes

-- Digvijay (47k points)

**4.15.15 Relations: GATE1999\_1.2** [top](#)<http://gateoverflow.in/1456>

Selected Answer

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.

11 votes

-- Rajarshi Sarkar (35k points)

**4.15.16 Relations: GATE1999\_2.3** [top](#)<http://gateoverflow.in/1481>

Selected Answer

Which of the following **is/are** true? This is question with Multiple answers.

As our Relation R on Set L is Reflexive , anti symmetric &amp; Transitive it is poset.

Since LUB &amp; GLB exists for any two elements it is lattice.

Answer -&gt; A &amp; C.

B is not guaranteed to be true.

Ref: <http://uosis.mif.vu.lt/~valdas/PhD/Kursinis2/Sasao99/Chapter2.pdf>

6 votes

-- Akash (43.8k points)

**4.15.17 Relations: GATE1999\_3** [top](#)<http://gateoverflow.in/1522>



Let set A be  $\{1, 2, 3\}$ , and let a relation R on A be

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

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 elements in R, but to be reflexive, all elements must be related to themselves.

12 votes

-- Happy Mittal (10.9k points)

### 4.15.18 Relations: GATE2000-2.5 [top](#)



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.

$$\{\dots, -4, -2, 0, 2, 4, \dots\}, \{\dots, -3, -1, 1, 3, \dots\}$$

C choice.

14 votes

-- Anu (10.6k points)

### 4.15.19 Relations: GATE2001-1.2 [top](#)



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 :  $a+a=2a$  can't be odd ever

R3) Reflexive:  $a.a>0$

Symmetric: if  $a,b>0$  then both must be +ve or -ve, which means  $b.a > 0$  also exists

Transitive : if  $a.b>0$  and  $b.c>0$  then to have b as same number, both pairs must be +ve or -ve which implies  $a.c>0$

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  $|b-c| \leq 2$ , doesn't 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

B)

 7 votes

-- confused\_luck (891 points)

### 4.15.20 Relations: GATE2002-2.17 top

<http://gateoverflow.in/847>

Selected Answer

**answer = option D**

$S=\emptyset$  (empty set) on a set  $A = \{1,2,3\}$  is Irreflexive, Symmetric, Anti Symmetric, Asymmetric, Transitive.. but it is not Reflexive

 9 votes

-- Digvijay (47k points)

### 4.15.21 Relations: GATE2002-3 top

<http://gateoverflow.in/856>

Selected Answer

no of binary relation =  $2^{n^2}$   
 no of function =  $n^n$

$2^{n^2}$   
 $n^n$   
 $n^2 \log(2)$   
 $n \log(n)$  // apply log on both  
 $n^2 \log(2) >$   
 $n \log(n)$

**No of relation** > No of function 14 votes

-- Digvijay (47k points)

### 4.15.22 Relations: GATE2004-24 top

<http://gateoverflow.in/1021>

Selected Answer

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  $x$ .

 9 votes

-- anshu (3.2k points)

### 4.15.23 Relations: GATE2004-IT-4 top

<http://gateoverflow.in/3645>

Selected Answer

Answer is C.

Explanation:

$$R1 = \{(1,2), (1,8), (3,6), (5,4), (7,2), (7,8)\}$$

$$R2 = \{(2,2), (4,4), (6,2), (6,4), (8,2)\}$$

$$\text{So, } R1R2 = \{(1,2), (3,2), (3,4), (5,4), (7,2)\}$$

 10 votes

-- chetna (465 points)

### 4.15.24 Relations: GATE2005-42 top

<http://gateoverflow.in/1167>

## Selected Answer

RUS 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 U S will contain, (a, b) and (b, c) but not (a, c) and hence not transitive.

option c.

7 votes

-- anshu (3.2k points)

## 4.15.25 Relations: GATE2005-7 top

<http://gateoverflow.in/1349>



## Selected Answer

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)  $O(N^{1.5})$

10 votes

-- Akash (43.8k points)

## 4.15.26 Relations: GATE2006-4 top

<http://gateoverflow.in/883>



## Selected Answer

ans is (A).. because the relation is not reflexive.. which is a necessary condition for both partial order and equivalence relation..!!

11 votes

-- Vicky Bajoria (4.9k points)

## 4.15.27 Relations: GATE2007-2 top

<http://gateoverflow.in/1201>



## Selected Answer

ans 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  $n^2$

12 votes

-- jayendra (8.1k points)

## 4.15.28 Relations: GATE2009-4 top

<http://gateoverflow.in/797>



## Selected Answer

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 b then b 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 antisymmetric rule.

Answer is D.  $\therefore$  Not AntiSymmetric.

13 votes

-- Sona Praneeth Akula (4k points)

### 4.15.29 Relations: GATE2010-3 [top](#)

<http://gateoverflow.in/1149>



Selected Answer

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

$$2^{(n^2-n)}$$

16 votes

-- Arjun Suresh (294k points)

### 4.15.30 Relations: GATE2015-2\_16 [top](#)

<http://gateoverflow.in/8089>



Selected Answer

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.

21 votes

-- Rajarshi Sarkar (35k points)

### 4.15.31 Relations: GATE2015-3\_41 [top](#)

<http://gateoverflow.in/8500>



Selected Answer

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

$$\forall_{a,b} f((a, b), (a, b)) \in R \rightarrow \text{reflexive}$$

$((a, b), (a, b)) \in R \leftrightarrow (a - b = b - a)$  (not possible for any positive 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.**

27 votes

-- Tamojit Chatterjee (2.2k points)

1. take example for symmetric relation ... for  $p=6, q=4, r=4, s=6, (6,4)(4,6)$

$$p-s=6-6=0$$

$$q-r=4-4=0$$

so if we will check the condition (means  $p-s$  and  $q-r$ ) for symmetric relation then  $p-s = q-r$  will b same always

now we can see the relation  $(6,4)(4,6)$  is not reflexive but exist in the relation R. so we can say that R may or may not b reflexive. so option C is correct Not reflexive but symmetric

10 votes

-- Anoop Sonkar (4.8k points)

**4.16****Ring(1)** top**4.16.1 Ring: GATE2010-4** top<http://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](#) [set-theory&algebra](#) [normal](#) [ring](#) [groups](#)

Answer

**Answers: Ring****4.16.1 Ring: GATE2010-4** top<http://gateoverflow.in/1150>

Selected Answer

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, commutativity. The structure also has an identity element (i.e. 1) and an inverse for each element. So, the structure is an abelian group.

10 votes

-- Rajarshi Sarkar (35k points)

**4.17****Sets(33)** top**4.17.1 Sets: GATE 2016-2-28** top<http://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.

[gate2016-2](#) | [set-theory&algebra](#) | [difficult](#) | [sets](#)

[Answer](#)

## 4.17.2 Sets: GATE1993-8.3 [top](#)

<http://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 set  $S_i$  is a finite set
- B. not more than one of the set  $S_i$  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](#)

## 4.17.3 Sets: GATE1993\_17 [top](#)

<http://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](#)

[Answer](#)

## 4.17.4 Sets: GATE1993\_8.4 [top](#)

<http://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](#)

## 4.17.5 Sets: GATE1994\_2.4 [top](#)

<http://gateoverflow.in/2471>

The number of subsets  $\{1, 2, \dots, n\}$  with odd cardinality is \_\_\_\_\_

[gate1994](#) | [set-theory&algebra](#) | [easy](#) | [sets](#)

[Answer](#)

## 4.17.6 Sets: GATE1994\_3.8 [top](#)

<http://gateoverflow.in/2494>

Give a relational algebra expression using only the minimum number of operators from  $(\cup, -)$  which is equivalent to  $R \cap S$ .

[gate1994](#) | [set-theory&algebra](#) | [normal](#) | [sets](#)

[Answer](#)

## 4.17.7 Sets: GATE1994\_3.9 [top](#)

<http://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](#)

[Answer](#)

### 4.17.8 Sets: GATE1995\_1.20 [top](#)

<http://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](#)

### 4.17.9 Sets: GATE1996\_1.1 [top](#)

<http://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](#)

### 4.17.10 Sets: GATE1996\_2.4 [top](#)

<http://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](#)

[Answer](#)

### 4.17.11 Sets: GATE1998\_2.4 [top](#)

<http://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****4.17.12 Sets: GATE2000-2.6** [top](#)<http://gateoverflow.in/653>

Let  $P(S)$  denotes the power set of set  $S$ . Which of the following is always true?

$$P(P(S)) = P(S)$$

$$P(S) \cap P(P(S)) = \{ \emptyset \}$$

$$P(S) \cap S = P(S)$$

$$S \notin P(S)$$

[gate2000](#) [set-theory&algebra](#) [normal](#) [sets](#)

**Answer****4.17.13 Sets: GATE2000-6** [top](#)<http://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?

[gate2000](#) [set-theory&algebra](#) [normal](#) [descriptive](#) [sets](#)

**Answer****4.17.14 Sets: GATE2001-2.2** [top](#)<http://gateoverflow.in/720>

Consider the following statements:

- S1: There exists infinite sets  $A, B, C$  such that  $A \cap (B \cup C)$  is finite.
- S2: There exists two irrational numbers  $x$  and  $y$  such that  $(x + y)$  is rational.

Which of the following is true about S1 and S2?

- A. Only S1 is correct
- B. Only S2 is correct
- C. Both S1 and S2 are correct
- D. None of S1 and S2 is correct

[gate2001](#) [set-theory&algebra](#) [normal](#) [sets](#)

**Answer****4.17.15 Sets: GATE2004-IT-2** [top](#)<http://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 Data Structures 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****4.17.16 Sets: GATE2005-8** [top](#)<http://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

gate2005 set-theory&algebra easy sets

[Answer](#)

### 4.17.17 Sets: GATE2005-IT-33 [top](#)

<http://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](#)

### 4.17.18 Sets: GATE2006-22 [top](#)

<http://gateoverflow.in/983>

Let  $E, F$  and  $G$  be finite sets. Let

$$\begin{aligned} X &= (E \cap F) - (F \cap G) \text{ and} \\ Y &= (E - (E \cap G)) - (E - F). \end{aligned}$$

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 set-theory&algebra normal sets

[Answer](#)

### 4.17.19 Sets: GATE2006-24 [top](#)

<http://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 set-theory&algebra normal sets

[Answer](#)

### 4.17.20 Sets: GATE2006-IT-23 [top](#)

<http://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.  $P \cap (Q \Delta R) = (P \cap Q) \Delta (P \cap R)$
- A. I only
- B. II only

- C. Neither I nor II  
D. Both I and II

[gate2006-it](#) [set-theory&algebra](#) [normal](#) [sets](#)

[Answer](#)

### 4.17.21 Sets: GATE2006-IT-24 [top](#)

<http://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](#)

### 4.17.22 Sets: GATE2008-2 [top](#)

<http://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](#) [normal](#) [set-theory&algebra](#) [sets](#)

[Answer](#)

### 4.17.23 Sets: GATE2014-2-50 [top](#)

<http://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

[gate2014-2](#) [set-theory&algebra](#) [normal](#) [sets](#)

[Answer](#)

### 4.17.24 Sets: GATE2014-3-16 [top](#)

<http://gateoverflow.in/2050>

Let  $\Sigma$  be a finite non-empty alphabet and let  $2^{\Sigma^*}$  be the power set of  $\Sigma^*$ . Which one of the following is **TRUE**?

- A. Both  $2^{\Sigma^*}$  and  $\Sigma^*$  are countable  
B.  $2^{\Sigma^*}$  is countable and  $\Sigma^*$  is uncountable  
C.  $2^{\Sigma^*}$  is uncountable and  $\Sigma^*$  is countable  
D. Both  $2^{\Sigma^*}$  and  $\Sigma^*$  are uncountable

[gate2014-3](#) | [set-theory&algebra](#) | [sets](#) | [normal](#)
**Answer****4.17.25 Sets: GATE2015-1\_16** [top](#)<http://gateoverflow.in/6238>

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.  $\phi \in 2^A$
- II.  $\phi \subseteq 2^A$
- 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

[gate2015-1](#) | [set-theory&algebra](#) | [sets](#) | [normal](#)
**Answer****4.17.26 Sets: GATE2015-2\_18** [top](#)<http://gateoverflow.in/8092>

The cardinality of the power set of  $\{0, 1, 2, \dots, 10\}$  is \_\_\_\_\_

[gate2015-2](#) | [set-theory&algebra](#) | [sets](#) | [easy](#) | [numerical-answers](#)
**Answer****4.17.27 Sets: GATE2015-3\_23** [top](#)<http://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.  $\exists X \in U, \exists Y \in U, (|X| = 5, |Y| = 5 \text{ and } X \cap Y = \phi)$
- C.  $\forall X \in U, \forall Y \in U, (|X| = 2, |Y| = 3 \text{ and } X \setminus Y = \phi)$
- D.  $\forall X \in U, \forall Y \in U, (X \setminus Y = Y' \setminus X')$

[gate2015-3](#) | [set-theory&algebra](#) | [sets](#) | [normal](#)
**Answer****4.17.28 Sets: GATE2017-1-47** [top](#)<http://gateoverflow.in/118330>

The number of integers between 1 and 500 (both inclusive) that are divisible by 3 or 5 or 7 is \_\_\_\_\_.

[gate2017-1](#) | [set-theory&algebra](#) | [normal](#) | [numerical-answers](#) | [sets](#)
**Answer****4.17.29 Sets: TIFR2010-A-15** [top](#)<http://gateoverflow.in/18394>

Let  $A, B$  be sets. Let  $\bar{A}$  denote the compliment of set  $A$  (with respect to some fixed universe), and  $(A - B)$  denote the set of elements in  $A$  which are not in  $B$ . Set  $(A - (A - B))$  is equal to:

- a.  $B$
- b.  $A \cap \bar{B}$
- c.  $A - B$
- d.  $A \cap B$
- e.  $\bar{B}$

[tifr2010](#) [set-theory&algebra](#) [sets](#)
**Answer****4.17.30 Sets: TIFR2010-A-18** [top](#)<http://gateoverflow.in/18496>

Let  $X$  be a set of size  $n$ . How many pairs of sets  $(A, B)$  are there that satisfy the condition  $A \subseteq B \subseteq X$  ?

- a.  $2^{n+1}$
- b.  $2^{2n}$
- c.  $3^n$
- d.  $2^n + 1$
- e.  $3^{n+1}$

[tifr2010](#) [sets](#)
**Answer****4.17.31 Sets: TIFR2011-A-10** [top](#)<http://gateoverflow.in/20039>

Let  $m, n$  denote two integers from the set  $\{1, 2, \dots, 10\}$ . The number of ordered pairs  $(m, n)$  such that  $2^m + 2^n$  is divisible by 5 is.

- a. 10
- b. 14
- c. 24
- d. 8
- e. None of the above.

[tifr2011](#) [set-theory&algebra](#) [sets](#)
**Answer****4.17.32 Sets: TIFR2012-A-8** [top](#)<http://gateoverflow.in/21007>

How many pairs of sets  $(A, B)$  are there that satisfy the condition  $A, B \subseteq \{1, 2, \dots, 5\}, A \cap B = \emptyset$ ?

- a. 125
- b. 127
- c. 130
- d. 243
- e. 257

[tifr2012](#) [set-theory&algebra](#) [sets](#)
**Answer****4.17.33 Sets: TIFR2016-A-8** [top](#)<http://gateoverflow.in/97234>

Let  $A$  and  $B$  be finite sets such that  $A \subseteq B$ . Then, what is the value of the expression:

$$\sum_{C:A \subseteq C \subseteq B} (-1)^{|C \setminus A|},$$

Where  $C \setminus A = \{x \in C : x \notin A\}$  ?

- A. Always 0
- B. Always 1
- C. 0 if  $A = B$  and 1 otherwise
- D. 1 if  $A = B$  and 0 otherwise
- E. Depends on the size of the universe

[tifr2016](#) [set-theory&algebra](#) [sets](#)
**Answer****Answers: Sets**

### 4.17.1 Sets: GATE 2016-2-28 [top](#)

<http://gateoverflow.in/39595>



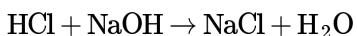
Selected Answer  
Option *B* should be the correct answer.

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  $S \times$  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.

34 votes

-- Anurag Pandey (13.1k points)

## 4.17.2 Sets: GATE1993-8.3 [top](#)

<http://gateoverflow.in/2301>

Selected Answer

A) at least one of the set  $S_i$  is 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 set into few sets (Some of which can be finite). This seems True, but I'm not able to prove it. **Please Give 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 set can be finite  $\rightarrow$  This is false.

ex ->  $a^*b^* \Rightarrow \{ab\} \cup \{\} \cup \{aa+bb+\}$

C) at least one of the sets is Infinite  $\rightarrow$  This must be True. As this is finite union of sets, one of set must be infinite to make 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.

8 votes

-- Akash (43.8k points)

## 4.17.3 Sets: GATE1993\_17 [top](#)

<http://gateoverflow.in/2314>

Selected Answer

Answer: 10

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$$

Let  $Y$  be the no. of persons who eat at least one item.

$$Y = 9 + 10 + 7 - [P(A \cap B) + P(A \cap C) + P(B \cap C)] + 5$$

$$[P(A \cap B) + P(A \cap C) + P(B \cap C)] = 31 - Y.$$

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 as

$$31 - Y - 2*5 = 21 - Y.$$

Minimum value of  $Y$  is 10 as 10 people eat fish. Is this possible? Yes.

Maximum value of  $Y$  is 21. Is this possible? No. Because 5 person eat all three item. 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  $21 - 10 \geq X \geq 21 - 16 \implies 5 \leq X \leq 11$ .

7 votes

-- Rajarshi Sarkar (35k points)

## 4.17.4 Sets: GATE1993\_8.4 [top](#)

<http://gateoverflow.in/2302>

Selected Answer

$$\text{Cardinality of } A \times A = n^2$$

$$\text{Cardinality of power set of } A \times A = 2^{n^2}$$

15 votes

-- Digvijay (47k points)

### 4.17.5 Sets: GATE1994\_2.4 [top](#)

<http://gateoverflow.in/2471>Answer:  $2^{n-1}$ No. of subsets with cardinality  $i = {}^n C_i$ 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,

$${}^n C_0 + {}^n C_1 + {}^n C_2 + \dots + {}^n C_n = 2^n$$

$$\begin{aligned} {}^n C_0 + {}^n C_1 + {}^n C_2 + \dots + {}^n C_n &= \left\{ \begin{array}{l} {}^{n+1} C_1 + {}^{n+1} C_3 + \dots + {}^{n+1} C_n, n \text{ is even} \\ {}^{n+1} C_1 + {}^{n+1} C_3 + \dots + {}^{n+1} C_{n-1} + {}^n C_n, n \text{ is odd} \end{array} \right. \quad (\because {}^n C_r + {}^n C_{r-1} = {}^{n+1} C_r) = 2^n \\ &\implies \left. \begin{array}{l} {}^n C_1 + {}^n C_3 + \dots + {}^n C_{n-1}, n \text{ is even} \\ {}^n C_1 + {}^n C_3 + \dots + {}^n C_n, n \text{ is odd} \end{array} \right\} = 2^{n-1} \quad (\text{replacing } n \text{ by } n-1, {}^n C_n = {}^{n-1} C_{n-1}) \end{aligned}$$

Proof for  ${}^n C_r + {}^n C_{r-1} = {}^{n+1} C_r$ 

$${}^n C_r + {}^n C_{r-1} = \frac{n!}{r!(n-r)!} + \frac{n!}{(r-1)!(n-r+1)!} = \frac{n!(n-r+1)+n!r}{r!(n-r+1)!} = \frac{n!(n+1)}{r!(n-r+1)!} = \frac{(n+1)!}{r!(n-r+1)!} = {}^{n+1} C_r$$

9 votes

-- Rajarshi Sarkar (35k points)

### 4.17.6 Sets: GATE1994\_3.8 [top](#)

<http://gateoverflow.in/2494>

R-(R-S)

There is no need to use Union operator here.

Just because they say you can use operators from ( $\cup$ ,  $-$ ) we don't need to use both of them.Also they are saying that **only the minimum number of operators from ( $\cup$ ,  $-$ )** which is equivalent to  $R \cap S$ .

My expression is Minimal.

13 votes

-- Akash (43.8k points)

### 4.17.7 Sets: GATE1994\_3.9 [top](#)

<http://gateoverflow.in/2495>

True

[https://proofwiki.org/wiki/Subset\\_of\\_Countable\\_Set\\_is\\_Countable](https://proofwiki.org/wiki/Subset_of_Countable_Set_is_Countable)

6 votes

-- Anu (10.6k points)

### 4.17.8 Sets: GATE1995\_1.20 [top](#)

<http://gateoverflow.in/260>

no of elements in power set is =  $2^{(\text{no of elements in the set})} = 2^3 = 8$

Elements are  $\{\emptyset, \{\{\emptyset\}\}, \{1\}, \{\{2,3\}\}, \{\{\emptyset\}, 1\}, \{1, \{2,3\}\}, \{\{\emptyset\}, \{2,3\}\}, \{\{\emptyset\}, 1, \{2,3\}\}\}$

Hence, Option(C)8.

13 votes

-- jayendra (8.1k points)

### 4.17.9 Sets: GATE1996\_1.1 [top](#)



Selected Answer

$(A - B) \cup (B - A) \cup (A \cap B)$   
 $A - B$  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)  
 $= A \cup B$

12 votes

-- Digvijay (47k points)

### 4.17.10 Sets: GATE1996\_2.4 [top](#)



Selected Answer

(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-> b to b->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)

13 votes

-- Arjun Suresh (294k points)

### 4.17.11 Sets: GATE1998\_2.4 [top](#)



Selected Answer

apply set formula of A union B union C ....  
 $28 = (18 + 15 + 22) - (9 + 11 + 13) + x$   
 $28 = 55 - 33 + x$   
 $x = 6$

9 votes

-- Digvijay (47k points)

### 4.17.12 Sets: GATE2000-2.6 [top](#)

<http://gateoverflow.in/653>



Selected Answer

$$\begin{aligned} S &= \{1\}, \\ P(S) &= \{\{\}, \{1\}\}, \\ P(P(S)) &= \{\{\}, \{\{\}\}, \{\{1\}\}, \{\{\}, \{1\}\}\} \end{aligned}$$

- A)  $P(P(S)) = P(S) \Rightarrow$  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)

$$\begin{aligned} S &= \{\emptyset\} \\ P(S) &= \left\{ \emptyset, \{\emptyset\} \right\} \\ P(P(S)) &= \left\{ \emptyset, \{\emptyset\}, \left\{ \emptyset \right\}, \left\{ \left\{ \emptyset \right\} \right\} \right\}, \\ P(S) \cap P(P(S)) &= \left\{ \emptyset, \{\emptyset\} \right\} \\ &\neq \{\emptyset\} \end{aligned}$$

So Answer is none of the above, all options are false.

But if we consider Simple sets(Except Empty Set) only then best Suitable Option is B among the given Options.

13 votes

-- Akash (43,8k points)

### 4.17.13 Sets: GATE2000-6 [top](#)

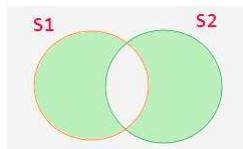
<http://gateoverflow.in/657>



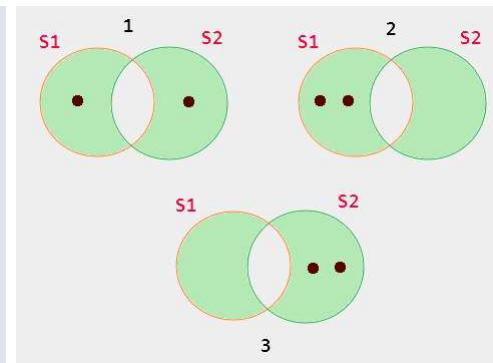
Selected Answer

$$S = 1, 2, 3, 4, 5, 6, \dots, n$$

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.

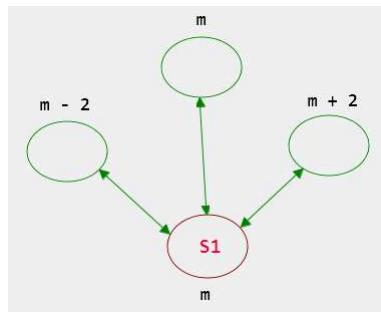


Now there are three cases in which  $(S_1 \setminus S_2) \cup (S_2 \setminus S_1)$  Or,  $(S_1 \oplus S_2)$  has only 2 element.



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  $n(S_1) = m$  )

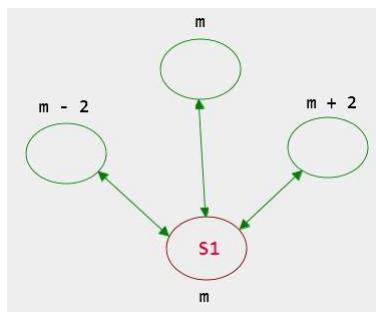
$$\begin{aligned}
 &= m \cdot (n-m) + \binom{m}{2} + \binom{n-m}{2} \\
 &= m \cdot n - m^2 + \frac{m^2}{2} - \frac{m}{2} + \frac{(n-m) \cdot (n-m-1)}{2} \\
 &= m \cdot n - m^2 + \frac{m^2}{2} - \frac{m}{2} + \frac{n \cdot (n-1)}{2} \\
 &\quad - \frac{n \cdot m}{2} - \frac{n \cdot m}{2} + \frac{m^2}{2} + \frac{m}{2} \\
 &= \frac{n \cdot (n-1)}{2} \\
 &= \binom{n}{2}
 \end{aligned}$$

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  $S_1 = \emptyset$ , Then  $S_1$  will be connected to all  $m = 2$  type of sets or 2 cardinality sets.

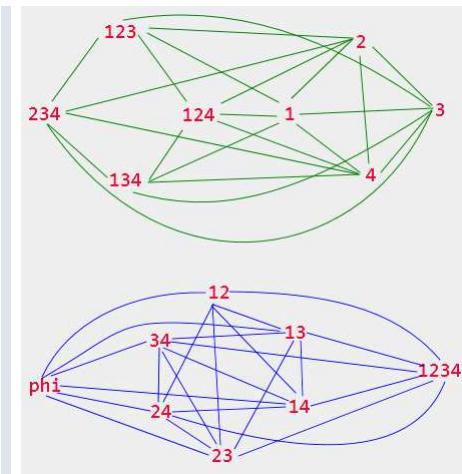
if  $m = 1$  then  $S_1$  will be one of all 1 element sets, Then  $S_1$  will be connected to all other 1 cardinality sets and at least one 3 cardinality set.

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  $\emptyset$  set vertex. There for all even cardinality sets are connected to  $\emptyset$  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 :  $n = 4$  :



8 votes

-- Debasish Deka (51.4k points)

Best way to solve this for GATE is to take  $n = 2$  and  $n = 3$  and we get degree of each vertex =  ${}^nC_2$  and no. of connected components = 2.

Lets do it more formally.

It is clear  $\{\}$  should get connected to all 2 element subsets (and not to any other) of  $S$ . So, degree of the corresponding vertex is  ${}^nC_2$  as we have  ${}^nC_2$  ways of choosing 2 elements from  $n$ . So, answer to first part must be this as it is given degree of all vertices are same.

Now, for the second part, from the definition of  $G$  all the vertices of cardinality  $k$  will be disconnected from all the vertices of cardinality  $k - 1$ . This is because either all the  $k - 1$  elements must be same in both or  $k - 2$  elements must be same in both or else the symmetric difference will be more than 2. Now if  $k - 1$  elements are same, symmetric difference will just be 1. If  $k - 2$  elements are same, we have one element in one set not in other and 2 elements in other set not in this, making symmetric difference 3. Thus symmetric difference won't be 2 for any vertices of adjacent cardinality making them disconnected.

All the vertices of same cardinality will be connected - when just one element differs. Also, vertices with cardinality difference 2 will be connected- when 2 new elements are in one vertex. Thus we will be getting 2 connected components in total.

10 votes

-- Arjun Suresh (294k points)

#### 4.17.14 Sets: GATE2001-2.2 [top](#)

<http://gateoverflow.in/720>



Selected Answer

S1->

CounterExample ->  $a^* \cap (b^* \cup c^*)$ , Here  $a^*, b^*, c^*$  all are infinite, Result is finite language =  $\{\epsilon\}$

So S1 is True

S2->

Counterexample ->

$x = 1 + \sqrt{2}$ ,  $y = 1 - \sqrt{2}$ ,

$x+y = 2$ .

So S2 is True.

Answer -> C

12 votes

-- Akash (43.8k points)

Answer is C

S1 : take set universal set =  $U = \{\text{set of natural numbers}\} = \{1, 2, 3, 4, 5, 6, 7, 8, \dots, \text{infinite}\}$ ,

set (A) = {set of even numbers} = {2, 4, 6, 8, 10, 12, ..., infinite},

set (B) = {set of prime numbers} = {2, 3, 5, 7, 11, 13, ..., infinite},

and set (C) = {set of odd numbers} = {1, 3, 5, 7, 9, 11, 13, ..., infinite}

$$\text{now } A \cap (B \cup C) = \{\text{set of even numbers}\} \cap (\{\text{set of prime numbers}\} \cup \{\text{set of odd numbers}\})$$

$$= \{\text{set of even numbers}\} \cap \{2, 3, 5, 7, 11, 13, \dots, \text{infinite}\} \cup \{1, 3, 5, 7, 9, 11, 13, \dots, \text{infinite}\}$$

$$= \{\text{set of even numbers}\} \cap \{1, 2, 3, 5, 7, 9, 11, 13, \dots, \text{infinite}\}$$

$$= \{\text{set of even numbers}\} \cap \{2\} \cup \{1, 3, 5, 7, 9, 11, 13, \dots, \text{infinite}\}$$

$$= \{\text{set of even numbers}\} \cap \{2\} \cup \{\text{set of odd numbers}\}$$

$$= \{\text{set of even numbers}\} \cap \{2\} \cup \{\text{set of odd numbers}\} = \{2\} = \text{only one element i.e. 2}$$

= finite set

NOTE :- all, prime numbers are odd number except 2.

S2: True because two irrational no. are  $-\sqrt{2}$  and  $+\sqrt{2}$ , when we add  $= -\sqrt{2} + \sqrt{2} = 0$  (0 is a rational number)

17 votes

-- Mithlesh Upadhyay (5.4k points)

### 4.17.15 Sets: GATE2004-IT-2 [top](#)

<http://gateoverflow.in/3643>



Selected Answer

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:

$$\begin{aligned} & |A \cup B \cup C| = |A| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C| \\ & = 125 + 85 + 65 - 50 - 35 - 30 + 15 \\ & = 175 \end{aligned}$$

Therefore, the number of students who haven't taken any of the 3 courses is:  $200 - 175 = 25$

Hence, the answer is Option C.

16 votes

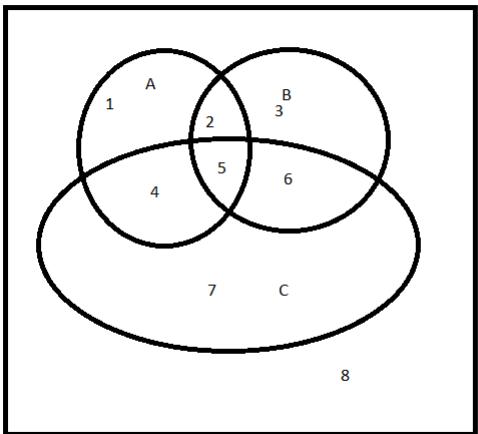
-- Pragy Agarwal (19.5k points)

### 4.17.16 Sets: GATE2005-8 [top](#)

<http://gateoverflow.in/1157>



Selected Answer



$$x = (A - B) - C = \{1, 4\} - \{4, 5, 6, 7\} = 1$$

$$y = (A - C) - (B - C) = \{1, 2\} - \{2, 3\} = 1$$

So  $X = Y$ . Answer A

5 votes

-- Akash (43.8k points)

### 4.17.17 Sets: GATE2005-IT-33 [top](#)

<http://gateoverflow.in/3779>



Selected Answer

Let's take an example set  $\{a, b, c\}$

Now let's 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 let's 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 all size till  $n$ .

So the answer should be  $2^n + 1$  ( include the empty set )

18 votes

-- Omesh Pandita (2.7k points)

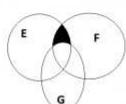
### 4.17.18 Sets: GATE2006-22 [top](#)

<http://gateoverflow.in/983>



Selected Answer

Answer c using **Venn diagram**



10 votes

-- Anu (10,6k points)

### 4.17.19 Sets: GATE2006-24 [top](#)

<http://gateoverflow.in/987>

Selected Answer

$\min(n(N)) = 1$ , since in a permutation of  $n$  elements from  $1..n$ , some element must get 1.

Similarly, in any subsets A and B,  $\min(n(A)) = \min(n(B))$  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  $|A \cup B|$  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.

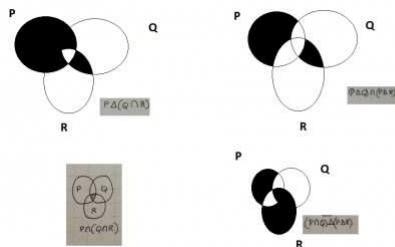
 13 votes

-- Arjun Suresh (294k points)

### 4.17.20 Sets: GATE2006-IT-23 [top](#)

<http://gateoverflow.in/3562>

Selected Answer



I got answer c

 12 votes

-- Anu (10,6k points)

### 4.17.21 Sets: GATE2006-IT-24 [top](#)

<http://gateoverflow.in/3562>

Selected Answer

No's divisible by 2 in X = 61      [ = integer(123/2) ]

No's divisible by 3 in X = 41

No's divisible by 5 in X = 24

No's divisible by 2 and 3 .i.e by 6 = 20

No's divisible by 2 and 5 i.e by 10 = 12

No's divisible by 3 and 5 , i.e by 15 = 8

No's divisible by 2 and 3 and 5 ..i.e by 30 = 4

No'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 =  $123 - 90 = 33$

19 votes

-- Praveen Saini (53.5k points)

### 4.17.22 Sets: GATE2008-2 [top](#)

<http://gateoverflow.in/400>



Answer D

$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c = (P \cup P^c) \cap (Q \cap R) \cup Q^c \cup R^c = (Q \cap R) \cup Q^c \cup R^c = (Q \cap R) \cup (Q \cap R)^c$$

18 votes

-- Anu (10.6k points)

### 4.17.23 Sets: GATE2014-2-50 [top](#)

<http://gateoverflow.in/2016>



Symmetric difference (S.D)- 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)

$S.D = \{3,4\}$  (just exclude the elements which are common in the 2 sets)

Minimum element of S.D is 3 which is in U. and if we observe carefully minimum element will always be in U .Whatever the V is.

So acc. 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)

$S.D = \{1,2\}$

Symmetric difference will be always equal to V . So minimum element of S.D will always exist in V when U is  $\{\emptyset\}$ .

So acc. to the que,  $\{\emptyset\}$  is the 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**

6 votes

-- Soumya Jain (1.6k points)

S1 seems satisfied by  $\{L\}$  where L is largest element in S, only until we compare it to  $\{\}$ , where symm. diff. is  $\{L\}$ . Now consider  $\{\}$ . Any other subset of S is smaller than  $\{\}$  as the minimum element in their symmetric difference will be in that set. So,  $\{\}$ , satisfies S1, any other subset should be less than it.

S2 on the other hand, will be satisfied by S, as any other subset will be like  $S - \{\text{some other elements}\}$ . So symm. diff. will be  $\{\text{some other elements}\}$ , which will belong in S, so min. elem. will belong in S. So, that's it - (A)

22 votes

-- Arindam Sarkar (875 points)

**4.17.24 Sets: GATE2014-3-16** [top](#)<http://gateoverflow.in/2050>

Selected Answer

A set is countable means there exist a enumeration procedure to generate each of its elements and for a given element of set, it take finite step to generate it using the enumeration procedure.

Let  $\Sigma = \{a,b\}$  and there exist a enumeration procedure to generate all the string of the language  $\Sigma^*$ .

$\Sigma^* = \{\in, a, b, aa, ab, ba, bb, aaa, \dots\}$

Here enumeration procedure is simply the generating string of the language by length for the fixed length string are in alphabetical order.

This way  $\Sigma^*$  is countably infinite &  $2^{\Sigma^*}$  will be uncountable set

Because the power set of countably infinite set are uncountable.

Ref: <http://www.cs.xu.edu/csci250/06s/Theorems/powerSetuncountable.pdf>

12 votes

-- Sandeep Singh (9.1k points)

**4.17.25 Sets: GATE2015-1\_16** [top](#)<http://gateoverflow.in/8238>

Selected Answer

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.

37 votes

-- Arjun Suresh (294k points)

**4.17.26 Sets: GATE2015-2\_18** [top](#)<http://gateoverflow.in/8092>

Selected Answer

Answer: 2048

Number of elements in set = 11.

Therefore, cardinality of power set =  $2^{11} = 2048$ .

15 votes

-- Rajarshi Sarkar (35k points)

**4.17.27 Sets: GATE2015-3\_23** [top](#)<http://gateoverflow.in/8426>

Selected Answer

Answer 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.

21 votes

-- overtomano (1.2k points)

### 4.17.28 Sets: GATE2017-1-47 [top](#)

<http://gateoverflow.in/118330>



Selected Answer

Here we can apply the property of set

$$N((\text{either div by } 3) \cup (\text{either div by } 5) \cup (\text{either div by } 7)) = N(\text{div by } 3) + N(\text{div by } 5) + N(\text{div by } 7) - N(\text{div by } 3 \& 5) - N(\text{div by } 5 \& 7) - N(\text{div by } 3 \& 7) + N(\text{div by } 3 \& 5 \& 7)$$

$$= 166 + 100 + 71 - 33 - 14 - 23 + 4$$

$$= 271$$

5 votes

-- sriv\_shubham (2.7k points)

### 4.17.29 Sets: TIFR2010-A-15 [top](#)

<http://gateoverflow.in/18394>



Selected Answer

$$(A - (A - B)) = A \cap (A \cap B)' \quad \text{Since } A - B = A \cap B'$$

$$= A \cap (A' \cup B) \quad \text{Since } (A \cap B)' = A' \cup B'$$

$$= A \cap B \text{ Option D}$$

8 votes

-- Umang Raman (15.1k points)

### 4.17.30 Sets: TIFR2010-A-18 [top](#)

<http://gateoverflow.in/18496>



Selected Answer

Option C) i.e.  $3^n$  must be the right answer.

It is given that there are  $n$  elements in the set  $X$ .

Consider an element  $p$  of set  $X$ .

What are the choices it will have,

1) Either it can be present in set  $A$  & set  $B$  both,

2) Or it can absent from set  $A$  & present in set  $B$ ,

3) Or it can be absent from both set  $A$  & set  $B$ .

but since it is given that  $A$  must be a subset of  $B$ , it is not possible that it can be present in  $A$  & absent from  $B$ .

So each of the  $n$  elements of set  $X$  have 3 choices available.

So total choices available for formation of sets  $A$  &  $B$  =  $3^n$ , which will give  $3^n$  such different  $(A, B)$  pairs.

15 votes

-- Anurag Pandey (13.1k points)

### 4.17.31 Sets: TIFR2011-A-10 [top](#)

<http://gateoverflow.in/20039>



Selected Answer

$$\text{Ending in } 2 : \{2^1, 2^5, 2^9\}$$

Ending in 4 :  $\{2^2, 2^6, 2^{10}\}$

Ending in 6 :  $\{2^4, 2^8\}$

Ending in 8 :  $\{2^3, 2^7\}$

To make  $2^m + 2^n$  divisible by 5, it must end in either a 0 or a 5.

Since  $m, n > 1$ , all numbers  $2^m, 2^n$  are even. Since sum of even numbers is even,  $2^m + 2^n$  cannot end in a 5

Thus,  $2^m + 2^n$  must end in a 0

Possible ways to achieve a number ending with 0 are:

$$2^m + 2^n : \quad m \in \{1, 5, 9\}, \quad n \in \{3, 7\} \implies 3 \times 2 = 6 \text{ pairs}$$

$$2^m + 2^n : \quad m \in \{3, 7\}, \quad n \in \{1, 5, 9\} \implies 2 \times 3 = 6 \text{ pairs}$$

$$2^m + 2^n : \quad m \in \{2, 6, 10\}, \quad n \in \{4, 8\} \implies 3 \times 2 = 6 \text{ pairs}$$

$$2^m + 2^n : \quad m \in \{4, 8\}, \quad n \in \{2, 6, 10\} \implies 2 \times 3 = 6 \text{ pairs}$$

$$\text{Total} = 6 + 6 + 6 + 6 = 24 \text{ ordered pairs}$$

**Thus, option c is correct.**

17 votes

-- Pragy Agarwal (19.5k points)

### 4.17.32 Sets: TIFR2012-A-8 [top](#)

<http://gateoverflow.in/21007>



Selected Answer

D) 243. First take A as  $\emptyset$  and B as power set of  $\{1, 2, 3, 4, 5\}$  which is  $2^5$ . then take A as set of one element ex: when A = {1} then set B could be any of the  $2^4$  elements of power set. This will give us  $16 \times 5$ . In similar fashion when A consist of 2 element set we get total pairs  $5C2 \times 2^3$ ; when A is of three elements we get 40; for 4 elements we get 10 pairs and when A is of 5 elements we get one pair which is A = {1, 2, 3, 4, 5} and B = {}.....so in total =  $32 + 80 + 80 + 40 + 10 + 1 = 243$

19 votes

-- Shaun Patel (6.9k points)

### 4.17.33 Sets: TIFR2016-A-8 [top](#)

<http://gateoverflow.in/97234>

Let set B be of cardinality n.

Total subsets(A) possible are :  $nC0 + nC1 + nC2 + \dots + nCn$ . i.e  $nCr$  number of subsets exist with r cardinality.

Note that for each r, summation has  $2^{n-r}$  terms to sum.

**Case 1:** r= 0. Which is  $\Phi$ .

Total terms =  $2^n$ .

Total terms when  $|C \setminus A|$  even =  $nC0 + nC2 + nC4 + \dots + nC(n-1)$  { if n is odd,  $nCn$  otherwise }

Similarly for odd =  $2^n - |C \setminus A|$

Even contributes to 1 whereas odd contributes to -1.

Therefore Summation = 0 as  $2^n$  terms are present with half as 1 & half as -1.

**Case 2:** r = 1 , total terms =  $2^{n-1}$

Total terms when  $|C \setminus A|$  even =  $nCr + nC(r+2) + \dots + nCn$  { if n is odd n-1 otherwise }

Total terms when  $|C \setminus A|$  odd =  $nC(r+1) + nC(r+3) + \dots$

Again we are end up with total even terms with half contributing to 1 & half -1.

**same situation will arise for every  $r \neq n$ . (as for such  $r$ ,  
 $2^r$  is always even) i.e summation = 0 for all  $r, r \neq n$ .**

**Case n:**  $r = n$ , total terms =  $2^{n-n} = 1$ . This is the case when  $B = A$ .

THEREFORE  $|C \setminus A| = 0$  as both are equal.

Summation = 1.

therefore answer is : 1 if  $A = B$ , 0 otherwise.

Lemme know if I'm wrong.

4 3 votes

-- Aghori (4.6k points)

## 5 Engineering Mathematics: Calculus (51) [top](#)

5.1

Continuity(4) [top](#)

### 5.1.1 Continuity: GATE2010\_ME [top](#)

<http://gateoverflow.in/41570>

**The function  $y = |2 - 3x|$**

- a) is continuous  $\forall x \in \mathbb{R}$  and differentiable  $\forall x \in \mathbb{R}$
- b) is continuous  $\forall x \in \mathbb{R}$  and differentiable  $\forall x \in \mathbb{R}$  except at  $x = 3/2$
- c) is continuous  $\forall x \in \mathbb{R}$  and differentiable  $\forall x \in \mathbb{R}$  except at  $x = 2/3$
- d) is continuous  $\forall x \in \mathbb{R}$  except  $x=3$  and differentiable  $\forall x \in \mathbb{R}$

[calculus](#) [gate2010](#) [engineering-mathematics](#) [continuity](#)

[Answer](#)

### 5.1.2 Continuity: GATE2013\_22 [top](#)

<http://gateoverflow.in/1533>

Which one of the following functions is continuous at  $x = 3$ ?

- (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)  $f(x) = \begin{cases} \frac{1}{x^3 - 27}, & \text{if } x \neq 3 \end{cases}$

[gate2013](#) [calculus](#) [continuity](#) [normal](#)

[Answer](#)

### 5.1.3 Continuity: GATE2014-1-47 [top](#)

<http://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  $f(y) = -f(2 - y)$

[gate2014-1](#) [calculus](#) [continuity](#) [normal](#)

[Answer](#)

### 5.1.4 Continuity: GATE2015-2\_26 [top](#)

<http://gateoverflow.in/8124>

Let  $f(x) = x^{-(1/3)}$  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

gate2015-2 continuity Functions normal

**Answer**

## Answers: Continuity

### 5.1.1 Continuity: GATE2010\_ME [top](#)

<http://gateoverflow.in/41570>



Selected Answer

$$y = 2 - 3x \quad 2 - 3x \geq 0 \\ 3x - 2 \quad 2 - 3x < 0$$

$$y = 2 - 3x \quad x \leq \frac{2}{3} \\ 3x - 2 \quad x > \frac{2}{3}$$

as y is polynomial it is continuous and differentiable at all points but don't know at  $x = \frac{2}{3}$

continuity at  $x = \frac{2}{3}$

$$\text{left limit} = 2 - 3 \times \frac{2}{3} = 0$$

$$\text{right limit} = 3 \times \frac{2}{3} - 2 = 0$$

$$f(a) = f(2/3) = 2 - 3 \times \frac{2}{3} = 0$$

$\therefore \text{LL} = \text{RL} = f(a)$  so y is continuous  
 $\forall x \in R$

Differentiability at  $x = \frac{2}{3}$

$$\text{left derivative} = 0 - 3 = -3$$

$$\text{right derivative} = 3 - 0 = 3$$

$\therefore \text{LD} \neq \text{RD}$ , so y is not differentiable at  
 $x = \frac{2}{3}$

**So Answer is option c**

7 votes

-- Lokesh . (9.8k points)

### 5.1.2 Continuity: GATE2013\_22 [top](#)

<http://gateoverflow.in/1533>



Selected Answer

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.  $f(3) = 2$ .  $f(3+) = x - 1 = 2$ .  $f(3-) = (x+3)/3 = 6/3 = 2$ . Hence continuous.  
 B.  $f(3) = 4$ .  $f(3+) = f(3-) = 8 - 3 = 5$ . So, not continuous.  
 C.  $f(3) = f(3-) = x + 3 = 6$ .  $f(3+) = x - 4 = -1$ . So, not continuous.  
 D.  $f(3)$  is not existing. So, not continuous.

16 votes

-- Arjun Suresh (294k points)

### 5.1.3 Continuity: GATE2014-1-47 [top](#)

<http://gateoverflow.in/1925>

Let's define a new function  $g$ ,

$$g(y) = f(y) - f(y+1)$$

Since function  $f$  is continuous in  $[0,2]$ , therefore  $g$  would be continuous in  $[0,1]$

$$g(0) = -2, g(1) = 2$$

since  $g$  is continuous and goes from negative to positive value in  $[0,1]$ . therefore at some point  $g$  would be 0 in  $(0,1)$ .

$$g=0 \Rightarrow f(y) = f(y+1) \text{ for some } y \text{ in } (0,1).$$

Therefore, correct answer would be (A).

29 votes

-- suraj (5.1k points)

## 5.1.4 Continuity: GATE2015-2\_26 [top](#)

<http://gateoverflow.in/8124>



Selected Answer

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.

11 votes

-- Rajarshi Sarkar (35k points)

## 5.2

## Differentiability(8) [top](#)

<http://gateoverflow.in/39571>

### 5.2.1 Differentiability: GATE 2016-2-02 [top](#)

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 \_\_\_\_\_.

gate2016-2 calculus normal numerical-answers differentiability

Answer

### 5.2.2 Differentiability: GATE1996\_1.6 [top](#)

<http://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 differentiability normal

Answer

### 5.2.3 Differentiability: GATE1996\_3 [top](#)

<http://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 differentiability normal

Answer

### 5.2.4 Differentiability: GATE1998\_1.4 [top](#)

<http://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 differentiability easy

Answer

### 5.2.5 Differentiability: GATE2007-1 [top](#)

<http://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 calculus continuity differentiability easy

Answer

### 5.2.6 Differentiability: GATE2014-1-46 [top](#)

<http://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\_\_\_\_\_.

gate2014-1 calculus easy numerical-answers differentiability

Answer

### 5.2.7 Differentiability: GATE2014-1-6 [top](#)

<http://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  $\theta \in (\frac{\pi}{6}, \frac{\pi}{3})$  such that  $f'(\theta) = 0$   
 II. There exists  $\theta \in (\frac{\pi}{6}, \frac{\pi}{3})$  such that  $f'(\theta) \neq 0$

- A. I only  
 B. II only  
 C. Both I and II  
 D. Neither I Nor II

gate2014-1 calculus differentiability normal

Answer

## 5.2.8 Differentiability: GATE2017-2-10 [top](#)

<http://gateoverflow.in/118262>

If  $f(x) = R \sin(\frac{\pi x}{2}) + S$ .  $f'(\frac{1}{2}) = \sqrt{2}$  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  $\frac{16}{\pi}$

gate2017-2 engineering-mathematics calculus differentiability

Answer

## Answers: Differentiability

### 5.2.1 Differentiability: GATE 2016-2-02 [top](#)

<http://gateoverflow.in/39571>



Selected Answer

$$\begin{aligned} f(x) &= x^{10} \quad \text{Degree 10.} \\ f(x) + f(-x) &= x^{10} + (-x)^{10} \\ &= x^{10} + x^{10} \\ &= 2x^{10} \\ \text{for } g(x) - g(-x) \\ g(x) &= 10 \cdot x^9 \\ g(-x) &= 10 \cdot (-x)^9 \\ &= -10 \cdot x^9 \\ g(x) - g(-x) &= 10x^9 - (-10x^9) \\ &= 20x^9. \end{aligned}$$

So answer is 9 !

19 votes

-- Akash (43.8k points)

9

F is some function where the largest even degree term is having degree 10. no restriction on odd degree terms.

since  $f(x) + f(-x) = \text{degree 10}$

even power gets converted to odd in derivative.

then the the degree of required expression =9.

the odd powers in F will become even in derivative and G(X)-G(-X) retains only odd powers.

11 votes

-- viv696 (2.2k points)

## 5.2.2 Differentiability: GATE1996\_1.6 [top](#)

<http://gateoverflow.in/2710>



Selected Answer

Option D.

Ref: [http://en.wikipedia.org/wiki/Second\\_derivative](http://en.wikipedia.org/wiki/Second_derivative)

3 votes

-- Arjun Suresh (294k points)

## 5.2.3 Differentiability: GATE1996\_3 [top](#)

<http://gateoverflow.in/2755>



Selected Answer

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

$$\lim_{x \rightarrow 2^-} f(x) = \lim_{x \rightarrow 2^+} f(x) = f(2)$$

$$\Rightarrow 4a+2b+c = 2+d$$

$$\Rightarrow d = 0.5$$

$$\text{So } a = -0.5, b = 3, c = -1.5, d = 0.5$$

9 votes

-- Happy Mittal (10.9k points)

## 5.2.4 Differentiability: GATE1998\_1.4 [top](#)

<http://gateoverflow.in/1641>



Selected Answer

(b) It 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.

5 votes

-- Gate\_15\_isHere (639 points)

## 5.2.5 Differentiability: GATE2007-1 [top](#)

<http://gateoverflow.in/1200>



Selected Answer

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.

Ref: <http://math.stackexchange.com/questions/991475/why-is-the-absolute-value-function-not-differentiable-at-x-0>

8 votes

-- jayendra (8.1k points)

## 5.2.6 Differentiability: GATE2014-1-46 [top](#)

<http://gateoverflow.in/1924>



Selected Answer

$$f'(x) = x \cos(x) + \sin(x)$$

$$f''(x) = x(-\sin x) + \cos x + \cos x$$

$$\text{now } f''(x) + f(x) + t \cos x = 0 \implies x(-\sin x) + \cos x + \cos x + x \sin x + t \cos x = 0$$

$$\implies 2 \cos x + t \cos x = 0$$

$$\implies \cos x(t+2) = 0$$

$$\implies t+2 = 0, t = -2$$

8 votes

-- SAKET NANDAN (4k points)

## 5.2.7 Differentiability: GATE2014-1-6 [top](#)

<http://gateoverflow.in/1763>



Selected Answer

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  $f'(x) = 0$

So, for the above 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  $f'(\theta) \neq 0$

So, answer is C

14 votes

-- Saurabh Sharma (791 points)

## 5.2.8 Differentiability: GATE2017-2-10 [top](#)

<http://gateoverflow.in/11826>



Selected Answer

C.

$$\begin{aligned}f(x) &= R * \sin\left(\frac{\pi * x}{2}\right) + S \\f'(x) &= R * \cos\left(\frac{\pi * x}{2}\right) * \frac{\pi}{2} \\f'\left(\frac{1}{2}\right) &= R * \cos\left(\frac{\pi}{4}\right) * \frac{\pi}{2} = \sqrt{2} \\R &= \frac{\sqrt{2} * \sqrt{2} * 2}{\pi} = \frac{4}{\pi}\end{aligned}$$

$$\begin{aligned}f(x) &= \frac{4}{\pi} * \sin\left(\frac{\pi * x}{2}\right) + S \\ \int_0^1 f(x) * dx &= \int_0^1 \left(\frac{4}{\pi} * \sin\left(\frac{\pi * x}{2}\right) + S\right) * dx = \frac{2 * R}{\pi} = \frac{8}{\pi^2} \\ \frac{4}{\pi} \int_0^1 \sin\left(\frac{\pi * x}{2}\right) * dx + \int_0^1 S * dx &= \frac{8}{\pi^2} \\ \frac{4}{\pi} \left[ -\cos\left(\frac{\pi * x}{2}\right) * \frac{2}{\pi} \right]_0^1 + S[x]_0^1 &= \frac{8}{\pi^2} \\ \frac{8}{\pi^2} [-0 + 1] + S &= \frac{8}{\pi^2} \\ S &= 0\end{aligned}$$

3 votes

-- Dhruv Patel (1.4k points)

## 5.3

## Functions(4) top

### 5.3.1 Functions: GATE1987-1-xxvi top

<http://gateoverflow.in/80571>

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](#) [functions](#)

[Answer](#)

### 5.3.2 Functions: GATE1995\_1.21 top

<http://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](#) [functions](#)

[Answer](#)

### 5.3.3 Functions: ISI 2004 MITI top

<http://gateoverflow.in/124324>

Q23 If  $f(x) = x^2$  and  $g(x) = x \sin x + \cos x$  then

- A) f and g agree at no point
- B) f and g agree at exactly one point

- C) f and g agree at exactly two point  
 D) f and g agree at more than two point

[isi2004](#) [engineering-mathematics](#) [functions](#)

[Answer](#)

### 5.3.4 Functions: ISI 2004 MIII [top](#)

<http://gateoverflow.in/124264>

Q22 If  $f(x) = \frac{\sqrt{3}\sin x}{2+\cos x}$  then the range of  $f(x)$  is

A) the interval  $[-1, \frac{\sqrt{3}}{2}]$

B) the interval  $[\frac{-\sqrt{3}}{2}, 1]$

C) the interval  $[-1, 1]$

D) none of the above

[isi2004](#) [engineering-mathematics](#) [functions](#)

[Answer](#)

## Answers: Functions

### 5.3.1 Functions: GATE1987-1-xxvi [top](#)

<http://gateoverflow.in/80571>



Selected Answer

as  $f(x_i) \cdot f(x_{i+1}) < 0$

means one of them is positive and one of them is 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  $x_{i+1}$

1 upvote

-- Amit Pal (3.5k points)

### 5.3.2 Functions: GATE1995\_1.21 [top](#)

<http://gateoverflow.in/2608>



Selected Answer

ans is B.

if you consider  $x=0$  then  $\cos x=1$

now if  $x = \pi/4 = 0.785$  then  $\cos x=0.7071$

for some x value  $x=\cos x$

after this x is increasing and cos x is decreasing. so we can say exactly 1 solution.

EDIT-

It is very easy to show that the equation  $x = \cos x$  has a unique solution. For example take  $f(x) = x - \cos x$  and notice that  $f'(x) = 1 + \sin x \geq 0$  (equality holding in isolated points) so  $f(x)$  is strictly increasing and hence the equation can have at most one solution.

At  $x = 0$ ,  $f(x)$  is  $< 0$  and at  $x = \frac{\pi}{2}$ ,  $f(x)$  is  $> 0$ , and function is continuous (difference of two continuous functions is continuous). Therefore there is solution in  $x \in [0, \frac{\pi}{2}]$ , hence there is a solution in  $[0, \pi]$

1 upvote

-- jayendra (8.1k points)

### 5.3.3 Functions: ISI 2004 MIII top

<http://gateoverflow.in/124324>



Selected Answer

$$f(x) = x^2$$

$$g(x) = x \sin x + \cos x$$

We are asked to make these two functions equal and see at how many points they meet.

$$\Rightarrow f(x) = g(x)$$

$$\Rightarrow x^2 = x \sin x + \cos x$$

$$\Rightarrow x^2 - x \sin x - \cos x = 0$$

$$\Rightarrow F(x) = 0$$

This  $F(x)$  is even and we just need to check at how many points  $F(x)$  crosses the  $X$ -axis for  $x > 0$ .

$$F(0) = -1$$

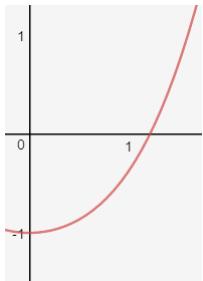
$$F'(x) = 2x - x \cos x$$

$$F'(x) = x(2 - \cos x)$$

Here  $2 - \cos x$  is greater than 0 and  $x(2 - \cos x)$  will be also greater than 0 for  $x > 0$ .

$\Rightarrow F(x)$  is strictly increasing function

Therefore  $F(x)$  will cut at only one point for  $x > 0$ .



As we have already seen that  $F(x)$  is even, therefore  $F(x)$  has only two real roots.

4 votes

-- Debashish Deka (51.4k points)

### 5.3.4 Functions: ISI 2004 MIII top

<http://gateoverflow.in/124264>



Selected Answer

$$\frac{\sqrt{3} \sin x}{2 + \cos x}$$

This is of the form  $\frac{u}{v}$

Differentiating above equation we get

$$\frac{(2+\cos x)\sqrt{3}\cos x - \sqrt{3}\sin x(-\sin x)}{(2+\cos x)^2} = 0$$

$$2\sqrt{3}\cos x + \sqrt{3}\cos^2 x + \sqrt{3}\sin^2 x = 0$$

$$2\sqrt{3}\cos x + \sqrt{3} = 0$$

$$2\cos x + 1 = 0$$

$$x = \frac{2\pi}{3}, \frac{-2\pi}{3}$$

for  $x = \frac{2\pi}{3}$ ,  $\frac{\sqrt{3}\sin x}{2+\cos x} = 1$  and

for  $x = -\frac{2\pi}{3}$ ,  $\frac{\sqrt{3}\sin x}{2+\cos x} = -1$

Hence Option C is correct

1 votes

-- Heisenberg (1.7k points)

## 5.4

## Integration(11) top

### 5.4.1 Integration: GATE1998\_8 top

<http://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

[Answer](#)

### 5.4.2 Integration: GATE2000-2.3 top

<http://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 calculus integration normal

[Answer](#)

### 5.4.3 Integration: GATE2005-IT-35 top

<http://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](#)

### 5.4.4 Integration: GATE2009-25 top

<http://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](#) [calculus](#) [integration](#) [normal](#)
**Answer****5.4.5 Integration: GATE2011\_31** [top](#)<http://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](#) [calculus](#) [integration](#) [normal](#)
**Answer****5.4.6 Integration: GATE2014-3-47** [top](#)<http://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.  $2\pi$

[gate2014-3](#) [calculus](#) [limits](#) [integration](#) [normal](#)
**Answer****5.4.7 Integration: GATE2014-3-6** [top](#)<http://gateoverflow.in/2040>

If  $\int_0^{2\pi} |x \sin x| dx = k\pi$ , then the value of  $k$  is equal to \_\_\_\_\_.

[gate2014-3](#) [calculus](#) [integration](#) [limits](#) [numerical-answers](#) [easy](#)
**Answer****5.4.8 Integration: GATE2015-1\_44** [top](#)<http://gateoverflow.in/8314>

Compute the value of:

$$\int_{\frac{1}{\pi}}^{\frac{2}{\pi}} \frac{\cos(1/x)}{x^2} dx$$

[gate2015-1](#) [calculus](#) [integration](#) [normal](#) [numerical-answers](#)
**Answer****5.4.9 Integration: GATE2015-3\_45** [top](#)<http://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.  $\frac{1}{a^2-b^2} \left[ a(\ln 2 - 25) - \frac{47b}{2} \right]$

gate2015-3 calculus integration normal

Answer

### 5.4.10 Integration: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123887>

Q13 Let  $X = \frac{1}{1001} + \frac{1}{1002} + \frac{1}{1003} + \dots + \frac{1}{3001}$ . Then

- A)  $X < 1$   
 B)  $X > \frac{3}{2}$   
 C)  $1 < X < \frac{3}{2}$   
 D) none of the above

isi2004 engineering-mathematics integration

Answer

### 5.4.11 Integration: TIFR2011-A-11 [top](#)

<http://gateoverflow.in/20219>

$$\int_0^1 \ln x \, dx =$$

- a. 1  
 b. -1  
 c.  $\infty$   
 d.  $-\infty$   
 e. None of the above.

tifr2011 calculus integration

Answer

## Answers: Integration

### 5.4.1 Integration: GATE1998\_8 [top](#)

<http://gateoverflow.in/1722>



Selected Answer

(a)  $f(x) = x^3 - 6x^2 + 9x + 15$

so  $f'(x) = 3x^2 - 12x + 9 = 0 \implies x = 1, 3$

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.

7 votes

-- Happy Mittal (10.9k points)

### 5.4.2 Integration: GATE2000-2.3 [top](#)

<http://gateoverflow.in/650>



Selected Answer

$x \log_2 x$  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.

7 votes

-- Happy Mittal (10.9k points)

### 5.4.3 Integration: GATE2005-IT-35 [top](#)

<http://gateoverflow.in/3782>



Selected Answer

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.

5 votes

-- SAKET NANDAN (4k points)

### 5.4.4 Integration: GATE2009-25 [top](#)

<http://gateoverflow.in/802>



Selected Answer

$$\text{Let } I = \int_0^{\frac{\pi}{4}} \frac{1 - \tan x}{1 + \tan x} dx = \int_0^{\frac{\pi}{4}} \frac{\cos x - \sin x}{\cos x + \sin x} dx$$

Now put

$$\cos x + \sin x = t, \text{ Then}$$

$$(-\sin x + \cos x) dx = dt \text{ and changing limit}$$

So we get

$$I = \int_1^{\sqrt{2}} \frac{1}{t} dt = [\ln t] = \ln(\sqrt{2}) = \frac{\ln 2}{2}$$

16 votes

-- Jagdish Singh (491 points)

### 5.4.5 Integration: GATE2011\_31 [top](#)

<http://gateoverflow.in/2133>



Answer is D.

$$\int_0^{\frac{\pi}{2}} \frac{e^{ix}}{e^{-ix}} dx = \int_0^{\frac{\pi}{2}} e^{2ix} dx = \frac{e^{2ix}}{2i} \Big|_0^{\frac{\pi}{2}} = \frac{-2}{2i} = \frac{i^2}{i} = i.$$

10 votes

-- Sona Praneeth Akula (4k points)

#### 5.4.6 Integration: GATE2014-3-47 [top](#)



ans is A

$$\int_0^{\pi} x^2 \cos x dx = x^2 \sin x \Big|_0^{\pi} - \int_0^{\pi} 2x \sin x = x^2 \sin x \Big|_0^{\pi} + 2x \cos x \Big|_0^{\pi} - \int_0^{\pi} 2 \cos x dx = x^2 \sin x \Big|_0^{\pi} + 2x \cos x \Big|_0^{\pi} - 2 \sin x \Big|_0^{\pi} =$$

Integral of a multiplied by b equals

a multiplied by integral of b

minus

integral of derivative of a multiplied by integral of b

9 votes

-- Keith Kr (6.3k points)

#### 5.4.7 Integration: GATE2014-3-6 [top](#)



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

$$\int_0^{2\pi} |x \sin x| dx = \int_0^{\pi} x \sin x dx + \left( - \int_{\pi}^{2\pi} x \sin x dx \right) = \int_0^{\pi} x \sin x dx - \int_{\pi}^{2\pi} x \sin x dx$$

$$\int_0^{\pi} u dv = uv - \int_0^{\pi} v du \text{ Here } u = x, du = dx, dv = \sin x dx, \text{ so } v = -\cos x \therefore \int_0^{\pi} x \sin x dx = [-x \cos x]_0^{\pi} + \int_0^{\pi} \cos x dx = \pi$$

So, given integral =  $\pi - (-3\pi) = 4\pi$

So, k = 4.

15 votes

-- Arjun Suresh (294k points)

#### 5.4.8 Integration: GATE2015-1\_44 [top](#)



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:

$$\begin{aligned} I &= \sin(u) \Big|_{\pi/2}^{\pi} \\ &= \sin(\pi) - \sin\left(\frac{\pi}{2}\right) \\ &= 0 - 1 \end{aligned}$$

$$I = -1$$

28 votes

-- Shyam Singh (1.5k points)

#### 5.4.9 Integration: GATE2015-3\_45 [top](#)

<http://gateoverflow.in/8554>



Selected Answer

$$af(x) + bf\left(\frac{1}{x}\right) = \frac{1}{x} - 25 \quad \dots (1)$$

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

$$\therefore (a^2 - b^2) \int_1^2 f(x) dx = a(\log 2 - 25) + b \times \frac{47}{2}$$

$$\therefore \int_1^2 f(x) dx = \frac{1}{(a^2 - b^2)} [a(\log 2 - 25) + \frac{47b}{2}]$$

$$\text{Answer: A. } \frac{1}{(a^2 - b^2)} [a(\log 2 - 25) + \frac{47b}{2}]$$

24 votes

-- Shyam Singh (1.5k points)

#### 5.4.10 Integration: ISI 2004 MIII [top](#)

<http://gateoverflow.in/123887>



Selected Answer

Take the series as  $1/x$

and use **Riemann integral to evaluate the series**

**integrate  $1/x$  dx from  $x=1001$  to  $3001$  then we get  $1.0979$  which is in between  $1$  and  $3/2$**

So C is correct option.

$1 < X < 3/2$

2 votes

-- Shubham Sharma (3k points)

### 5.4.11 Integration: TIFR2011-A-11 [top](#)

<http://gateoverflow.in/20219>



Selected Answer

#### Use Integration by Parts

$$\int \ln(x) dx$$

set

$$u = \ln(x), \quad dv = dx$$

then we find

$$du = (1/x) dx, \quad v = x$$

substitute

$$\int \ln(x) dx = \int u dv$$

and use integration by parts

$$= uv - \int v du$$

substitute  $u = \ln(x)$ ,  $v = x$ , and  $du = (1/x)dx$

$$= \ln(x) x - \int x (1/x) dx$$

$$= \ln(x) x - \int dx$$

$$= \ln(x) x - x + C$$

$$= x \ln(x) - x + C.$$

Now Put Limits

$$[\ln(1)-1+C] - [0-0+C] = -1$$

Note-Lim  $[x \ln x] = 0$ .

$x \rightarrow 0$

4 votes

-- sonu (2.4k points)

## 5.5

### Limits(11) [top](#)

<http://gateoverflow.in/39630>

### 5.5.1 Limits: GATE 2016-1-3 [top](#)

$$\lim_{x \rightarrow 4} \frac{\sin(x-4)}{x-4}$$

=\_\_\_\_\_.

[gate2016-1](#) | [calculus](#) | [limits](#) | [easy](#) | [numerical-answers](#)

[Answer](#)

### 5.5.2 Limits: GATE1993\_02.1 [top](#)

<http://gateoverflow.in/605>

Q2). In questions 2.1 to 2.10 below, each blank (\_\_\_\_) is to be suitably filled in.  $\lim_{x \rightarrow 0} \frac{x(e^x - 1) + 2(\cos x - 1)}{x(1 - \cos x)}$  is \_\_\_\_\_

gate1993 | limits | calculus | normal

[Answer](#)

### 5.5.3 Limits: GATE2008-1 [top](#)

<http://gateoverflow.in/399>

$\lim_{x \rightarrow \infty} \frac{x - \sin x}{x + \cos x}$  equals

- A. 1
- B. -1
- C.  $\infty$
- D.  $-\infty$

gate2008 | calculus | limits | easy

[Answer](#)

### 5.5.4 Limits: GATE2010-5 [top](#)

<http://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 | calculus | limits | normal

[Answer](#)

### 5.5.5 Limits: GATE2015-1\_4 [top](#)

<http://gateoverflow.in/8021>

$\lim_{x \rightarrow \infty} x^{\frac{1}{x}}$  is

- A.  $\infty$
- B. 0
- C. 1
- D. Not defined

gate2015-1 | calculus | limits | normal

[Answer](#)

### 5.5.6 Limits: GATE2015-3\_9 [top](#)

<http://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.  $\infty$

gate2015-3 | calculus | limits | normal

[Answer](#)

### 5.5.7 Limits: GATE2017-1-28 [top](#)

<http://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

[gate2017-1](#) | [calculus](#) | [limits](#) | [normal](#)

[Answer](#)

### 5.5.8 Limits: TIFR2010-A-7 [top](#)

<http://gateoverflow.in/18234>

The limit of  $10^n/n!$  as  $n \rightarrow \infty$  is.

- A. 0  
 B. 1  
 C.  $e$   
 D. 10  
 E.  $\infty$

[tifr2010](#) | [calculus](#) | [limits](#)

[Answer](#)

### 5.5.9 Limits: TIFR2011-A-14 [top](#)

<http://gateoverflow.in/20224>

What is the value of the following limit?

$$\lim_{x \rightarrow 0} \frac{d}{dx} \frac{\sin^2 x}{x}$$

- a. 0  
 b. 2  
 c. 1  
 d.  $\frac{1}{2}$   
 e. None of the above

[tifr2011](#) | [calculus](#) | [limits](#)

[Answer](#)

### 5.5.10 Limits: TIFR2011-A-17 [top](#)

<http://gateoverflow.in/20254>

What is the value of the following limit?

$$\lim_{x \rightarrow 0} \frac{2^x - 1}{x}$$

- a. 0  
 b.  $\log_2(e)$   
 c.  $\log_e(2)$   
 d. 1  
 e. None of the above.

[tifr2011](#) | [limits](#)

[Answer](#)

### 5.5.11 Limits: TIFR2012-A-14 [top](#)

<http://gateoverflow.in/25037>

The limit  $\lim_{n \rightarrow \infty} (\sqrt{n^2 + n} - n)$  equals.

- A.  $\infty$   
 B. 1  
 C.  $1/2$   
 D. 0  
 E. None of the above.

Answer

## Answers: Limits

### 5.5.1 Limits: GATE 2016-1-3 top

<http://gateoverflow.in/39630>


Selected Answer

substitute  $h=x-4$ . so it becomes  $\lim_{h \rightarrow 0} (\sinh)/h$  ... which is a standard limit.. Ans would be 1.

thumb up 12 votes

thumb down -- Abhilash Panicker (8.8k points)

### 5.5.2 Limits: GATE1993\_02.1 top

<http://gateoverflow.in/605>


Selected Answer

Use LH rule:

First Derivative:  $[x(e^x) + (e^x - 1) - 2(\sin x)]/[x \sin x + (1 - \cos x)]$

Second Derivative:  $[x e^x + e^x + e^x - 2 \cos x]/[\{x \cos x + \sin x + \sin x\}]$

Third Derivative:  $[x e^x + e^x + e^x + e^x + 2 \sin x]/[-x \sin x + \cos x + \cos x + \cos x]$

Put  $x = 0$ :  $[0+1+1+1+0]/[0+1+1+1] = 3/3 = 1$ .

thumb up 4 votes

thumb down -- Rajarshi Sarkar (35k points)

### 5.5.3 Limits: GATE2008-1 top

<http://gateoverflow.in/399>


Selected Answer

$$\begin{aligned}\lim_{x \rightarrow \infty} \frac{x - \sin x}{x + \cos x} &= \lim_{x \rightarrow \infty} \frac{x(1 - \frac{\sin x}{x})}{x(1 + \frac{\cos x}{x})} \\ &= \lim_{x \rightarrow \infty} \frac{1 - \frac{\sin x}{x}}{1 + \frac{\cos x}{x}}\end{aligned}$$

now to calculate values of  $\frac{\sin x}{x}$  and  $\frac{\cos x}{x}$  we use Squeezing Theorem.

$$\begin{aligned}-1 \leq \sin x &\leq +1 & -1 \leq \cos x &\leq +1 \\ -\frac{1}{x} \leq \frac{\sin x}{x} &\leq \frac{+1}{x} & -\frac{1}{x} \leq \frac{\cos x}{x} &\leq \frac{+1}{x}\end{aligned}$$

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**

12 votes

-- Amar Vashishth (28.7k points)

## 5.5.4 Limits: GATE2010-5 top

<http://gateoverflow.in/1151>

Selected Answer

I will solve by two methods

method 1

$$y = \lim_{n \rightarrow \infty} (1 - 1/n)^{2n}$$

taking log

$$\log y = \lim_{n \rightarrow \infty} 2n \log(1 - 1/n)$$

$$= \lim_{n \rightarrow \infty} \log(1 - 1/n)/(1/2n) \text{----- (converted this so as to have form } 0/0)$$

apply l hospital rule

$$\log y = \lim_{n \rightarrow \infty} (1 - 1/n)/n^2 / (-1/2n^2)$$

$$\log y = -2$$

$$y = e^{-2}$$

method two

it takes 1 to power infinity form

$$\lim_{x \rightarrow \infty} f(x)g(x)$$

$$= \lim_{x \rightarrow \infty} (f(x)-1)g(x)$$

$$(f(x)-1)*g(x) = -1/n * 2n = -2$$

ie -2 constant

so we get final ans  $e^{-2}$ 

$y = \lim_{n \rightarrow \infty} (1 - \frac{1}{n})^{2n}$

M-I :

$$\begin{aligned} \log y &= \lim_{n \rightarrow \infty} 2n \log(1 - \frac{1}{n}) \\ &= \lim_{n \rightarrow \infty} \frac{\log(1 - \frac{1}{n})}{\frac{1}{2n}} \\ &\stackrel{\text{l'Hopital}}{=} \lim_{n \rightarrow \infty} \frac{-\frac{1}{n^2}}{-\frac{1}{2n^2}} \\ &= \frac{1}{2} \end{aligned}$$

$$\log y = -2$$

$$y = e^{-2}$$

M-II  $\lim_{n \rightarrow \infty} f(x)g(x) = 1 \text{ for } n > 0$

$$\frac{1}{n} \rightarrow 0 \text{ when } n \rightarrow \infty$$

$$\lim_{n \rightarrow \infty} e^{\frac{1}{n} \log(1 - \frac{1}{n})} = e^{\lim_{n \rightarrow \infty} \frac{1}{n} \log(1 - \frac{1}{n})} = e^{\lim_{n \rightarrow \infty} -\frac{1}{n^2}} = e^{-\frac{1}{2}}$$

u 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)

11 votes

-- Pooja Palod (32.4k points)

## 5.5.5 Limits: GATE2015-1\_4 [top](#)



Selected Answer

Apply an exponential of a logarithm to the expression.

$$\lim_{x \rightarrow \infty} x^{\frac{1}{x}} = \lim_{x \rightarrow \infty} \exp\left(\log\left(x^{\frac{1}{x}}\right)\right) = \lim_{x \rightarrow \infty} \exp\left(\frac{\log(x)}{x}\right)$$

$$\lim_{x \rightarrow \infty} \exp\left(\frac{\log(x)}{x}\right)$$

Since the exponential function is continuous, we may factor it out of the limit.

$$\lim_{x \rightarrow \infty} \exp\left(\frac{\log(x)}{x}\right) = \exp\left(\lim_{x \rightarrow \infty} \frac{\log(x)}{x}\right)$$

$$\exp\left(\lim_{x \rightarrow \infty} \frac{\log(x)}{x}\right)$$

Logarithmic functions grow asymptotically slower than polynomials.

Since  $\log(x)$  grows asymptotically slower than the polynomial  $x$  as  $x$  approaches  $\infty$ ,

$$\lim_{x \rightarrow \infty} \frac{\log(x)}{x} = 0:$$

$$e^0 = 1$$

16 votes

-- Shyam Singh (1.5k points)

## 5.5.6 Limits: GATE2015-3\_9 [top](#)



Selected Answer

Apply an exponential of a logarithm to the expression.

$$\lim_{x \rightarrow \infty} (x^2 + 1)^{e^{-x}} = \lim_{x \rightarrow \infty} \exp\left(\log\left((x^2 + 1)^{e^{-x}}\right)\right) = \lim_{x \rightarrow \infty} \exp\left(\frac{\log(x^2 + 1)}{e^x}\right);$$

$$\lim_{x \rightarrow \infty} \exp\left(\frac{\log(x^2 + 1)}{e^x}\right)$$

Since the exponential function is continuous, we may factor it out of the limit.

$$\lim_{x \rightarrow \infty} \exp\left(\frac{\log(x^2 + 1)}{e^x}\right) = \exp\left(\lim_{x \rightarrow \infty} \frac{\log(x^2 + 1)}{e^x}\right);$$

$$\exp\left(\lim_{x \rightarrow \infty} \frac{\log(x^2 + 1)}{e^x}\right)$$

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

21 votes

-- Shyam Singh (1.5k points)

### 5.5.7 Limits: GATE2017-1-28 [top](#)

<http://gateoverflow.in/118309>



Selected Answer

Since substituting  $x=1$  we get  $0/0$  which is indeterminate

after applying L'H we get  $((7x^6)-(10x^4))/((3x^2)-(6x))$

now substituting  $x=1$  we get  $-3/-3$

=1

hence answer is 1

6 votes

-- sriv\_shubham (2.7k points)

### 5.5.8 Limits: TIFR2010-A-7 [top](#)

<http://gateoverflow.in/10234>



Selected Answer

$$\lim_{n \rightarrow \infty} \frac{10^n}{n!} = \frac{\overbrace{10 \times 10 \times 10 \times \dots \times 10 \times 10}^{n \text{ times}}}{1 \times 2 \times 3 \times \dots \times (n-1) \times n}$$

$$= \underbrace{\frac{10}{1} \cdot \frac{10}{2} \cdot \frac{10}{3} \cdots \frac{10}{n}}_{\approx 2755} \cdot \underbrace{\frac{10}{11} \cdots \frac{10}{100} \cdot \frac{10}{101} \cdots \frac{10}{10000} \cdot \frac{10}{10001}}_{\ll 1} \cdots \text{goes forever}$$

Now we can see that after the  $\frac{10}{10}$  term, all subsequent terms are  $< 1$ , and keep decreasing. As we increase the value of  $n$  it the product will get close to 0.

So as  $n \rightarrow \infty$   $10^n/n! \rightarrow 0$ .

Hence, the answer is option a) 0

9 votes

-- sonam\_vyas (13.2k points)

### 5.5.9 Limits: TIFR2011-A-14 [top](#)

<http://gateoverflow.in/20224>



Selected Answer

Answer is 1.

$$\begin{aligned}
 & \underset{x \rightarrow 0}{\text{Lt}} \frac{d}{dx} \frac{\sin^2 x}{x} \\
 & \text{And} \quad \frac{d}{dx} \left( \frac{\sin^2 x}{x} \right) \\
 & = \frac{(\sin^2 x)'x - (\sin x)^2 \cdot x'}{x^2} \\
 & = \frac{[2\sin x \cdot \cos x]x - \sin^2 x}{x^2} \\
 & \Rightarrow \frac{x \sin x \cos x - \sin^2 x}{x^2} \\
 & \underset{x \rightarrow 0}{\text{Lt}} \left( \frac{x \sin x \cos x - \sin^2 x}{x^2} \right) \\
 & \Rightarrow \underset{x \rightarrow 0}{\text{Lt}} \left( \frac{2x \sin 2x}{x^2} - \frac{\sin^2 x}{x^2} \right) \\
 & \Rightarrow \underset{x \rightarrow 0}{\text{Lt}} \frac{2 \sin 2x}{x^2} \downarrow \underset{x \rightarrow 0}{\text{Lt}} \frac{(\sin x)^2}{x^2} \\
 & \stackrel{\text{HRule}}{\Rightarrow} \underset{x \rightarrow 0}{\text{Lt}} \frac{\cos 2x \cdot 2}{1} - 1 \\
 & = 2[\cos 2(0)] - 1 \\
 & \Rightarrow 2(1) - 1 \Rightarrow \underline{\underline{1}}
 \end{aligned}$$

8 votes

-- Prabhanjan\_1 (11.9k points)

**5.5.10 Limits: TIFR2011-A-17** [top](#)<http://gateoverflow.in/20254>

Selected Answer

Since we have a  $\frac{0}{0}$  form, we can apply the L'Hôpital's rule.

$$\begin{aligned}
 L &= \underset{x \rightarrow 0}{\lim} \frac{2^x - 1}{x} \\
 &= \underset{x \rightarrow 0}{\lim} \frac{\frac{d}{dx}(2^x - 1)}{\frac{d}{dx}x} \\
 &= \underset{x \rightarrow 0}{\lim} \frac{2^x \ln 2}{1} \\
 &= \ln 2
 \end{aligned}$$

$$L = \log_e(2)$$

Hence, option c is correct.

9 votes

-- Pragy Agarwal (19.5k points)

**5.5.11 Limits: TIFR2012-A-14** [top](#)<http://gateoverflow.in/25037>

Selected Answer

$$\begin{aligned}
 L &= \lim_{n \rightarrow \infty} \sqrt{n^2 + n} - n \\
 &= \lim_{n \rightarrow \infty} \left( \sqrt{n^2 + n} - n \right) \times \left( \frac{\sqrt{n^2 + n} + n}{\sqrt{n^2 + n} + n} \right) \\
 &= \lim_{n \rightarrow \infty} \frac{n^2 + n - n^2}{\sqrt{n^2 + n} + n} \\
 &= \lim_{n \rightarrow \infty} \frac{n}{n \left( \sqrt{1 + \frac{1}{n}} + 1 \right)} \\
 &= \lim_{n \rightarrow \infty} \frac{1}{\sqrt{1 + \frac{1}{n}} + 1} \\
 &= \frac{1}{\sqrt{1 + \frac{1}{\infty}} + 1} \\
 L &= \frac{1}{2}
 \end{aligned}$$

Hence, option C is the correct answer.

4 votes

-- Jagdish Singh (491 points)

## 5.6

## Maxima Minima(12) top

### 5.6.1 Maxima Minima: GATE1995\_25 top

<http://gateoverflow.in/2864>

Find the minimum value of  $3 - 4x + 2x^2$ .

Determine the number of positive integers ( $\leq 720$ ) which are not divisible by any of 2, 3 or 5.

[gate1995](#) [calculus](#) [normal](#) [maxima-minima](#)

[Answer](#)

### 5.6.2 Maxima Minima: GATE1997\_4.1 top

<http://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](#)

### 5.6.3 Maxima Minima: GATE2008-25 top

<http://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](#) [calculus](#) [maxima-minima](#) [easy](#)
[Answer](#)**5.6.4 Maxima Minima: GATE2008-IT-31** [top](#)<http://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.  $2(1/12)$
- C.  $2(1/6)$
- D.  $2(1/2)$

[gate2008-it](#) [calculus](#) [maxima-minima](#) [normal](#)
[Answer](#)**5.6.5 Maxima Minima: GATE2012\_9** [top](#)<http://gateoverflow.in/41>

Consider the function  $f(x) = \sin(x)$  in the interval  $x = [\pi/4, 7\pi/4]$ . The number and location(s) of the local minima of this function are

- (A) One, at  $\pi/2$
- (B) One, at  $3\pi/2$
- (C) Two, at  $\pi/2$  and  $3\pi/2$
- (D) Two, at  $\pi/4$  and  $3\pi/2$

[gate2012](#) [calculus](#) [maxima-minima](#) [normal](#) [nielit](#)
[Answer](#)**5.6.6 Maxima Minima: ISI 2004 MIII** [top](#)<http://gateoverflow.in/123886>

Q12 The maximum possible value of  $xy^2z^3$  subjected to condition  $x, y, z \geq 0$  and  $x+y+z=3$  is

- A) 1
- B)  $\frac{9}{8}$
- C)  $\frac{9}{4}$
- D)  $\frac{27}{16}$

[isi2004](#) [engineering-mathematics](#) [maxima-minima](#)
[Answer](#)**5.6.7 Maxima Minima: TIFR2010-A-3** [top](#)<http://gateoverflow.in/16209>

The function  $f(x) = 2.5 \log_e (2 + \exp(x^2 - 4x + 5))$  attains a minimum at  $x = ?$

- a. 0
- b. 1
- c. 2
- d. 3
- e. 4

[tifr2010](#) [calculus](#) [maxima-minima](#)
[Answer](#)**5.6.8 Maxima Minima: TIFR2011-A-4** [top](#)<http://gateoverflow.in/20002>

Consider the problem of maximizing  $x^2 - 2x + 5$  such that  $0 < x < 2$ . The value of  $x$  at which the maximum is achieved

is:

- a. 0.5
- b. 1
- c. 1.5
- d. 1.75
- e. None of the above.

[tifr2011](#) [calculus](#) [maxima-minima](#)

[Answer](#)

### 5.6.9 Maxima Minima: TIFR2012-A-15 [top](#)

<http://gateoverflow.in/25040>

Consider the differential equation  $dx/dt = (1-x)(2-x)(3-x)$ . Which of its equilibria is unstable?

- a.  $x = 0$
- b.  $x = 1$
- c.  $x = 2$
- d.  $x = 3$
- e. None of the above.

[tifr2012](#) [calculus](#) [maxima-minima](#)

[Answer](#)

### 5.6.10 Maxima Minima: TIFR2013-A-16 [top](#)

<http://gateoverflow.in/25496>

The minimum of the function  $f(x) = x \log_e(x)$  over the interval  $[1/2, \infty)$  is

- a. 0
- b.  $-e$
- c.  $-\log_e(2)/2$
- d.  $-1/e$
- e. None of the above

[tifr2013](#) [calculus](#) [maxima-minima](#)

[Answer](#)

### 5.6.11 Maxima Minima: TIFR2014-A-9 [top](#)

<http://gateoverflow.in/25996>

Solve  $\min x^2 + y^2$

subject to

$$x + y \geq 10,$$

$$2x + 3y \geq 20,$$

$$x \geq 4,$$

$$y \geq 4.$$

- a. 32
- b. 50
- c. 52
- d. 100
- e. None of the above

[tifr2014](#) [calculus](#) [maxima-minima](#)

[Answer](#)

### 5.6.12 Maxima Minima: TIFR2015-A-11 [top](#)

<http://gateoverflow.in/29581>

Suppose that  $f(x)$  is a continuous function such that  $0.4 \leq f(x) \leq 0.6$  for  $0 \leq x \leq 1$ . Which of the following is always true?

- A.  $f(0.5) = 0.5$ .
- B. There exists  $x$  between 0 and 1 such that  $f(x) = 0.8x$ .
- C. There exists  $x$  between 0 and 0.5 such that  $f(x) = x$ .
- D.  $f(0.5) > 0.5$ .
- E. None of the above statements are always true.

[tifr2015](#) [maxima-minima](#) [calculus](#)

[Answer](#)

## Answers: Maxima Minima

### 5.6.1 Maxima Minima: GATE1995\_25 [top](#)

<http://gateoverflow.in/266>



Selected Answer

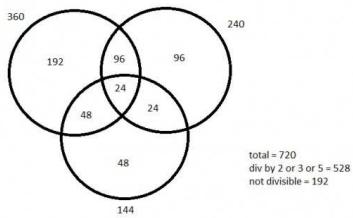
$$f(x) = 3 - 4x + 2x^2$$

$$f'(x) = -4 + 4x = 0 \Rightarrow x=1$$

$$f''(x) = 4$$

$f''(1) = 4 > 0$ , therefore at  $x=1$  we will get minimum value, which is :  $3 - 4(1) + 2(1)^2 = 1$

ans for B:



7 votes

-- jayendra (8.1k points)

### 5.6.2 Maxima Minima: GATE1997\_4.1 [top](#)

<http://gateoverflow.in/2242>



Selected Answer

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).

$$f(2) = 2(2)^2 - 2(2) + 6 = 8 - 4 + 6 = 10$$

$$f\left(\frac{1}{2}\right) = 2\frac{1}{2}^2 - 2\frac{1}{2} + 6 = 5.5, \text{ so } x = \frac{1}{2} \text{ is a minimum.}$$

$$f(0) = 6.$$

So, the maximum value is at  $x = 2$  which is 10 as there are no other extremum for the given function.

7 votes

-- Rajarshi Sarkar (35k points)

### 5.6.3 Maxima Minima: GATE2008-25 [top](#)

<http://gateoverflow.in/423>



answer is (b)

$$f(x) = 3x^4 - 16x^3 + 24x^2 + 37$$

$$f'(x) = 12x^3 - 48x^2 + 48x = 0$$

$$\Rightarrow 12x(x^2 - 4x + 4) = 0$$

$$x(x-2)^2 = 0$$

$$\Rightarrow x = 0, 2$$

$$f''(x) = 36x^2 - 96x + 48$$

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.  $x=0$ .

R e f : [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)

12 votes

-- SAKET NANDAN (4k points)

#### 5.6.4 Maxima Minima: GATE2008-IT-31 [top](#)



Answer: B

$$\text{at } x = 3/2, f(x) = 2 \frac{1}{12} = \text{Option B.}$$

8 votes

-- Rajarshi Sarkar (35k points)

#### 5.6.5 Maxima Minima: GATE2012\_9 [top](#)



answer is (d)

$f(s) = \cos x = 0$  gives root  $\frac{\pi}{2}$  and  $\frac{3\pi}{2}$  which lie between given domain in question  $[\frac{\pi}{4}, \frac{7\pi}{4}]$

$f''(x) = -(\sin x)$  at  $\frac{\pi}{2}$  it gives  $-1 < 0$  it means it is local maxima and at  $\frac{3\pi}{2}$  it gives  $1 > 0$  which is local minima

and since it at  $\frac{\pi}{2}$  is local maxima so before its graph is strictly increasing so  $\frac{\pi}{4}$  is also local minima

so there are two local minima  $\frac{\pi}{4}$  and  $\frac{3\pi}{2}$

8 votes

-- SAKET NANDAN (4k points)

Sine function increases till  $\pi/2$  and so for the considered interval  $\pi/4$  would be a local minimum. From  $\pi/2$ , value of sine keeps on decreasing till  $3\pi/2$  and hence  $3\pi/2$  would be another local minima. So, (D) is the correct answer here.

12 votes

-- gatcse (13.4k points)

### 5.6.6 Maxima Minima: ISI 2004 MIII [top](#)



Given ,

$$x + y + z = 3$$

$$\Rightarrow x + (y/2) + (y/2) + (z/3) + (z/3) + (z/3) = 3$$

Now using A.M. G.M inequality , we have :

$$[x + (y/2) + (y/2) + (z/3) + (z/3) + (z/3)] / 6 \geq (x . (y/2) . (y/2) . (z/3) . (z/3) . (z/3))^{(1/6)}$$

$$\Rightarrow (x . (y/2) . (y/2) . (z/3) . (z/3))^{(1/6)} \leq 1/2$$

$$\Rightarrow (x . (y/2) . (y/2) . (z/3) . (z/3)) \leq 1/64$$

$$\Rightarrow x . y^2 . z^3 \leq 108 / 64 = 27 / 16$$

**Hence D) is the correct answer**

6 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

### 5.6.7 Maxima Minima: TIFR2010-A-3 [top](#)



Digvijay is right,  $f(x)$  will be minimum at  $x = 2$ ,  
Here is another approach.

Since log and exponent are monotonically increasing functions, the problem of minimizing  $f(x)$  can be reduced to just minimizing the quadratic expression

$x^2 - 4x + 5$ ,  
this quadratic expression can be written as  $(x^2 - 4x + 4) + 1$  which is equal to

$(x - 2)^2 + 1$ .  
now since  $(x - 2)^2$  can not be less than 0, so  $(x - 2)^2 + 1$  can not be less than 1.  
Also  $(x - 2)^2 + 1$  will be at its minimum value (= 1), when  $x = 2$ .

so value of  $f(x)$  will be minimum at  $x = 2$ .

3 votes

-- Anurag Pandey (13.1k points)

### 5.6.8 Maxima Minima: TIFR2011-A-4 [top](#)



$$P(x) = x^2 - 2x + 5$$

Since a polynomial is defined and continuous everywhere, we only need to check the critical point and the boundaries.

$$\frac{d}{dx} P(x) = 2x - 2$$

**Critical point:**  $2x - 2 = 0 \implies x = 1$  gives  $P(x) = 4$ , which is the minimum.

**Boundaries:**  $\lim_{x \rightarrow 0^+} P(x) = \lim_{x \rightarrow 2^-} P(x) = 5$

Since  $P(x)$  increases as  $x$  goes farther away from the 1, but  
 $P(x)$  is defined on an open interval,  
 $P(x)$  never attains a maximum!

Hence, e. None of the above is the correct answer.

6 votes

-- Pragy Agarwal (19.5k points)

### 5.6.9 Maxima Minima: TIFR2012-A-15 [top](#)

<http://gateoverflow.in/25040>

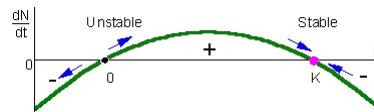
For unstable equilibrium point,  $dx/dt > 0$

At  $x = 0$ ,  $dx/dt = (1-0)(2-0)(3-0) = 6 > 0$

Hence  $x = 0$  is point of unstable equilibrium.

We can understand equilibrium in terms of radioactive decay.

Let  $dN/dt = -KN$ ;  $K > 0$  its significance is that an element is losing energy so it is getting stability because we know more energy an element gets, more de-stability it gains and vice versa.



2 votes

-- Shashank Kumar (3.5k points)

### 5.6.10 Maxima Minima: TIFR2013-A-16 [top](#)

<http://gateoverflow.in/25496>

Minimum value of function occurs at end points or critical points

$$f'(x) = 1 + \log x$$

Equate it to 0

$$x = 1/e$$

$$f''(x) = 1/x$$

Put  $x = 1/e$   $f''(x) = e$  so minima at  $1/e$

$$\text{But } 1/e = 0.36$$

But  $x \in [1/2, \infty)$

So min occurs at  $1/2$

$$\text{So min value} = 1/2 \log 1/2$$

So ans is c

3 votes

-- Pooja Palod (32.4k points)

### 5.6.11 Maxima Minima: TIFR2014-A-9 [top](#)

<http://gateoverflow.in/25996>



Selected Answer

Answer -> Option B) 50

$x \geq 4$  and  $y \geq 4$ , So we can take both  $x = 5$  &  $y = 5$

$x+y \geq 10 \Rightarrow$  Satisfied ,  $5+5 = 10$

$2x + 3y \geq 20$ . Satisfied.

This is infact minimum value.

Other options =>

4,4 =>  $x+y$  constraint fail

4,5 =>  $x+y$  fail

6,4 => Still giving 52 as sum which is more than 50 !, This can not be answer.

7,3 =>  $49+9 > 58 > 50$ .

4 votes

-- Akash (43.8k points)

## 5.6.12 Maxima Minima: TIFR2015-A-11 [top](#)

<http://gateoverflow.in/29581>

This is a repeating question on continuity. Let me solve it a non-standard way -- which should be useful in GATE.

From the question  $f$  is a function mapping the set of real (or rational) numbers between  $[0,1]$  to  $[0.4,0.6]$ . So, clearly the co-domain here is smaller than the domain set. The function is not given as onto and so, there is no requirement that all elements in co-domain set be mapped to by the domain set. We are half done now. Lets see the options:

A.  $f(0.5) = 0.5$ . False, as we can have  $f(0.5) = 0.4$ , continuity does not imply anything other than all points being mapped being continuous.

C. Again false, we can have  $f(x) = 0.6$  for all  $x$ .

D. False, same reason as for A.

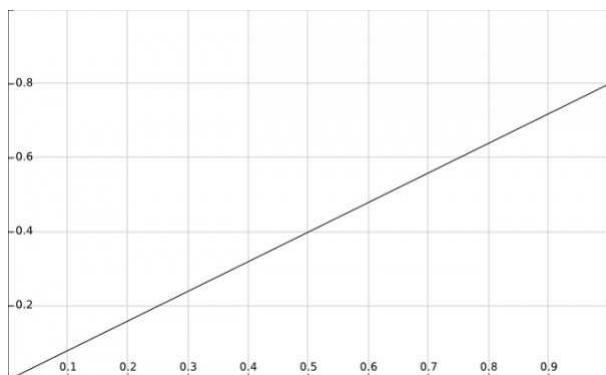
Only B option left- which needs to be proved as correct now since we also have E option. We know that for a function all elements in domain set must have a mapping. All these can map to either 1 or more elements but at least one element must be there in the range set. i.e.,  $f(x) = y$  is true for some  $y$  which is in  $[0.4,0.6]$ . In the minimal case this is a single element say  $c$ . Now for  $x = 1/0.8$ , option B is true. In the other case, say the minimal value of  $f(x) = a$  and the maximum value be  $f(x) = b$ . Now,

as per Intermediate Value theorem (see: [https://www.math.ucdavis.edu/~hunter/intro\\_analysis\\_pdf/ch7.pdf](https://www.math.ucdavis.edu/~hunter/intro_analysis_pdf/ch7.pdf)), all points between  $a$  and  $b$  are also in the range set as  $f$  is continuous. Now, we need to consider  $x$  in the range  $[0.5,0.75]$  as then only  $f(x)$  can be  $0.8x$  and be in  $[0.4,0.6]$ . In our case we have

$f(x_1) = a, f(x_2) = b$ . Lets assume  $a = 0.8x_1$  and  $b = 0.8x_2$ . Now, for all other points in  $[0.5,0.75]$ ,  $f(x)$  must be between  $a$  and  $b$  and all points between  $a$  and  $b$  must be mapped by some  $x$ .

Moreover, for  $x = 0.5$ ,  $f(x) \geq 0.4$  and for  $x = 0.75$ ,  $f(x) \leq 0.6$ . So, if we plot  $g(x) = 0.8x$ , **this line should cross  $f(x)$  at some point between 0.5 and 0.75**

0.75 because at  $x = 0.5$ ,  $f(x)$  must be above or equal to the line  $0.8x$  (shown below) and for  $x = 0.75$  it must be below or equal which means an intersection must be there.



This shows there exist some  $x$  between 0.5 and 0.75 for which  $f(x) = 0.8x$  a stronger case than option B. So, B option is

true. Now please try for  $f(x) = 0.9x$  and see if it is true.

3 votes

-- Arjun Suresh (294k points)

## 5.7

## Polynomials(1) top

### 5.7.1 Polynomials: GATE1987-1-xxii top

<http://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](#)

## Answers: Polynomials

### 5.7.1 Polynomials: GATE1987-1-xxii top

<http://gateoverflow.in/80379>



Selected Answer

since the polynomial has highest degree 7. So there are 7 roots possible for it

now suppose if an imaginary number  $a+bi$  is also root of this polynomial then  $a-bi$  will also be the root of this polynomial

That means there must be even number of complex root possible becoz they occur in pair.

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 even number of complex root 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 even number of complex root is possible, that means this polynomial has max 6 complex roots and Hence minimum 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 atmost 7 roots. So this option is also wrong

**Hence answer should be B)**

3 votes

-- Digvijaysingh Gautam (7.9k points)

# 6 Engineering Mathematics: Linear Algebra (68) top

6.1

**Determinant(5)** top

## 6.1.1 Determinant: GATE1997-1.3 top

<http://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](#)

## 6.1.2 Determinant: GATE2000-1.3 top

<http://gateoverflow.in/626>

The determinant of the matrix

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 8 & 1 & 7 & 2 \\ 2 & 0 & 2 & 0 \\ 9 & 0 & 6 & 1 \end{bmatrix}$$

4  
0  
15  
20

[gate2000](#) [linear-algebra](#) [easy](#) [determinant](#)

[Answer](#)

## 6.1.3 Determinant: GATE2005-IT-3 top

<http://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](#)

### 6.1.4 Determinant: GATE2013\_3 [top](#)

<http://gateoverflow.in/1412>

Which one of the following does NOT equal

$$\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$$

?

(A)

$$\begin{vmatrix} 1 & x(x+1) & x+1 \\ 1 & y(y+1) & y+1 \\ 1 & z(z+1) & z+1 \end{vmatrix}$$

(B)

$$\begin{vmatrix} 1 & x+1 & x^2+1 \\ 1 & y+1 & y^2+1 \\ 1 & z+1 & z^2+1 \end{vmatrix}$$

(C)

$$\begin{vmatrix} 0 & x-y & x^2-y^2 \\ 0 & y-z & y^2-z^2 \\ 1 & z & z^2 \end{vmatrix}$$

(D)

$$\begin{vmatrix} 2 & x+y & x^2+y^2 \\ 2 & y+z & y^2+z^2 \\ 1 & z & z^2 \end{vmatrix}$$

[gate2013](#) [linear-algebra](#) [normal](#) [determinant](#)

[Answer](#)

### 6.1.5 Determinant: GATE2014-2-4 [top](#)

<http://gateoverflow.in/1958>

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 \_\_\_\_\_.

[gate2014-2](#) [linear-algebra](#) [numerical-answers](#) [easy](#) [determinant](#)

[Answer](#)

## Answers: Determinant

### 6.1.1 Determinant: GATE1997-1.3 [top](#)

<http://gateoverflow.in/2219>



Selected Answer

As it's upper triangular matrix ... So determinant will be product of main diagonal element.

$$\det(A) = 6*2*4 * -1 = -48.$$

Similar concept can be applied, if Matrix is lower triangular or Diagonal Matrix

7 votes

-- durgesh (185 points)

### 6.1.2 Determinant: GATE2000-1.3 [top](#)

<http://gateoverflow.in/626>

Answer: A

$$2 * \begin{bmatrix} 1 & 7 & 2 \\ 0 & 2 & 0 \\ 0 & 6 & 1 \end{bmatrix} = 4$$

2 votes

-- Rajarshi Sarkar (35k points)

### 6.1.3 Determinant: GATE2005-IT-3 [top](#)

<http://gateoverflow.in/3747>

$$\begin{aligned} &+0 \begin{bmatrix} 1 & 1 & 3 \\ 0 & 0 & 1 \\ -2 & 0 & 1 \end{bmatrix} -1 \begin{bmatrix} -1 & 1 & 3 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} +0 \begin{bmatrix} -1 & 1 & 3 \\ 0 & 0 & 1 \\ 1 & -2 & 1 \end{bmatrix} -2 \begin{bmatrix} -1 & 1 & 1 \\ 0 & 0 & 0 \\ 1 & -2 & 0 \end{bmatrix} \\ &= -1 \begin{bmatrix} -1 & 1 & 3 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} = -1 \end{aligned}$$

7 votes

-- neha pawar (4.4k points)

### 6.1.4 Determinant: GATE2013\_3 [top](#)

<http://gateoverflow.in/1412>

Answer is A.

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  $|A|$ 

9 votes

-- Sona Praneeth Akula (4k points)

### 6.1.5 Determinant: GATE2014-2-4 [top](#)

<http://gateoverflow.in/1956>

Hi,

For this 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  $|A| = 0$ .References: [https://www.youtube.com/watch?v=aKX5\\_DucNq8&list=PL221E2BBF13BECF6C&index=19](https://www.youtube.com/watch?v=aKX5_DucNq8&list=PL221E2BBF13BECF6C&index=19)

18 votes

-- Prasanna Ranganathan (4.3k points)

**6.2****Eigen Value(21)** [top](#)**6.2.1 Eigen Value: GATE 2016-1-05** [top](#)<http://gateoverflow.in/39634>

Two eigenvalues of a  $3 \times 3$  real matrix  $P$  are  $(2 + \sqrt{-1})$  and 3. The determinant of  $P$  is \_\_\_\_\_.

[gate2016-1](#) [linear-algebra](#) [eigen-value](#) [numerical-answers](#) [normal](#)

[Answer](#)

**6.2.2 Eigen Value: GATE 2016-2-06** [top](#)<http://gateoverflow.in/39549>

Suppose that the eigenvalues of matrix  $A$  are 1, 2, 4. The determinant of  $(A^{-1})^T$  is \_\_\_\_\_.

[gate2016-2](#) [linear-algebra](#) [eigen-value](#) [normal](#) [numerical-answers](#)

[Answer](#)

**6.2.3 Eigen Value: GATE1993\_01.1** [top](#)<http://gateoverflow.in/596>

In questions 1.1 to 1.7 below, one or more of the alternatives are correct. Write the code letter(s) a, b, c, d corresponding to the correct alternative(s) in the answer book. Marks will be given only if all the correct alternatives have been selected and no incorrect alternative is picked up.

1.1). 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](#)

[Answer](#)

**6.2.4 Eigen Value: GATE2002-5a** [top](#)<http://gateoverflow.in/858>

a. 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](#) [linear-algebra](#) [eigen-value](#) [normal](#) [descriptive](#)

[Answer](#)

**6.2.5 Eigen Value: GATE2005-49** [top](#)<http://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 linear-algebra eigen-value easy

[Answer](#)

### 6.2.6 Eigen Value: GATE2006-IT-26 [top](#)

<http://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](#)

### 6.2.7 Eigen Value: GATE2007-25 [top](#)

<http://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 eigen-value linear-algebra difficult

[Answer](#)

### 6.2.8 Eigen Value: GATE2007-IT-2 [top](#)

<http://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. 3  
 B.  $(5 + \sqrt{5})/2$   
 C. 3  
 D.  $(5 - \sqrt{5})/2$

gate2007-it linear-algebra eigen-value normal

[Answer](#)

### 6.2.9 Eigen Value: GATE2008-28 [top](#)

<http://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](#)
[eigen-value](#)
[linear-algebra](#)
**Answer**

### 6.2.10 Eigen Value: GATE2010-29 [top](#)

<http://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](#)
[linear-algebra](#)
[eigen-value](#)
[easy](#)
**Answer**

### 6.2.11 Eigen Value: GATE2011\_40 [top](#)

<http://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](#)
[linear-algebra](#)
[eigen-value](#)
[easy](#)
**Answer**

### 6.2.12 Eigen Value: GATE2012\_11 [top](#)

<http://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](#)
[linear-algebra](#)
[eigen-value](#)
**Answer**

### 6.2.13 Eigen Value: GATE2014-1-5 [top](#)

<http://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 \_\_\_\_\_

[gate2014-1](#)
[linear-algebra](#)
[eigen-value](#)
[numerical-answers](#)
[normal](#)
**Answer**

### 6.2.14 Eigen Value: GATE2014-2-47 [top](#)

<http://gateoverflow.in/2013>

The product of the non-zero eigenvalues of the matrix is \_\_\_\_\_

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}$$

gate2014-2 | linear-algebra | eigen-value | normal | numerical-answers

[Answer](#)

## 6.2.15 Eigen Value: GATE2014-3-4 [top](#)

<http://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.

gate2014-3 | linear-algebra | eigen-value | normal |

[Answer](#)

## 6.2.16 Eigen Value: GATE2015-1\_36 [top](#)

<http://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.  $a = 5, b = 3$

gate2015-1 | linear-algebra | eigen-value | normal |

[Answer](#)

## 6.2.17 Eigen Value: GATE2015-2\_5 [top](#)

<http://gateoverflow.in/8051>

The larger of the two eigenvalues of the matrix  $\begin{bmatrix} 4 & 5 \\ 2 & 1 \end{bmatrix}$  is \_\_\_\_\_.

gate2015-2 | linear-algebra | eigen-value | easy | numerical-answers

[Answer](#)

## 6.2.18 Eigen Value: GATE2015-3\_15 [top](#)

<http://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.  $\{a(-\sqrt{2}, 0, 1) \mid a \neq 0, a \in \mathbb{R}\}$

gate2015-3 | linear-algebra | eigen-value | normal |

[Answer](#)

### 6.2.19 Eigen Value: GATE2017-1-31 [top](#)

<http://gateoverflow.in/116312>

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)

[gate2017-1](#) [linear-algebra](#) [eigen-value](#) [normal](#)

[Answer](#)

### 6.2.20 Eigen Value: GATE2017-2-22 [top](#)

<http://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 \_\_\_\_\_.

[gate2017-2](#) [linear-algebra](#) [eigen-value](#) [numerical-answers](#)

[Answer](#)

### 6.2.21 Eigen Value: GATE2017-2-52 [top](#)

<http://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 \_\_\_\_\_.

[gate2017-2](#) [engineering-mathematics](#) [linear-algebra](#) [numerical-answers](#) [eigen-value](#)

[Answer](#)

## Answers: Eigen Value

### 6.2.1 Eigen Value: GATE 2016-1-05 [top](#)

<http://gateoverflow.in/39634>



Selected Answer

Given two eigen values are  $(2+i)$  and  $3..$  since it is a real matrix the 3rd eigen value is  $2-i$   
determinant of  $P =$  product of eigen values.

Solving we get,

Answer 15.

29 votes

-- Abhilash Panicker (8.8k points)

Eigen values are roots of Characterstic equation  $|A - \lambda I| = 0$

For a  $3 \times 3$  matrix, characterstic 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 characterstic equation, then  $2-i$  must be other root.

$\lambda_1 = 2+i$ ,  $\lambda_2 = 2-i$  and  $\lambda_3 = 3$

$$\det(A) = \lambda_1 \lambda_2 \lambda_3 = (2+i) * (2-i) * 3 = (2^2 - i^2) * 3 = 5 * 3 = 15$$

10 votes

-- Manish Joshi (25.2k points)

## 6.2.2 Eigen Value: GATE 2016-2-06 [top](#)

<http://gateoverflow.in/39549>



Selected Answer

Determinant of Matrix A = product of eigen values =  
 $1 \times 2 \times 4 = 8$

Determinant of Inverse Matrix of A,  
 $\det(A^{-1}) = \frac{1}{\det(A)} = \frac{1}{8}$

Determinant remains same after the Transpose

so, Determinant of  
 $(A^{-1})^T =$   
 $\det(A^{-1}) = \frac{1}{8} = 0.125$

15 votes

-- Praveen Saini (53.5k points)

## 6.2.3 Eigen Value: GATE1993\_01.1 [top](#)

<http://gateoverflow.in/596>

Answer: B, D

Eigen values are: 0,0,0

The eigen vector should satisfy the equation:  $\alpha z = 0$

6 votes

-- Rajarshi Sarkar (35k points)

## 6.2.4 Eigen Value: GATE2002-5a [top](#)

<http://gateoverflow.in/858>



Selected Answer

5(a) the eigen value for upper triangular/lower triangular/diagonal matrices are the diagonal elements of the matrix

7 votes

-- Madhur Rawat (2.6k points)

## 6.2.5 Eigen Value: GATE2005-49 [top](#)

<http://gateoverflow.in/1174>



Selected Answer

Let the eigen values be a,b

**Sum of Eigen Values = Trace(Diagonal Sum)**

$$\Rightarrow a+b = 2+5 = 7$$

**Product of Eigen Values = Det(A)**

$$\Rightarrow a.b = 6$$

Solving these we get **1 and 6..** So, **Option(B) is Correct ..**

7 votes

-- Himanshu Agarwal (16.2k points)

## 6.2.6 Eigen Value: GATE2006-IT-26 [top](#)

<http://gateoverflow.in/3985>



Selected Answer

$$\det(A - \lambda I) = 0$$

$$\begin{vmatrix} a-\lambda & 1 & 0 \\ 1 & a-\lambda & 1 \\ 0 & 1 & a-\lambda \end{vmatrix} = 0$$

$$(a-\lambda)^2[(a-\lambda)^2(a-\lambda)-1^*1] - 1^*[1^*(a-\lambda)-0^*1] + 0^*[1^*1 - 0^*(a-\lambda)] = 0$$

$$(a-\lambda)^3 - 2(a-\lambda) = 0$$

$$(a-\lambda)((a-\lambda)^2 - 2) = 0$$

$$(a-\lambda)((a-\lambda)^2 - (\sqrt{2})^2) = 0$$

$$(a-\lambda)(a-\lambda+\sqrt{2})(a-\lambda-\sqrt{2}) = 0$$

Eigen values ,  
 $\lambda = a, a + \frac{\sqrt{2}}{2}, a - \frac{\sqrt{2}}{2}$

14 votes

-- Praveen Saini (53.5k points)

## 6.2.7 Eigen Value: GATE2007-25 [top](#)

<http://gateoverflow.in/254>



Selected Answer

Ans is (C) 2

$Ax = \lambda x$ , where  $\lambda$  is the eigen value of  $A$ . Hence  $(A - \lambda I)x = 0$  or

|

$A -$

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 (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 give us the value of  $\lambda$ . If we take  $\alpha = 1$ , we get  $\lambda = 2$ , and that is one of the choices. For no other choice, this equation holds. So, (c) 2 is the answer.

13 votes

-- Keith Kr (6.3k points)

### 6.2.8 Eigen Value: GATE2007-IT-2 [top](#)

<http://gateoverflow.in/3433>

Selected Answer

$x = [x_1, x_2]$  be a unit eigen vector

Given  $\sqrt{x_1^2 + x_2^2} = 1$  i.e.  $x_1^2 + x_2^2 = 1$  {  
 $\because x$  is a unit Eigen vector}

$Ax = Lx$ , where  $L$  = eigen value

$x^T Ax = x^T Lx = L[x_1, x_2]^T [x_1, x_2] = L[x_1^2 + x_2^2] = L(1) = L$ .

The maximum value of  $L = (5 + \sqrt{5})/2$ .

maximum value of  $x^T Ax$  is  $(5 + \sqrt{5})/2$ . Option B

19 votes

-- saloni (247 points)

### 6.2.9 Eigen Value: GATE2008-28 [top](#)

<http://gateoverflow.in/428>

Selected Answer

Characteristic equation is  $|A - \lambda I| = 0$   
(1)

$$\begin{vmatrix} 1-\lambda & 0 \\ 0 & -\lambda \end{vmatrix} = 0$$

$$(1-\lambda)(-\lambda) = 0$$

$$\lambda = 0, 1$$

$$\text{Similarly, (2)} \quad \lambda = 0, 0$$

$$(3) \lambda \neq 1$$

$$(4) \lambda = -1, -1$$

Therefore, Answer is (A) one

9 votes

-- Keith Kr (6.3k points)

### 6.2.10 Eigen Value: GATE2010-29 [top](#)

<http://gateoverflow.in/1155>

Selected Answer

Sum of eigen values is equal to trace(sum of diagonal elements), and product of eigen values is equal to det of matrix

$$\text{So } 2+y=8+4 \quad y=10$$

$$2y-3x=32$$

Solving this we get

$$x=-4$$

Option d is ans

9 votes

-- Pooja Palod (32.4k points)

### 6.2.11 Eigen Value: GATE2011\_40 [top](#)

<http://gateoverflow.in/2142>

Selected Answer

Answer is A.

The given matrix is a upper triangular matrix and the eigenvalues of upper or lower triangular matrix are the diagonal values itself. (Property)

12 votes

-- Sona Praneeth Akula (419 points)

### 6.2.12 Eigen Value: GATE2012\_11 [top](#)

<http://gateoverflow.in/43>

Selected Answer

Characteristic Equation is  $A - \mu I = 0$ 

$$\begin{vmatrix} 1 - \mu & 1 \\ 1 & -1 - \mu \end{vmatrix} = 0$$

$$\Rightarrow (1 - \mu)(-1 - \mu) - 1 = 0$$

$$\Rightarrow -1 - \mu + \mu + \mu^2 - 1 = 0$$

$$\Rightarrow \mu^2 - 2 = 0$$

$$\Rightarrow \mu = +\sqrt{2} \text{ and } -\sqrt{2}$$

so according to properties of Eigen values,

**eigen values of**  
 $A^{19}_{19}$  = (eigen value of A)

=

$(\sqrt{2})^{19}$  and  
 $(-\sqrt{2})^{19}$

=option (D)

17 votes

-- Narayan Kunal (419 points)

### 6.2.13 Eigen Value: GATE2014-1-5 [top](#)

<http://gateoverflow.in/1760>

Selected Answer

Answer to this question is ZERO.

This is because eigen vectors corresponding to DIFFERENT eigen values of a REAL symmetric matrix are ORTHOGONAL to each other.

However, same eigen values they may not be.

And Dot -product of orthogonal vectors(perpendicular vectors ) is 0 (ZERO)

For more info see the link: <http://math.stackexchange.com/questions/82467/eigenvectors-of-real-symmetric-matrices-are-orthogonal>

18 votes

-- Sandeep\_Uniyal (7.3k points)

## 6.2.14 Eigen Value: GATE2014-2-47 [top](#)

<http://gateoverflow.in/2013>



Selected Answer

We can see that the rank of the given matrix is 2 (since 3 rows are same, and other 2 rows are also same). Sum of eigen values = sum of diagonals. So, we have two eigen values which sum to 5. This information can be used to get answer in between the following solution.

Let Eigen value be X. Now, equating the determinant of the following to 0 gives us the values for X. To find X in the following matrix, we can equate the determinant to 0. For finding the determinant we can use row and column additions and make the matrix a triangular one. Then determinant will just be the product of the diagonals which should equate to 0.

$$\begin{matrix} 1-X & 0 & 0 & 0 & 1 \\ 0 & 1-X & 1 & 1 & 0 \\ 0 & 1 & 1-X & 1 & 0 \\ 0 & 1 & 1 & 1-X & 0 \\ 1 & 0 & 0 & 0 & 1-X \end{matrix}$$

R1  $\leftarrow$  R1 + R5, R4  $\leftarrow$  R4 - R3

$$\begin{matrix} 2-X & 0 & 0 & 0 & 2-X \\ 0 & 1-X & 1 & 1 & 0 \\ 0 & 1 & 1-X & 1 & 0 \\ 0 & 0 & X & -X & 0 \\ 1 & 0 & 0 & 0 & 1-X \end{matrix}$$

Taking X out from R4, 2-X from R1, (so, X = 2 is one eigen value)

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1-X & 1 & 1 & 0 \\ 0 & 1 & 1-X & 1 & 0 \\ 0 & 0 & 1 & -1 & 0 \\ 1 & 0 & 0 & 0 & 1-X \end{matrix}$$

R2  $\leftarrow$  R2 - R3, R5  $\leftarrow$  R5 - R1

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 \\ 0 & -X & X & 0 & 0 \\ 0 & 1 & 1-X & 1 & 0 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 0 & 0 & 0 & -X \end{matrix}$$

C3  $\leftarrow$  C3 + C4

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 \\ 0 & -X & X & 0 & 0 \\ 0 & 1 & 2-X & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & -X \end{matrix}$$

Taking X out from R2

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 1 & 2-X & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & -X \end{matrix}$$

R3  $\leftarrow$  R3 + R2

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 3-X & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 \end{matrix}$$

Now, we got a triangular matrix and determinant of a triangular matrix is product of the diagonal.

So  $(3-X)(-X) = 0 \Rightarrow X = 3$  or  $X = 0$ . So,  $X = 3$  is another eigen value and product of non-zero eigen values =  $2 * 3 = 6$ .

<https://people.richland.edu/james/lecture/m116/matrices/determinant.html>

28 votes

-- Arjun Suresh (294k points)

## 6.2.15 Eigen Value: GATE2014-3-4 [top](#)

<http://gateoverflow.in/2038>



Selected Answer

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 ,atleast one eigen value has to be negative(but reverse may not be true).  
 {you can take simple example with upper or lower triangular matrices. In the case option (b) , (c) and (d) reverse is always true .}

14 votes

-- Srinath Jayachandran (3.7k points)

## 6.2.16 Eigen Value: GATE2015-1\_36 [top](#)

<http://gateoverflow.in/8285>



Selected Answer

$$\text{Sum of Eigens} = \text{trace of matrix}$$

$$-1 + 7 = 1 + a$$

$$\text{Product of Eigens} = \text{Determinant of matrix}$$

$$-1 \times 7 = a - 4b$$

this gives  $a = 5$  and  $b = 3$

answer = **option D**

12 votes

-- Amar Vashishth (28.7k points)

## 6.2.17 Eigen Value: GATE2015-2\_5 [top](#)

<http://gateoverflow.in/8051>



Selected Answer

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 2 roots for  $\lambda$ .

$$(4-\lambda)(1-\lambda) - 10 = 0$$

$$4 - 5\lambda + \lambda^2 = 10$$

$$\lambda^2 - 5\lambda - 6 = 0$$

$$(\lambda - 6)(\lambda + 1) = 0$$

So  $\lambda = -1, 6$ .

6 is larger and hence is the Answer.

17 votes

-- Gate Keeda (19.1k points)

### 6.2.18 Eigen Value: GATE2015-3\_15 [top](#)

<http://gateoverflow.in/8411>

Selected Answer

$$\begin{bmatrix} 1-1 & -1 & 2 \\ 0 & 1-1 & 0 \\ 1 & 2 & 1-1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 2 \\ 0 & 0 & 0 \\ 1 & 2 & 0 \end{bmatrix} * \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$-y + 2z = 0$$

$$x + 2y = 0$$

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.

21 votes

-- Tamojit Chatterjee (2.2k points)

### 6.2.19 Eigen Value: GATE2017-1-31 [top](#)

<http://gateoverflow.in/118312>

Selected Answer

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>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,

$\leq \sum_{i=1}^2 \sum_{j=1}^2 A_{ij}^2$  (For real symmetric matrix,  $b=c$  and  $\leq$  would be replaced by equal sign)

7 votes

-- suraj (5.1k points)

## 6.2.20 Eigen Value: GATE2017-2-22 [top](#)

<http://gateoverflow.in/11836>



Selected Answer

$$P + Q = \begin{bmatrix} 0 & -1 & -2 \\ 8 & 9 & 10 \\ 8 & 8 & 8 \end{bmatrix}$$

$\det(P + Q) = 0$ , So Rank cannot be 3, but there exists a  $2 \times 2$  submatrix such that determinant of submatrix is not 0.

So  $\text{Rank}(P + Q) = 2$

12 votes

-- Manish Joshi (25.2k points)

## 6.2.21 Eigen Value: GATE2017-2-52 [top](#)

<http://gateoverflow.in/11861>



Selected Answer

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 :  $\lambda^3 - 4\lambda^2 - 11\lambda + 30$

$$\Rightarrow (\lambda - 2)(\lambda - 5)(\lambda + 3) = 0$$

$\lambda_1 = 2, \lambda_2 = 5$  and  $\lambda_3 = -3$

Max Eigen Value = 5

16 votes

-- Manish Joshi (25.2k points)

## 6.3

## Matrices(26) [top](#)

### 6.3.1 Matrices: GATE1987-1-xxiii [top](#)

<http://gateoverflow.in/80380>

A square matrix is singular whenever

- A. The rows are linearly independent
- B. The columns are linearly independent
- C. The row are linearly dependent
- D. None of the above

gate1987 linear-algebra matrices

Answer

### 6.3.2 Matrices: GATE1993\_02.7 [top](#)

<http://gateoverflow.in/61>

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

Answer

### 6.3.3 Matrices: GATE1994-1.2 [top](#)

<http://gateoverflow.in/2438>

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](#)

### 6.3.4 Matrices: GATE1994\_1.9 [top](#)

<http://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](#) [easy](#)

[Answer](#)

### 6.3.5 Matrices: GATE1994\_3.12 [top](#)

<http://gateoverflow.in/2498>

Find the inverse of the matrix  $\begin{bmatrix} 1 & 0 & 1 \\ -1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

[gate1994](#) [linear-algebra](#) [matrices](#) [easy](#)

[Answer](#)

### 6.3.6 Matrices: GATE1995\_1.24 [top](#)

<http://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](#)

[Answer](#)

### 6.3.7 Matrices: GATE1996\_10 [top](#)

<http://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

[Answer](#)

### 6.3.8 Matrices: GATE1996\_2.6 [top](#)

<http://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](#)

### 6.3.9 Matrices: GATE1997-4.2 [top](#)

<http://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](#)

### 6.3.10 Matrices: GATE1998\_2.1 [top](#)

<http://gateoverflow.in/1673>

The rank of the matrix given below is:

$$\begin{bmatrix} 1 & 4 & 8 & 7 \\ 0 & 0 & 3 & 0 \\ 4 & 2 & 3 & 1 \\ 3 & 12 & 24 & 2 \end{bmatrix}$$

- A. 3
- B. 1
- C. 2
- D. 4

gate1998 linear-algebra matrices normal

[Answer](#)

### 6.3.11 Matrices: GATE1998\_2.2 [top](#)

<http://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](#)

### 6.3.12 Matrices: GATE2001-1.1 [top](#)

<http://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](#) [linear-algebra](#) [normal](#) [matrices](#)

[Answer](#)

### 6.3.13 Matrices: GATE2002-1.1 [top](#)

<http://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](#) [linear-algebra](#) [easy](#) [matrices](#)

[Answer](#)

### 6.3.14 Matrices: GATE2004-26 [top](#)

<http://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.  $\text{power}(2, (n^2 + n)/2)$
- D.  $\text{power}(2, (n^2 - n)/2)$

[gate2004](#) [linear-algebra](#) [normal](#) [matrices](#)

[Answer](#)

### 6.3.15 Matrices: GATE2004-27 [top](#)

<http://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](#) [linear-algebra](#) [normal](#) [matrices](#)

[Answer](#)

### 6.3.16 Matrices: GATE2004-76 [top](#)

<http://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](#) [linear-algebra](#) [normal](#) [matrices](#)

[Answer](#)

### 6.3.17 Matrices: GATE2004-IT-32 [top](#)

<http://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](#)

### 6.3.18 Matrices: GATE2004-IT-36 [top](#)

<http://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](#)

### 6.3.19 Matrices: GATE2006-23 [top](#)

<http://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](#) [linear-algebra](#) [normal](#) [matrices](#)

[Answer](#)

### 6.3.20 Matrices: GATE2008-IT-29 [top](#)

<http://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](#)

### 6.3.21 Matrices: GATE2015-1\_18 [top](#)

<http://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 \_\_\_\_\_.

[gate2015-1](#) [linear-algebra](#) [matrices](#) [numerical-answers](#)

[Answer](#)

### 6.3.22 Matrices: GATE2015-2\_27 [top](#)

<http://gateoverflow.in/8131>

Perform the following operations on the matrix  $\begin{bmatrix} 3 & 4 & 45 \\ 7 & 9 & 105 \\ 13 & 2 & 195 \end{bmatrix}$

- Add the third row to the second row
- Subtract the third column from the first column.

The determinant of the resultant matrix is \_\_\_\_\_.

[gate2015-2](#) [linear-algebra](#) [matrices](#) [easy](#) [numerical-answers](#)

[Answer](#)

### 6.3.23 Matrices: ISI 2016 [top](#)

<http://gateoverflow.in/45220>

Let  $A$  be a matrix such that:

$$A = \begin{pmatrix} -1 & 2 \\ 0 & -1 \end{pmatrix}$$

and  $B = A + A^2 + A^3 + \dots + A^{50}$ . Then which of the following is true?

- A)  $B^2 = I$
- B)  $B^2 = 0$
- C)  $B^2 = B$
- D) None of the above

[isi-2016](#) [matrices](#)

[Answer](#)

### 6.3.24 Matrices: TIFR2010-A-16 [top](#)

<http://gateoverflow.in/18492>

Let the characteristic equation of matrix  $M$  be  $\lambda^2 - \lambda - 1 = 0$ . Then.

- a.  $M^{-1}$  does not exist.
- b.  $M^{-1}$  exists but cannot be determined from the data.
- c.  $M^{-1} = M + I$
- d.  $M^{-1} = M - I$
- e.  $M^{-1}$  exists and can be determined from the data but the choices (c) and (d) are incorrect.

[tifr2010](#) [linear-algebra](#) [matrices](#)

[Answer](#)

### 6.3.25 Matrices: TIFR2012-B-12 [top](#)

<http://gateoverflow.in/25141>

Let  $A$  be a matrix such that  $A^k = 0$ . What is the inverse of  $I - A$ ?

- a.  $0$
- b.  $I$
- c.  $A$
- d.  $1 + A + A^2 + \dots + A^{k-1}$
- e. Inverse is not guaranteed to exist.

[tifr2012](#) [linear-algebra](#) [matrices](#)

[Answer](#)

### 6.3.26 Matrices: TIFR2013-B-3 [top](#)

<http://gateoverflow.in/25659>

How many  $4 \times 4$  matrices with entries from  $0, 1$  have odd determinant?

Hint: Use modulo 2 arithmetic.

- a. 20160
- b. 32767
- c. 49152
- d. 57343
- e. 65520

[tifr2013](#) [linear-algebra](#) [matrices](#)

[Answer](#)

## Answers: Matrices

### 6.3.1 Matrices: GATE1987-1-xxiii [top](#)

<http://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.**

4 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

### 6.3.2 Matrices: GATE1993\_02.7 [top](#)

<http://gateoverflow.in/611>



Selected Answer

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

$$\text{So } A^4=I$$

12 votes

-- Pooja Palod (32.4k points)

### 6.3.3 Matrices: GATE1994-1.2 [top](#)

<http://gateoverflow.in/2438>



Selected Answer

Answer: D

Given  $A = A'$  and  $B = B'$

$$(AB)' = B'A' = BA$$

9 votes

-- Rajarshi Sarkar (35k points)

### 6.3.4 Matrices: GATE1994\_1.9 [top](#)

<http://gateoverflow.in/2446>



Selected Answer

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.

9 votes

-- Rajarshi Sarkar (35k points)

### 6.3.5 Matrices: GATE1994\_3.12 [top](#)

<http://gateoverflow.in/2498>



Selected Answer

An Easy Procedure.

Using Eigen values, the characteristic equation we get is -

$$-\lambda^3 + 2\lambda^2 - 2 = 0$$

Using Cayley-Hamilton Theorem-

$$-A^3 + 2A^2 - 2I = 0$$

$$\text{So, } A^{-1} = 1/2(2A - A^2)$$

Solving that we get,

$$A^{-1} = \begin{bmatrix} 1/2 & -1 & / & 21/2 \\ 0 & 0 & & 1 \\ 1/2 & 1/2 & -1 & / \end{bmatrix} / 2$$

2 votes

-- Shweta Nair (261 points)

### 6.3.6 Matrices: GATE1995\_1.24 [top](#)

<http://gateoverflow.in/261>



Selected Answer

Ans is A.

we can eliminate all other rows using row 1. in the last only 1 row will be left.

rank = no of non zero rows = 1

11 votes

-- jayendra (8.1k points)

### 6.3.7 Matrices: GATE1996\_10 [top](#)

<http://gateoverflow.in/2762>

$$AB = I$$

$$\text{so, } B = A^{-1}$$

$$\text{now } CD = I$$

$$\text{so, } D = C^{-1}$$

$$= \left( A \cdot \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \right)^{-1}$$

$$= \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}^{-1} \cdot A^{-1}$$

$$= \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix} \cdot B$$

$$= \begin{bmatrix} b_{11} & b_{12} \\ b_{21} - b_{11} & b_{22} - b_{12} \end{bmatrix}$$

12 votes

-- Sayantan Ganguly (6.8k points)

### 6.3.8 Matrices: GATE1996\_2.6 [top](#)

<http://gateoverflow.in/2735>



Selected Answer

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  $a\sin(\theta) = b\sin(\theta)$  or  $a = b$  or  $\theta = n\pi$

7 votes

-- Rajarshi Sarkar (35k points)

### 6.3.9 Matrices: GATE1997-4.2 [top](#)

<http://gateoverflow.in/2243>



Selected Answer

c is the answer, in AI12 matrix will result into the same matrix as A but first column will be exchanged with second column.

A matrix:

a b c  
d e f  
g h i

I12 matrix

0 1 0  
1 0 0  
0 0 1

resulted matrix

b a c  
e d f  
h g i

14 votes

-- Manu Thakur (6k points)

### 6.3.10 Matrices: GATE1998\_2.1 [top](#)

<http://gateoverflow.in/1673>



Selected Answer

Ans D

6 votes

-- Keith Kr (6.3k points)

### 6.3.11 Matrices: GATE1998\_2.2 [top](#)

<http://gateoverflow.in/1674>



Selected Answer

Answer is B

R2  $\rightarrow$  R2 - R1

R3  $\rightarrow$  R3 - R2

you will get  $\det = (a-b)*(a-c)*(b+c)$

in matrix operations, you cannot multiply rows or columns. That will not yield the same matrix. So abc is not correct

5 votes

-- Dhananjay (995 points)

### 6.3.12 Matrices: GATE2001-1.1 [top](#)

<http://gateoverflow.in/694>



Selected Answer

Yes A is correct option!, Both statements are True

**S1: True**

$$A = \begin{pmatrix} 2 & 10 \\ 1 & 5 \end{pmatrix}$$

$$B = \begin{pmatrix} 3 & 6 \\ 2 & 4 \end{pmatrix}$$

$$|A|=0 \quad |B|=0$$

$$|A+B| = -3$$

**S2: True**

$$A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$|A|=1 \quad |B|=-1$$

$$|A + B| = 0$$

3 votes

-- Vijay Thakur (15.4k points)

**6.3.13 Matrices: GATE2002-1.1** [top](#)<http://gateoverflow.in/805>

Selected Answer

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

7 votes

-- Bhagirathi Nayak (13.3k points)

**6.3.14 Matrices: GATE2004-26** [top](#)<http://gateoverflow.in/1023>

Selected Answer

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 C.

13 votes

-- Arjun Suresh (294k points)

**6.3.15 Matrices: GATE2004-27** [top](#)<http://gateoverflow.in/1024>

Selected Answer

**Given**

$$ABCD = I$$

**multiply LHS,RHS by**  
 $A^{-1}$

$A^{-1}ABCD =$   
 $A^{-1}I$  (**position of**  
 **$A^{-1}$  on both sides should be left**)

$$\Rightarrow BCD = A^{-1}$$

$$\Rightarrow BCDD^{-1} = A^{-1}D^{-1}$$

$$\Rightarrow BC =$$

$$A^{-1}D^{-1}$$

=>  
 $BCC^{-1} =$   
 $A^{-1}$   
 $D^{-1}C^{-1}$

=>  
 $B =$   
 $A^{-1}$   
 $D^{-1}C^{-1}$

Now  
 $B^{-1} =$   
 $(A^{-1}D^{-1}C^{-1})^{-1}$

$$B^{-1} = CDA$$

17 votes

-- Madhur Rawat (2.6k points)

### 6.3.16 Matrices: GATE2004-76 [top](#)

<http://gateoverflow.in/1070>



Selected Answer

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.

8 votes

-- Arjun Suresh (294k points)

### 6.3.17 Matrices: GATE2004-IT-32 [top](#)

<http://gateoverflow.in/3675>



Selected Answer

Best part of this question is dont solve by mathematical procedures. Verification is very easy in this question.

just put  $n=1$ , u'll get a matrix like [3].. find its determinant.. determinant = 3. now check options.

by putting  $n=1$ , i am getting following results..

- A. 5
- B. 7
- C. 3
- D. 3

A,B cant be answer..

now check for n=2.

determinantdeterminant = 9-1 =8

put n=2 in C,D.

C = 7

D = 8

so D is answer..

25 votes

-- Digvijay (47k points)

### 6.3.18 Matrices: GATE2004-IT-36 [top](#)

<http://gateoverflow.in/3679>



Selected Answer

Given,  $X^2 - X + I = 0$

$$\Rightarrow X^2 = X - I$$

$$\Rightarrow X^{-1}(X^2) = X^{-1}(X - I) \quad \{ \text{Multiplying } X^{-1} \text{ both sides..}\}$$

$$\Rightarrow X = I - X^{-1}$$

$\Rightarrow X^{-1} = I - X$  Which gives **Option (B)**..

11 votes

-- Himanshu Agarwal (16.2k points)

### 6.3.19 Matrices: GATE2006-23 [top](#)

<http://gateoverflow.in/964>



Selected Answer

**(A)** : Correct. We are given

$$Fu = b$$

$$Fv = b$$

$$\text{So } F(u - v) = 0$$

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.

8 votes

-- Happy Mittal (10.9k points)

### 6.3.20 Matrices: GATE2008-IT-29 [top](#)

<http://gateoverflow.in/3319>



Selected Answer

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.

13 votes

-- Happy Mittal (10.9k points)

### 6.3.21 Matrices: GATE2015-1\_18 [top](#)

<http://gateoverflow.in/8241>



Selected Answer

$$\text{Given, } \begin{bmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{bmatrix} * \begin{bmatrix} u_{11} & u_{12} \\ 0 & u_{22} \end{bmatrix} = \begin{bmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{bmatrix} * \begin{bmatrix} 1 & u_{12} \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$$

$$\begin{aligned} L11 &= 2 \\ L11 * U12 &= 2 \\ \text{Solving, } U12 &= 1 \\ L21 &= 4 \\ L21 * U12 + L22 &= 9 \\ \text{Solving, } L22 &= 5 \end{aligned}$$

13 votes

-- GATERush (1.2k points)

### 6.3.22 Matrices: GATE2015-2\_27 [top](#)

<http://gateoverflow.in/8131>



Selected Answer

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.

10 votes

-- Akash (43.8k points)

Ans Zero, row and column transformations doesn't affect determinant.

10 votes

-- Vikrant Singh (13.4k points)

### 6.3.23 Matrices: ISI 2016 [top](#)

<http://gateoverflow.in/45220>



Selected Answer

Answer B)

$$\begin{aligned}
 B &= \begin{pmatrix} -1 & 2 \\ 0 & -1 \end{pmatrix} + \begin{pmatrix} 1 & -4 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} -1 & 6 \\ 0 & -1 \end{pmatrix} + \dots \\
 &= \begin{pmatrix} 0 & (2-4)+6-8 \dots \\ 0 & 0 \end{pmatrix} \\
 &= \begin{pmatrix} 0 & -2-2-2 \dots \\ 0 & 0 \end{pmatrix} \quad [\text{taking } (2-4)=-2, (6-8)=-2] \\
 &= \begin{pmatrix} 0 & -2 \times 25 \\ 0 & 0 \end{pmatrix} \\
 &= \begin{pmatrix} 0 & -50 \\ 0 & 0 \end{pmatrix} \\
 B^2 &= \begin{pmatrix} 0 & -50 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} 0 & -50 \\ 0 & 0 \end{pmatrix} \\
 &= \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}
 \end{aligned}$$

3 votes

-- srestha (58.3k points)

**6.3.24 Matrices: TIFR2010-A-16** top<http://gateoverflow.in/1649>

Selected Answer

I think we can solve using Cayley- Hamilton Theorem

$$\lambda^2 - \lambda - 1 = 0$$

$$M^2 - M - I = 0$$

$$I = M^2 - M$$

NOW PRE MULTIPLYING  $M^{-1}$ 

$$M^{-1}I = M^{-1}M^2 - M^{-1}M$$

$$M^{-1} = M - I$$

SHOULD BE D.

6 votes

-- Umang Raman (15.1k points)

**6.3.25 Matrices: TIFR2012-B-12** top<http://gateoverflow.in/25141>

 Selected Answer

Given  $A^K = 0$

$$I - A^k = I$$

$$I - A^k = (I - A)(I + A + A^2 + A^3 + \dots + A^{k-1})$$

$$I = (I - A)(I + A + A^2 + A^3 + \dots + A^{k-1})$$

$$(I - A)^{-1} = (I + A + A^2 + A^3 + \dots + A^{k-1})$$

Hence (D) is the Answer.

 12 votes -- Leen Sharma (32.2k points)

### 6.3.26 Matrices: TIFR2013-B-3 [top](#)

<http://gateoverflow.in/25659>

OPTION a is correct

whenever 1st row is 0 then its determinant is 0 , and similarly if any 2 or more rows are linearly dependent then its  $|\det|=0$

In order to find the odd determinant the

1st row must be non zero --> totally( $2^{4-1}$ ) possibilities  $|0/1 \ 0/1 \ 0/1 \ 0/1|$  like totally=16-1

2nd row must be non zero and not linearly depends on 1st row so--> totally ( $2^{4-2}$ ) possibilities

for 3rd row it must be non-zero as well as not linearly depends on first 2 rows(not start with 0) --->totally ( $2^{4-4}$ )

for 4th row -->( $2^{4-8}$ )

$\therefore$  total possibilities= $(2^{4-2^0}) * (2^{4-2^1}) * (2^{4-2^2}) * (2^{4-2^3}) = 15 * 14 * 12 * 8 = 20160$  possible

 5 votes

-- venky.victory35 (673 points)

## 6.4

### System Of Equations(11) [top](#)

<http://gateoverflow.in/39545>

### 6.4.1 System Of Equations: GATE 2016-2-04 [top](#)

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.

[gate2016-2](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

Answer

### 6.4.2 System Of Equations: GATE1996\_1.7 [top](#)

<http://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](#)

### 6.4.3 System Of Equations: GATE1998\_1.2 [top](#)

<http://gateoverflow.in/1639>

Consider the following set of equations

$$x + 2y = 5 \quad 4x + 8y = 12 \quad 3x + 6y + 3z = 15$$

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](#)

### 6.4.4 System Of Equations: GATE2003-41 [top](#)

<http://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](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

[Answer](#)

### 6.4.5 System Of Equations: GATE2004-71 [top](#)

<http://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](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

[Answer](#)

## 6.4.6 System Of Equations: GATE2004-IT-6 [top](#)

<http://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](#)

## 6.4.7 System Of Equations: GATE2005-48 [top](#)

<http://gateoverflow.in/1173>

Consider the following system of linear equations :

$$\begin{aligned} 2x_1 - x_2 + 3x_3 &= 1 \\ 3x_1 + 2x_2 + 5x_3 &= 2 \\ -x_1 + 4x_2 + x_3 &= 3 \end{aligned}$$

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](#) [linear-algebra](#) [system-of-equations](#) [normal](#)

[Answer](#)

## 6.4.8 System Of Equations: GATE2008-3 [top](#)

<http://gateoverflow.in/401>

The following system of equations

$$\begin{aligned} x_1 + x_2 + 2x_3 &= 1 \\ x_1 + 2x_2 + 3x_3 &= 2 \end{aligned}$$

$$x_1 + 4x_2 + \alpha$$

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](#) [easy](#) [linear-algebra](#) [system-of-equations](#)

[Answer](#)

## 6.4.9 System Of Equations: GATE2014-1-4 [top](#)

<http://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 \_\_\_\_\_

[gate2014-1](#) | [linear-algebra](#) | [system-of-equations](#) | [numerical-answers](#) | [normal](#)

[Answer](#)

### 6.4.10 System Of Equations: GATE2015-3\_33 [top](#)

<http://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  $p = -q = -r$

[gate2015-3](#) | [linear-algebra](#) | [system-of-equations](#) | [normal](#)

[Answer](#)

### 6.4.11 System Of Equations: GATE2017-1-3 [top](#)

<http://gateoverflow.in/11828>

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

[gate2017-1](#) | [linear-algebra](#) | [system-of-equations](#) | [normal](#)

[Answer](#)

## Answers: System Of Equations

### 6.4.1 System Of Equations: GATE 2016-2-04 [top](#)

<http://gateoverflow.in/39545>



Selected Answer

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  $\Rightarrow$  What if this system of equations have 2 equations which are dependent ?

$$\text{ex } \Rightarrow a+b = 2$$

$$2a + 2b = 4$$

$$a-b = 0$$

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 !

15 votes

-- Akash (43.8k points)

#### 6.4.2 System Of Equations: GATE1996\_1.7 [top](#)

<http://gateoverflow.in/2711>



Selected Answer

Ans would be C because it is a case of linear non-homogeneous equations so 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

5 votes

-- Vivek sharma (2.3k points)

#### 6.4.3 System Of Equations: GATE1998\_1.2 [top](#)

<http://gateoverflow.in/1639>



Selected Answer

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.

11 votes

-- Happy Mittal (10.9k points)

#### 6.4.4 System Of Equations: GATE2003-41 [top](#)

<http://gateoverflow.in/832>



Selected Answer

Determinant=0. Therefore apply reduction method on  $(A|B)$

$R_2 \leftarrow R_2 - 2R_1, R_3 \leftarrow R_3 - 0.5R_1, R_3 \leftarrow R_3 - 1.5R_2$  obtain the resultant matrix

$$\begin{pmatrix} 2 & 1 & -4 & a \\ 4 & 3 & -12 & 5 \\ 1 & 2 & -8 & 7 \end{pmatrix} \rightarrow \begin{pmatrix} 1 & 0.5 & -2 & 0.5a \\ 0 & 1 & -4 & 5 - 2a \\ 0 & 0 & 0 & 2 + 1.5a \end{pmatrix}$$

or infinitely many solutions, we must have  $2 + 1.5a = 0$  i.e.,  $a = -4/3$  so for only 1 value of  $a$ , this system has infinitely many solutions. So option (B) is correct.

8 votes

-- Keith Kr (6.3k points)

### 6.4.5 System Of Equations: GATE2004-71 [top](#)

<http://gateoverflow.in/1065>

Selected Answer

answer = C

rank =  $r(A) = r(A|B) = 2$ rank = total number of variables  
Hence, unique solution

8 votes

-- Amar Vashishth (28.7k points)

### 6.4.6 System Of Equations: GATE2004-IT-6 [top](#)

<http://gateoverflow.in/3647>

Selected Answer

Correct answer is (C). It can be easily verified by keeping the value of variables in the equations.

6 votes

-- suraj (5.1k points)

### 6.4.7 System Of Equations: GATE2005-48 [top](#)

<http://gateoverflow.in/1173>

Selected Answer

rank of matrix = rank of augmented matrix = no of unknown = 3  
so unique solution..

4 votes

-- Digvijay (47k points)

### 6.4.8 System Of Equations: GATE2008-3 [top](#)

<http://gateoverflow.in/401>

Selected Answer

$$A \cdot X = B \implies \begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 1 & 4 & \alpha \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix}$$

So,  $X = A^{-1}BA^{-1} = adj(A)/det(A)$  ( $adj(A) = Transpose(cofactor(A))$ ,  $cofactor(A) = (-1)^{i+j} minor(A)$ )

$$adj(A) = \begin{bmatrix} 2\alpha - 12 & 8 - \alpha & -1 \\ 3 - \alpha & \alpha - 2 & -1 \\ 2 & -3 & 1 \end{bmatrix} \quad det(A) = 2\alpha - 12 + 3 - \alpha + 4 = \alpha - 5$$

$$\text{Now, } A^{-1}B = \frac{1}{\alpha-5} \begin{bmatrix} 0 \\ \alpha-5 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

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)

10 votes

-- Arjun Suresh (294k points)

### 6.4.9 System Of Equations: GATE2014-1-4 [top](#)



Selected Answer

<http://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.

11 votes

-- Happy Mittal (10.9k points)

### 6.4.10 System Of Equations: GATE2015-3\_33 [top](#)



Selected Answer

<http://gateoverflow.in/8490>

**for non-trivial solution**

$$|A| = 0$$

**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**

12 votes

-- Tamojit Chatterjee (2.2k points)

### 6.4.11 System Of Equations: GATE2017-1-3 [top](#)



Selected Answer

<http://gateoverflow.in/11828>

$\sum_i c_i a_i = 0$  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).

5 votes

-- suraj (5.1k points)

## 6.5

## Vector Space(5) [top](#)

### 6.5.1 Vector Space: GATE1995\_2.13 [top](#)

<http://gateoverflow.in/2625>

A unit vector perpendicular to both the vectors  $a = 2i - 2j + k$  and  $b = 1 + j - 2k$  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](#)

### 6.5.2 Vector Space: GATE2007-27 [top](#)

<http://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](#) [linear-algebra](#) [normal](#) [vector-space](#)

[Answer](#)

### 6.5.3 Vector Space: GATE2014-3-5 [top](#)

<http://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 \_\_\_\_.

[gate2014-3](#) [linear-algebra](#) [vector-space](#) [normal](#) [numerical-answers](#)

[Answer](#)

### 6.5.4 Vector Space: GATE2017-1-30 [top](#)

<http://gateoverflow.in/116311>

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) 1/2  |
| (C) 1 | (D) -1/2 |

[gate2017-1](#) [linear-algebra](#) [normal](#) [vector-space](#)

[Answer](#)

### 6.5.5 Vector Space: TIFR2010-A-11 [top](#)

<http://gateoverflow.in/18503>

The length of a vector  $x = (x_1, \dots, x_n)$  is defined as

$$\|x\| = \sqrt{\sum_{i=1}^n x_i^2}.$$

Given two vectors  $x = (x_1, \dots, x_n)$  and  $y = (y_1, \dots, y_n)$ , which of the following measures of discrepancy between  $x$  and  $y$  is insensitive to the length of the vectors?

$$\|x - y\|$$

$$\|x - y\| / \|x\| \|y\|$$

$$\|x\| - \|y\|$$

$$\left\| \frac{X}{\|X\|} - \frac{Y}{\|Y\|} \right\|$$

None of the above.

tiffr2010 linear-algebra vector-space

[Answer](#)

## Answers: Vector Space

### 6.5.1 Vector Space: GATE1995\_2.13 [top](#)



Selected Answer

ans should be A

dot product of two perpendicular vector is 0.

vector given in option A gives 0 dotproduct with vector b. while any other vector is not giving 0 in dotproduct. therefore ans should be A.

to find the perpendicular unit vector to two vectors the procedure is as follows:

<http://www.leadinglesson.com/problem-on-finding-a-vector-perpendicular-to-two-vectors>

4 votes

-- jayendra (8.1k points)

### 6.5.2 Vector Space: GATE2007-27 [top](#)

<http://gateoverflow.in/1225>

Option (a), Here is the answer,

<http://math.stackexchange.com/a/1843452/153195>

4 votes

-- Pranav Kant Gaur (1.2k points)

### 6.5.3 Vector Space: GATE2014-3-5 [top](#)

<http://gateoverflow.in/2039>



Selected Answer

A 6-dimensional vector space { a1,a2,a3,a4,a5,a6}

Let V1 be {a1,a2,a3,a4}

and V2 be {a3,a4,a5,a6}

$V_1 \cap V_2 = \{a3,a4\}$

This is the smallest possible dimension, which is 2.

The largest possible dimension will be 4 ,when  $V_1 = V_2$

18 votes

-- Srinath Jayachandran (3.7k points)

### 6.5.4 Vector Space: GATE2017-1-30 [top](#)

<http://gateoverflow.in/118311>



Selected Answer

Angle between u and w = Angle between w and v

$$\frac{\vec{u} \cdot \vec{w}}{\|\vec{u}\| \|\vec{w}\|} = \frac{\vec{w} \cdot \vec{v}}{\|\vec{w}\| \|\vec{v}\|}$$

$$\vec{u} \cdot \vec{w} = 2\vec{w} \cdot \vec{v}$$

$$(\alpha - 2)\vec{u} \cdot \vec{v} = 2(\alpha - 2)\|\vec{v}\|^2$$

LHS and RHS would be equal for  $\alpha = 2$ . Hence correct answer is (A).

8 votes

-- suraj (5.1k points)

## 6.5.5 Vector Space: TIFR2010-A-11 [top](#)

<http://gateoverflow.in/18503>



Selected Answer

**Option D is the correct answer.**

The following statement

discrepancy between  $x$  and  $y$  is insensitive to the length of the vectors

means that The discrepancy, as measured by the formula, between two vectors  $x$  and  $y$  is same as the discrepancy between the vectors  $c_1x$  and  $c_2y$ , for any **constant scalars**  $c_1, c_2$ . That is,

$$D(x, y) = D(c_1x, c_2y), \quad \forall c_1, c_2 \in \mathbb{R}$$

**Now, lets think about which formula achieves that.**

Let us also define two pairs of vectors as follows:

$$x_1 = (0.1067, 0.9619, 0.0046, 0.7749, 0.8173) \quad y_1 = (0.8687, 0.0844, 0.3998, 0.2599, 0.8001)$$

$$x_2 = 0.4314 \times x_1 = (0.0460, 0.4150, 0.0020, 0.3343, 0.3526) \quad y_2 = 0.9106 \times y_1 = (0.7911, 0.0769, 0.3641, 0.2367, 0.7286)$$

A)  $\|x - y\|$

Since the definition of  $\|x\|$  is sensitive to scaling, option A won't be insensitive to scaling either.

For example,

$$D(x_1, y_1) = \|x_1 - y_1\| \approx 1.3313$$

$$D(x_2, y_2) = \|x_2 - y_2\| \approx 0.9754$$

$$D(x_1, y_1) \neq D(x_2, y_2)$$

B)  $\frac{\|x-y\|}{\|x\|\|y\|}$

Once we've subtracted the vectors, scaling them according to their original lengths won't help at all.

For example,

$$D(x_1, y_1) = \frac{\|x_1 - y_1\|}{\|x_1\|\|y_1\|} \approx 0.7024$$

$$D(x_2, y_2) = \frac{\|x_2 - y_2\|}{\|x_2\|\|y_2\|} \approx 1.3099$$

$$D(x_1, y_1) \neq D(x_2, y_2)$$

C)  $\|x\| - \|y\|$

We aren't doing any scaling in this definition of discrepancy. So, this definition is certainly sensitive to scaling, and thus, not the correct answer.

For example,

$$D(x_1, y_1) = \|x_1\| - \|y_1\| \approx 0.2086$$

$$D(x_2, y_2) = \|x_2\| - \|y_2\| \approx -0.5217$$

$$D(x_1, y_1) \neq D(x_2, y_2)$$

D)  $\left\| \frac{x}{\|x\|} - \frac{y}{\|y\|} \right\|$

In this, we first scale each vector  $x$  and  $y$  down to their unit vectors, and then calculate the discrepancy.

Since  $x_2 = c_1 x_1$ ,  $x_2$  will have the same unit vector as  $x_1$ .  
Similarly,  $y_2$  will have the same unit vector as  $y_1$ .

Thus, no matter how we scale  $x_2$  and  $y_2$ , as long as they are derived from  $x_1$  and  $y_1$ , their discrepancy will be the same.

Therefore, our formula will be insensitive to scaling, which is exactly what we want!

For example,

$$D(x_1, y_1) = \left\| \frac{x_1}{\|x_1\|} - \frac{y_1}{\|y_1\|} \right\| \approx 0.9551$$

$$D(x_2, y_2) = \left\| \frac{x_2}{\|x_2\|} - \frac{y_2}{\|y_2\|} \right\| \approx 0.9551$$

$$D(x_1, y_1) = D(x_2, y_2)$$

Thus, **option D** is the correct answer.

You can use this matlab code to test the options with randomly generated vectors.

```
%% Get two random vectors x1 and y1, each of length 5
x1 = rand(5,1);
y1 = rand(5,1);

%% Create two more vectors x2 and y2, which are multiples of x1 and y1
x2 = rand()*x1;
y2 = rand()*y1;

%% Define the modd function
modd = @(z) sqrt(sum(z.^2));

%% Define the answers function that computes the values
% obtained from options A, B, C and D
answers = @(x,y) [
    modd(x-y);
    modd(x-y)/(modd(x)*modd(y));
    modd(x) - modd(y);
    modd(x/modd(x)) - y/modd(y)
];

%% Define function to perform floating point comparison
% Copied from stackoverflow.com/a/2203483/2570622
isequalRel = @(x,y,tol) ( abs(x-y) <= ( tol*max(abs(x),abs(y)) + eps ) );

%% Calculate the answers for (x1, y1) and (x2, y2) and see which option
% remains unaffected.
isequalRel(answers(x1,y1), answers(x2,y2), 1e-6)
```

2 votes

-- Pragy Agarwal (19.5k points)

# 7 Engineering Mathematics: Probability (97) [top](#)

7.1

## Bayes Theorem(4) [top](#)

### 7.1.1 Bayes Theorem: CMI2013-A-02 [top](#)

<http://gateoverflow.in/46592>

10% of all email you receive is spam. Your spam filter is 90% reliable: that is, 90% of the mails it marks as spam are indeed spam and 90% of spam mails are correctly labelled as spam. If you see a mail marked spam by your filter, what is the probability that it really is spam?

- A. 10%
- B. 50%
- C. 70%
- D. 90%

[cmi2013](#) [probability](#) [conditional-probability](#) [bayes-theorem](#)[Answer](#)

### 7.1.2 Bayes Theorem: GATE2005-51 [top](#)

<http://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  $1/3$  and  $2/3$  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.  $4/19$
- B.  $5/19$
- C.  $2/9$
- D.  $19/30$

[gate2005](#) [probability](#) [conditional-probability](#) [bayes-theorem](#) [normal](#)[Answer](#)

### 7.1.3 Bayes Theorem: GATE2012\_33 [top](#)

<http://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.  $10/21$
- B.  $5/12$
- C.  $2/3$
- D.  $1/6$

[gate2012](#) [probability](#) [conditional-probability](#) [bayes-theorem](#) [normal](#)[Answer](#)

### 7.1.4 Bayes Theorem: GATE2014-EC01-GA10 [top](#)

<http://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.  $1/4$
- B.  $1/3$
- C.  $1/2$
- D.  $2/3$

[gate2014-ec01](#) [numerical-ability](#) [probability](#) [bayes-theorem](#) [conditional-probability](#)[Answer](#)

## Answers: Bayes Theorem

### 7.1.1 Bayes Theorem: CMI2013-A-02 [top](#)



Selected Answer

10% email are spam, i.e. 90% email are not spam

90% of mail marked as spam is spam, 10% mail marked as spam are not spam

By Bayes theorem the probability that a mail marked spam is really a spam

$$\begin{aligned}
 &= \frac{\text{Probability of being spam and being detected as spam}}{\text{Probability of being detected as spam}} \\
 &= \frac{0.1 \times 0.9}{(0.1 \times 0.9) + (0.9 \times 0.1)} \\
 &= 50\%
 \end{aligned}$$

2 votes

-- srestha (58.3k points)

### 7.1.2 Bayes Theorem: GATE2005-51 [top](#)



Selected Answer

```
The probability of selecting a red ball =  

(1/3) * (2/5) + (2/3) * (3/4) = 2/15 + 1/2  

= 19/30
```

```
Probability of selecting a red ball from box P =  

(1/3) * (2/5) = 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 = (2/15) / (19/30) = 4/19
```

10 votes

-- akash (1.2k points)

### 7.1.3 Bayes Theorem: GATE2012\_33 [top](#)



Selected Answer

Here our sample space consists of  $3 + 3 * 6 = 21$  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)

Required Probability = No. of favorable cases/Total cases =  $10/21$

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  $1/6$  probability of occurrence, (1,5) has only  $1/36$  probability. So, our required probability

$$= 1/6 + (9 * 1/36) = 5/12$$

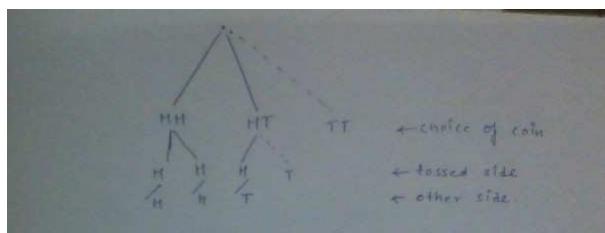
20 votes

-- Arjun Suresh (294k points)

### 7.1.4 Bayes Theorem: GATE2014-EC01-GA10 [top](#)



Selected Answer



we are given with 3 coins. out of which 1 coin (TT) is automatically removed. \_\_\_\_\_(1)

on second step we toss the any of two coin so probability of front side is (H, H, H, T), but it is given that tossed side is H, so forth option is automatically removed. \_\_\_\_\_(2)

now as we have one coin with HH and another coin is with HT and one H side is present, so the choice for another side is H, H, T \_\_\_\_\_(3)

now we want the T side. which is in 1 outcome and total outcome are 3,

so according to baues theorem or conditional probability

$$p(\text{another side is } T) = \frac{\#\text{required outcomes}}{\#\text{total outcomes}}$$

$$\therefore p = \frac{1}{3}$$

so answer is **B**

**Reference link:** <https://www.khanacademy.org/math/precalculus/prob-comb/dependent-events-precalc/v/bayes-theorem-visualized>

11 votes

-- Sheshang M. Ajwalia (2.8k points)

## 7.2

## Binomial Distribution(5) top

### 7.2.1 Binomial Distribution: GATE2005-52 top

<http://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 probability binomial-distribution easy

Answer

### 7.2.2 Binomial Distribution: GATE2005-IT-32 top

<http://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

### 7.2.3 Binomial Distribution: GATE2006-21 [top](#)

<http://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.  $\frac{2^n C_n}{4^n}$
- B.  $\frac{2^n C_n}{2^n}$
- C.  $\frac{1}{2^n C_n}$
- D.  $\frac{1}{2}$

[gate2006](#) [probability](#) [binomial-distribution](#) [normal](#)

[Answer](#)

### 7.2.4 Binomial Distribution: GATE2006-IT-22 [top](#)

<http://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.  $1/p$
- B.  $1/(1-p)$
- C.  $1/p^2$
- D.  $1/(1-p^2)$

[gate2006-it](#) [probability](#) [binomial-distribution](#) [expectation](#) [normal](#)

[Answer](#)

### 7.2.5 Binomial Distribution: TIFR2010-B-38 [top](#)

<http://gateoverflow.in/19050>

Suppose three coins are lying on a table, two of them with heads facing up and one with tails facing up. One coin is chosen at random and flipped. What is the probability that after the flip the majority of the coins(i.e., at least two of them) will have heads facing up?

- a.  $\frac{1}{3}$
- b.  $\frac{1}{8}$
- c.  $\frac{1}{4}$
- d.  $\frac{1}{4} + \frac{1}{8}$
- e.  $\frac{2}{3}$

[tifr2010](#) [probability](#) [binomial-distribution](#)

[Answer](#)

## Answers: Binomial Distribution

### 7.2.1 Binomial Distribution: GATE2005-52 [top](#)

<http://gateoverflow.in/1177>



Selected Answer

answer - D

suppose there are  $k$  places within  $n$  bit string where mismatch has occurred

probability of this occurring is  ${}^n C_k (\text{prob. of mismatch})^k (\text{prob. of match})^{(n-k)} = {}^n C_k (1/2)^k (1/2)^{(n-k)} = {}^n C_k (1/2)^n$

$k$  can range from 1 to  $n$  hence required probability sum  $\sum {}^n C_k (1/2)^n$  where  $k$  ranges from 1 to  $n$

hence  $(1/2^n)(2^n - 1)$

**Alternatively**

Probability of matching at given place  $1/2$

there are  $n$  places hence probability of matching  $1/(2^n)$

hence probability of mismatch  $1 - 1/(2^n)$

13 votes

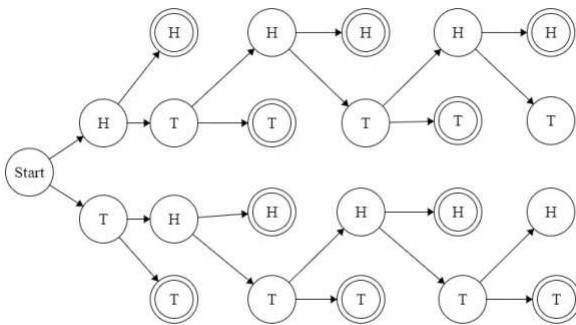
-- ankitrokdeonsns (9.1k points)

## 7.2.2 Binomial Distribution: GATE2005-IT-32 [top](#)

<http://gateoverflow.in/3778>



Selected Answer



Probability on each branch is  $= x = \frac{1}{2}$

2nd toss onwards, each toss layer gives us two success. (i.e. HH event or TT event )

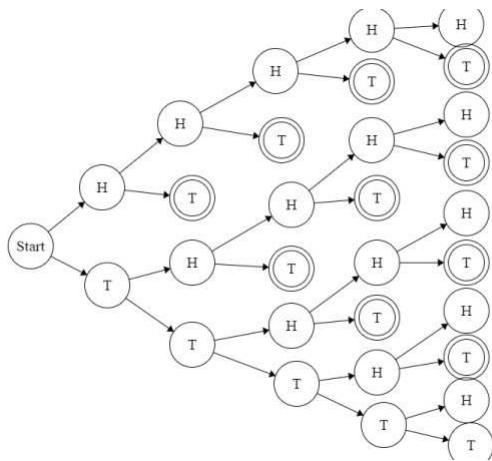
$$\begin{aligned} E &= \sum k \cdot p(k) \\ &= 2 \cdot (2x^2) + 3 \cdot (2x^3) + 4 \cdot (2x^4) + 5 \cdot (2x^5) + \dots \\ &= 2 \cdot [2x^2 + 3x^3 + 4x^4 + 5x^5 + \dots] \\ &= 2 \cdot \left[ \frac{x}{(1-x)^2} - x \right] \end{aligned}$$

$$\text{putting } x = \frac{1}{2} ;$$

$$\begin{aligned} &= 2 \cdot \left[ \frac{\frac{1}{2}}{\left(\frac{1}{2}\right)^2} - \frac{1}{2} \right] \\ &= 3 \end{aligned}$$

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 is = 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)

$$\sum_{k=2}^{\infty} k(k-1)x^{k-2} = \frac{2}{(1-x)^3} \text{ for } |x| < 1$$

In our case :  $x = 0.5$  So,

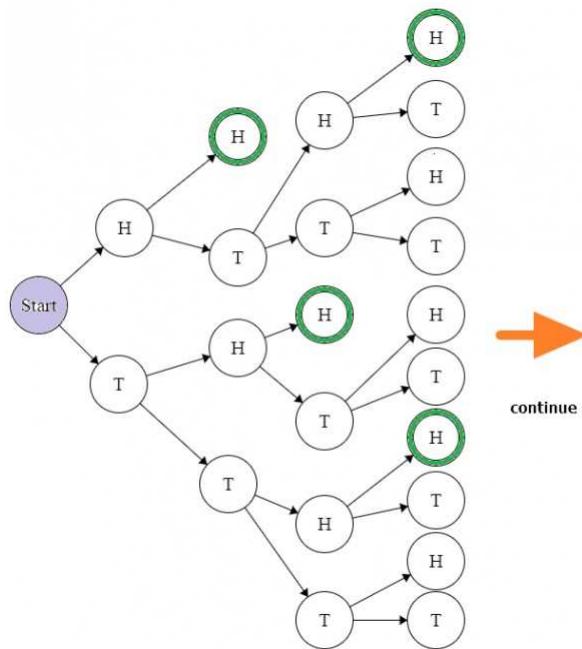
$$E = \sum_{k=2}^{\infty} k(k-1)x^k = x^2 \sum_{k=2}^{\infty} k(k-1)x^{k-2} = x^2 \cdot \frac{2}{(1-x)^3}$$

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.

4 24 votes

-- Debashish Deka (51.4k points)

**Answer is (A)**

$$E(X) = \sum X_i * P_i$$

Where  $X = \text{no of tosses when you get successive HEAD/TAIL(only one is possible at a time though).}$

$P_i = \text{Probability that you get in } X_i \text{ tosses.}$

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  $1/2$  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  $2/8 = 1/\text{square}(2)$ .

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  $1/(2^{n-1})$ .

Now coming to  $E(X) = 2 * 1/2 + 3 * 1/4 + 4 * 1/8 + \dots \text{till infinity}$

See this is combined AP-GP, So multiplying  $E(X)$  by  $1/2$  and subtracting from  $E(X)$

$$E(X) = 2 * 1/2 + 3 * 1/4 + 4 * 1/8 + \dots$$

$$0.5 * E(X) = 2 * 1/4 + 3 * 1/8 + \dots$$

$$\text{subtracting , we get } 1/2 * E(X) = 1 + 1/4 + 1/8 + 1/16 + \dots$$

$$0.5 * E(X) = 1 + (1/4)/(1-0.5) = 1 + 1/2 = 3/2 \quad (\text{a}/1-\text{r})$$

$$E(x) = 3$$

19 votes

-- Sandeep\_Uniyal (7.3k points)

### 7.2.3 Binomial Distribution: GATE2006-21 [top](#)

<http://gateoverflow.in/882>



answer - A

ways of getting  $n$  heads out of  $2n$  tries =  ${}^{2n}C_n$

probability of getting exactly  $n$  heads and  $n$  tails =  $(1/2^n)(1/2^n)$

number of ways =  ${}^{2n}C_n / 4^n$

10 votes

-- ankitrokdeonsns (9.1k points)

### 7.2.4 Binomial Distribution: GATE2006-IT-22 [top](#)

<http://gateoverflow.in/3561>



Selected Answer

$$E = 1 \times p + 2 \times (1-p)p + 3 \times (1-p)(1-p)p + \dots$$

multiply both side with  $(1-p)$  and subtract:

$$E - (1-p)E = 1 \times p + (1-p)p + (1-p)(1-p)p + \dots$$

$$= p/(1 - (1-p)) = 1 \quad (\text{because it is now forming a GP})$$

$$\Rightarrow (1 - 1 + p)E = 1$$

$$\Rightarrow E = 1/p$$

So, Option (A)...

14 votes

-- Vicky Bajoria (4.9k points)

### 7.2.5 Binomial Distribution: TIFR2010-B-38 [top](#)

<http://gateoverflow.in/19050>



(e) is correct

table has 3 coins with H,H,T facing up.

now, probability of choosing any coin is  $1/3$ , as we can choose any of three coins.

Case A: 1st coin : either H or T can come.

so, HHT THT possible. only HHT is favourable.  
which gives  $(1/3)*(1/2) = 1/6$ 

Case B: 2nd coin : either H or T can come.

so, HHT HTT possible. only HHT is favourable.  
which gives  $(1/3)*(1/2) = 1/6$ 

case C: 3rd coin : Table already contains two H's so, whatever comes is favourable.

which gives  $(1/3)*1 = 1/3$ summing up total gives  $1/6 + 1/6 + 1/3 = 2/3$ 

7 votes

-- Himanshu Agarwal (16.2k points)

## 7.3

## Conditional Probability(6) [top](#)

### 7.3.1 Conditional Probability: GATE 2016-2-05 [top](#)

<http://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 \_\_\_\_\_.

[gate2016-2](#) [probability](#) [conditional-probability](#) [normal](#) [numerical-answers](#)

Answer

### 7.3.2 Conditional Probability: GATE1994-1.4, ISRO2017-2 [top](#)

<http://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

### 7.3.3 Conditional Probability: GATE2017-2-26 [top](#)

<http://gateoverflow.in/118368>

P and Q are considering to apply for a job. The probability that P applies for the job is  $1/4$ , the probability that P applies for the job given that Q applies for the job is  $1/2$ , and the probability that Q applies for the job given that P applies for the job is  $1/3$ . Then the probability that P does not apply for the job given that Q does not apply for this job is

- A.  $4/5$
- B.  $5/6$
- C.  $7/8$
- D.  $11/12$

[gate2017-2](#) [probability](#) [conditional-probability](#)

Answer

### 7.3.4 Conditional Probability: TIFR 2012- Probability [top](#)

<http://gateoverflow.in/120512>

Amar and Akbar both tell the truth with probability  $\frac{3}{4}$  and lie with probability  $\frac{1}{4}$ . Amar watches a test match and talks to Akbar about the outcome. Akbar, in turn, tells Anthony, "Amar told me that India won".

What probability should Anthony assign to India's win?

- (a)  $\frac{9}{16}$
- (b)  $\frac{6}{16}$
- (c)  $\frac{7}{16}$
- (d)  $\frac{10}{16}$

[engineering-mathematics](#) [tifr2012](#) [conditional-probability](#)

[Answer](#)

### 7.3.5 Conditional Probability: TIFR2010-A-19, TIFR2014-A-6 [top](#)

<http://gateoverflow.in/18499>

Karan tells truth with probability  $\frac{1}{3}$  and lies with probability  $\frac{2}{3}$ . Independently, Arjun tells truth with probability  $\frac{3}{4}$  and lies with probability  $\frac{1}{4}$ . Both watch a cricket match. Arjun tells you that India won, Karan tells you that India lost. What probability will you assign to India's win?

- a.  $\frac{1}{2}$
- b.  $\frac{2}{3}$
- c.  $\frac{3}{4}$
- d.  $\frac{5}{6}$
- e.  $\frac{6}{7}$

[tifr2010](#) [probability](#) [conditional-probability](#) [tifr2014](#)

[Answer](#)

### 7.3.6 Conditional Probability: TIFR2012-A-1 [top](#)

<http://gateoverflow.in/20838>

Amar and Akbar both tell the truth with probability  $\frac{3}{4}$  and lie with probability  $\frac{1}{4}$ . Amar watches a test match and talks to Akbar about the outcome. Akbar, in turn, tells Anthony, "Amar told me that India won". What probability should Anthony assign to India's win?

- a.  $\frac{9}{16}$
- b.  $\frac{6}{16}$
- c.  $\frac{7}{16}$
- d.  $\frac{10}{16}$
- e. None of the above.

[tifr2012](#) [probability](#) [conditional-probability](#)

[Answer](#)

## Answers: Conditional Probability

### 7.3.1 Conditional Probability: GATE 2016-2-05 [top](#)

<http://gateoverflow.in/39541>



Selected Answer

Suppose that a 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.

Prob(100+ | Type1) => 0.7

$$\text{Prob}(100+ | \text{Type2}) \Rightarrow 0.4$$

$$\text{Prob}(100+) \Rightarrow \text{Prob}(100+ | \text{Type1}) * \text{Prob}(\text{Type1}) + \text{Prob}(100+ | \text{Type2}) * \text{Prob}(\text{Type2})$$

$$= 0.7 * .5 + .4 * .5$$

$$= 0.55$$

16 votes

-- Akash (43.8k points)

SIMPLY-

TYPE-1 bulbs ==> let total = 10 then 7 are going for 100 years

TYPE-2 bulbs ==> let total = 10 then 4 are going for 100 years

TOTAL ==> 20 out of which 11 are going for 100 years .. THEREFORE probability = 11/20 = .55

14 votes

-- Deepesh Kataria (1.8k points)

### 7.3.2 Conditional Probability: GATE1994-1.4, ISRO2017-2 [top](#)

<http://gateoverflow.in/2441>



Selected Answer

- (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  $P(A \cap B) \geq 0$ ,  $P(A \cup B) \leq P(A) + P(B)$

13 votes

-- Happy Mittal (10.9k points)

### 7.3.3 Conditional Probability: GATE2017-2-26 [top](#)

<http://gateoverflow.in/118368>



Selected Answer

Let,

$P = P$  applies for the job

$Q = Q$  applies for the job

$$P(P) = \frac{1}{4} \quad \dots \dots \dots (1)$$

$$P\left(\frac{P}{Q}\right) = \frac{1}{2} \quad \dots \dots \dots (2)$$

$$P\left(\frac{Q}{P}\right) = \frac{1}{3} \quad \dots \dots \dots (3)$$

Now, they have asked  $P\left(\frac{P'}{Q'}\right) = ?$

From (2),

$$\begin{aligned} P\left(\frac{P}{Q}\right) \\ = \frac{P(P \cap Q)}{P(Q)} \quad \dots \dots \dots (4) \end{aligned}$$

From (3),

$$\begin{aligned} P\left(\frac{Q}{P}\right) &= \frac{P(P \cap Q)}{P(P)} \\ &= \frac{P(P \cap Q)}{\frac{1}{4}} \end{aligned}$$

$$\therefore P(P \cap Q) = \frac{1}{12} \quad \dots\dots\dots(5)$$

From (2), (4) and (5),

$$\therefore P(Q) = \frac{1}{6} \quad \dots\dots\dots(6)$$

Now,

$$\mathbb{P}\left(\frac{P'}{Q'}\right) = \frac{P(P' \cap Q')}{P(Q')} \quad \dots \dots \dots (7)$$

$$\text{Now, } P(Q') = 1 - 1/6 = 5/6$$

$$\begin{aligned}
 & \text{Also, } P(P' \cap Q') \\
 &= 1 - [P(P \cup Q)] \\
 &= 1 - [P(P) + P(Q) - P(P \cap Q)] \\
 &= 1 - [1/4 + 1/6 - 1/12] \\
 &= 1 - [1/3] \\
 &= 2/3
 \end{aligned}$$

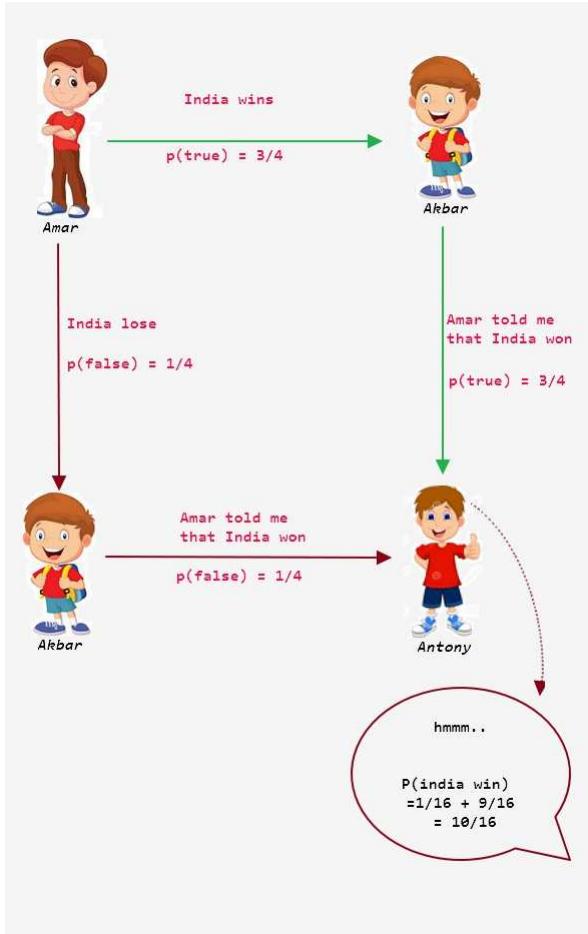
Hence, from (7),

$$\text{answer} = \frac{\frac{2}{3}}{\frac{5}{6}} = 4/5$$

 10 votes

-- Sushant Gokhale (15.4k points)

7.3.4 Conditional Probability: TIFR 2012- Probability top



3 votes

-- Debashish Deka (51.4k points)

### 7.3.5 Conditional Probability: TIFR2010-A-19, TIFR2014-A-6 [top](#)

<http://gateoverflow.in/18499>



Selected Answer

Probability of India win = 1/2

Probability of India lost = 1/2

If really India wins, then Karan lies i.e. = 2/3 and Arjun tells truth = 3/4

Now prob. of Karan lies and Arjun tells truth = 2/3 \* 3/4 = 1/2

Now prob. of Arjun lies and Karan tells truth = 1/4 \* 1/3 = 1/12

so, by Bayes theorem  $1/2 * 1/2$

$$\dots\dots\dots = 6/7$$

$$1/2 * 1/2 + 1/2 * 1/12$$

so answer is (e)

PS: Assuming superover in case of tie.

3 votes

-- srestha (58.3k points)

### 7.3.6 Conditional Probability: TIFR2012-A-1 [top](#)

<http://gateoverflow.in/20938>



Selected Answer

Option D should be the correct answer.

Consider the following events,

$W$  : India wins,

$W^\neg$  : India does not win (India Lost/ Match Draw/ Match Tie/ Match Suspended etc.)

$X$  : Akbar tells Anthony, "Amar told me that India won"

$X^\neg$  : Akbar tells Anthony, "Amar told me that India did not win"

Given  $X$ , we have to find  $W$ , that is we have to calculate  $P\left(\frac{W}{X}\right)$ .

$P\left(\frac{W}{X}\right)$  can be calculated using Bayes's theorem as follow:

$$P\left(\frac{\text{India Wins}}{\text{Akbar tells Anthony}"Amar told me that India won"}\right) = \frac{P\left(\frac{\text{Akbar tells Anthony}"Amar told me that India won"}{\text{India Wins}}\right)}{P\left(\frac{\text{Akbar tells Anthony}"Amar told me that India won"}{\text{India Won}}\right) \cup P\left(\frac{\text{Akbar tells Anthony}"Amar told me that India won"}{\text{India didn't win}}\right)}$$

rewriting same equation using the events defined:

$$P\left(\frac{W}{X}\right) = \frac{P\left(\frac{X}{W}\right)}{P\left(\frac{X}{W}\right) + P\left(\frac{X}{W^\neg}\right)}$$

**Calculation of  $P\left(\frac{X}{W}\right)$  and  $P\left(\frac{X}{W^\neg}\right)$ :**

$$P\left(\frac{X}{W}\right) = P\left(\frac{\text{Case 1}}{W}\right) \cup P\left(\frac{\text{Case 4}}{W}\right)$$

$$P\left(\frac{\text{Case 1}}{W}\right) = \frac{3}{4} \times \frac{3}{4} = \frac{9}{16}$$

$$P\left(\frac{\text{Case 4}}{W}\right) = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$

$$\text{So } P\left(\frac{X}{W}\right) = \frac{9}{16} + \frac{1}{16} = \frac{10}{16}$$

$$P\left(\frac{X}{W^\neg}\right) = P\left(\frac{\text{Case 6}}{W^\neg}\right) \cup P\left(\frac{\text{Case 7}}{W^\neg}\right)$$

$$P\left(\frac{\text{Case 6}}{W^\neg}\right) = \frac{3}{4} \times \frac{1}{4} = \frac{3}{16}$$

$$P\left(\frac{\text{Case 7}}{W^\neg}\right) = \frac{1}{4} \times \frac{3}{4} = \frac{3}{16}$$

$$\text{So } P\left(\frac{X}{W^\neg}\right) = \frac{3}{16} + \frac{3}{16} = \frac{6}{16}$$

$$\text{Hence } P\left(\frac{W}{X}\right) = \frac{\frac{10}{16}}{\frac{10}{16} + \frac{6}{16}} = \frac{10}{16}.$$

3 votes

-- Anurag Pandey (13.1k points)

## 7.4

## Expectation(9) top

### 7.4.1 Expectation: GATE1999\_1.1 top

<http://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 equal to 5.  
 D. None of the above

gate1999 | probability | expectation | easy

[Answer](#)

### 7.4.2 Expectation: GATE2004-74 [top](#)

<http://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 | probability | expectation | normal

[Answer](#)

### 7.4.3 Expectation: GATE2006-18 [top](#)

<http://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.  $\frac{2}{n}$   
 C.  $\sqrt{n}$   
 D.  $n$

gate2006 | probability | expectation | normal

[Answer](#)

### 7.4.4 Expectation: GATE2013\_24 [top](#)

<http://gateoverflow.in/1535>

Consider an undirected random graph of eight vertices. The probability that there is an edge between a pair of vertices is 1/2. What is the expected number of unordered cycles of length three?

- (A) 1/8 (B) 1 (C) 7 (D) 8

gate2013 | probability | expectation | normal

[Answer](#)

### 7.4.5 Expectation: GATE2014-2-2 [top](#)

<http://gateoverflow.in/1554>

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.)

gate2014-2 | probability | expectation | numerical-answers | easy

[Answer](#)

### 7.4.6 Expectation: TIFR2011-A-6 [top](#)

<http://gateoverflow.in/20011>

Assume that you are flipping a fair coin, i.e. probability of heads or tails is equal. Then the expected number of coin flips required to obtain two consecutive heads for the first time is.

- a. 4  
 b. 3  
 c. 6  
 d. 10  
 e. 5

tifr2011 probability expectation

Answer

**7.4.7 Expectation: TIFR2012-B-7** top<http://gateoverflow.in/25107>

A bag contains 16 balls of the following colors: 8 red, 4 blue, 2 green, 1 black, and 1 white. Anisha picks a ball randomly from the bag, and messages Babu its color using a string of zeros and ones. She replaces the ball in the bag, and repeats this experiment, many times. What is the minimum expected length of the message she has to convey to Babu per experiment?

- a.  $3/2$
- b.  $\log 5$
- c.  $15/8$
- d.  $31/16$
- e. 2

tifr2012 probability expectation

Answer

**7.4.8 Expectation: TIFR2014-A-17** top<http://gateoverflow.in/27111>

A fair dice (with faces numbered  $1, \dots, 6$ ) is independently rolled repeatedly. Let  $X$  denote the number of rolls till an even number is seen and let  $Y$  denote the number of rolls till 3 is seen. Evaluate  $E(Y|X=2)$ .

- A.  $6\frac{5}{6}$
- B. 6
- C.  $5\frac{1}{2}$
- D.  $6\frac{1}{3}$
- E.  $5\frac{2}{3}$

tifr2014 expectation

Answer

**7.4.9 Expectation: TIFR2015-A-6** top<http://gateoverflow.in/29567>

Ram has a fair coin, i.e., a toss of the coin results in either head or tail and each event happens with probability exactly half ( $1/2$ ). He repeatedly tosses the coin until he gets heads in two consecutive tosses. The expected number of coin tosses that Ram does is.

- A. 2
- B. 4
- C. 6
- D. 8
- E. None of the above.

tifr2015 expectation

Answer

**Answers: Expectation****7.4.1 Expectation: GATE1999\_1.1** top<http://gateoverflow.in/1455>

Selected Answer

Expectation of discrete random variable (finite case)

$$E(X) = x_1 p_1 + x_2 p_2 + \dots + x_n p_n$$

$$E(X) = 5, 0 \leq pi \leq 1$$

$$p_1 + p_2 + \dots + p_n = 1$$

Therefore,  $E(X) = 5$  is possible only if at-least one of the  $x_i \geq 5$

11 votes

-- suraj (5.1k points)

## 7.4.2 Expectation: GATE2004-74 [top](#)



Selected Answer

answer = **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 =  $9.375 \times 1000 = 9375$ .

15 votes

-- Arjun Suresh (294k points)

## 7.4.3 Expectation: GATE2006-18 [top](#)



Selected Answer

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  $S = \text{Probability of } X_1 \text{ not being in } S \times \text{Probability of } X_2 \text{ being in } S = \frac{1}{2} \cdot \frac{1}{2}$ .

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 =  $\sum_{i=1}^n 2^i \times (\frac{1}{2})^i = \sum_{i=1}^n 1 = n$ .

The answer is option D.

11 votes

-- Mari Ganesh Kumar (2.2k points)

## 7.4.4 Expectation: GATE2013\_24 [top](#)



Selected Answer

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 \* Probability of edge between vertices 2 and 3 \* Probability of edge between vertices 1 and 3

$$= 1/2 * 1/2 * 1/2 = 1/8$$

So, expected number of cycles of length 3 =  $56 * 1/8 = 7$

ref@ <http://stackoverflow.com/questions/14801072/number-of-cycles-in-a-random-graph>

131 votes

-- Arjun Suresh (294k points)

#### 7.4.5 Expectation: GATE2014-2-2 [top](#)



Selected Answer

Each of the nine words have equal probability. So, expected length  
 $= 3 \times \frac{1}{9} + 5 \times \frac{1}{9} + 5 \times \frac{1}{9} + 3 \times \frac{1}{9} + 5 \times \frac{1}{9} + 4 \times \frac{1}{9} + 3 \times \frac{1}{9} + 4 \times \frac{1}{9} + 3 \times \frac{1}{9}$   
 $= \frac{35}{9}$   
 $= 3.9$

131 votes

-- Arjun Suresh (294k points)

#### 7.4.6 Expectation: TIFR2011-A-6 [top](#)



Selected Answer

Let the expected number of coin flips be  $X$ . The case analysis goes as follows:

- a. If the first flip is a tails, then we have wasted one flip. The probability of this event is  $\frac{1}{2}$  and the total number of flips required is  $X + 1$ .
- b. If the first flip is a heads and second flip is a tails, then we have wasted two flips. The probability of this event is  $\frac{1}{4}$  and the total number of flips required is  $X + 2$ , as the same scenario as beginning is there even after 2 tosses.
- c. If the first flip is a heads and second flip is also heads, then we are done. The probability of this event is  $\frac{1}{4}$  and the total number of flips required is 2.

Adding, the equation that we get is -  

$$X = \frac{1}{2}(X + 1) + \frac{1}{4}(X + 2) + \frac{1}{4}2$$

Solving, we get  $X = 6$ .

Thus, the expected number of coin flips for getting two consecutive heads is 6.

7 votes

-- Avdhesh Singh Rana (2.3k points)

#### 7.4.7 Expectation: TIFR2012-B-7 [top](#)



Selected Answer

using static huffman compression you can encode the more common colours in fewer bits than the rare colours, that being the case on can expect that common colours will usually be chosen.

eg:

```
red    1
blue   01
green  001
white  0001
black  0000
```

on average from 16 draws there will be

```
8 reds  = 8 bits
4 blues = 8 bits
2 greens = 6 bits
1 white  = 4 bits
1 black  = 4 bits
```

for a total of  $30/16 = 15/8$  bits on average

6 votes

-- sudipta roy (379 points)

#### 7.4.8 Expectation: TIFR2014-A-17 [top](#)

<http://gateoverflow.in/27111>

X : The value of X denotes the number of rolls till an even number is seen.

Y: The value of Y denotes the number of rolls till a 3 is seen.

For example:

X = 2 implies an even number first time occurred on second roll, or outcome of the first roll is odd & outcome of the second roll is even.

Y = 4 implies 3 appeared for first time in the 4<sup>th</sup> die roll.

Ranges of Random Variables X & Y

X : { 1, 2, 3, ..., infinite}

Y: {1, 2, 3,... , infinite}

$E[Y|X=2]$  :Expected number of rolls till a 3 is seen given that an even number appeared for the first time in the second roll.

It is sure that 3 can't appear on 2<sup>nd</sup> toss, i.e.  $P[Y=2|X=2]=0$  and henceforth  $E[Y=2|X=2]=0$  :

Now there are two cases possible

**Case 1: 3 appears on the first toss given that outcome of first toss is odd.**

i.e.  $E[Y=1|X=2]$

here we need not to concern about outcomes of rolls other than the first roll.

Probability of getting 3 in first toss given that o/c of the first toss is odd= $P(Y=1|X=2)=1/3=0.33$

So Expectation  $E[Y=1|X=2]=y*P(Y=1|X=2)=1*0.33=0.33$

**Case 2: 3 appears on any toss after the second toss given that outcome of first toss is odd, & that of second toss is even**

$P[Y=y|X=2]$  = given that 1<sup>st</sup> roll is an odd number and 2<sup>nd</sup> roll is an even number, Probability that out of y rolls,

None of the first (y - 1) roll's outcome is 3 &

Outcome of the yth roll is 3.

So  $P[Y=y|X=2]=(2/3)\{ \text{for first o/c odd but not 3} \} \times (5/6)^{y-3} \{ \text{for not getting a 3 from } 3^{\text{rd}} \text{ to } (y-1)^{\text{th}} \text{ rolls} \} \times (1/6) \{ \text{for yth o/c to be 3} \}$ .

$P[Y=y|X=2]=(2/3)\times(5/6)^{y-3}\times(1/6)$

So  $E[Y=y|X=2]=\text{Summation from } y=3 \text{ to infinity}(y*P(Y=y|X=2))=5.33$  (where  $y \geq 3$ )

This summation will give sum of all the expectations from Y = 3 to infinity.

Now

Net Expectation is given as:

$E[Y=y|X=2]=E[Y=1|X=2]+E[Y=2|X=2]+E[Y=y'|X=2]$  where  $y' \geq 3$ .

Putting all the values,

$E[Y=y|X=2]=0.33+0+5.33$

So  $E[Y=y|X=2]=5.66=17/3$ .

6 votes

-- Anurag Pandey (13.1k points)

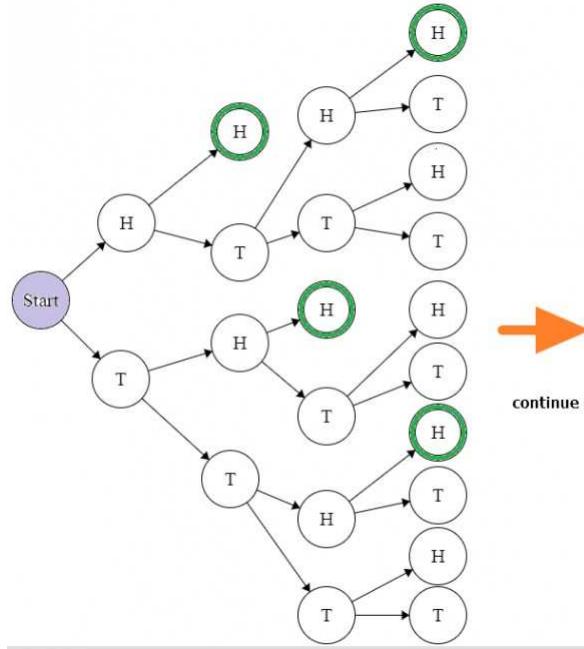
## 7.4.9 Expectation: TIFR2015-A-6 top

<http://gateoverflow.in/29567>



Selected Answer

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  $\frac{1}{1 - x - x^2}$
- probability on each branch is  $x = \frac{1}{2}$

$$\begin{aligned} \Rightarrow \frac{E}{x} &= 2.(1.x^1) + 3.(1.x^2) + 4.(2.x^3) + 5.(3.x^4) + 6.(5.x^5) + 7.(8.x^6) + \dots \infty \\ \Rightarrow \int \frac{E}{x} \cdot dx &= 1.x^2 + 1.x^3 + 2.x^4 + 3.x^5 + 5.x^6 + \dots \infty \\ \Rightarrow \int \frac{E}{x} \cdot dx &= x^2 \cdot (1.x^0 + 1.x^1 + 2.x^2 + 3.x^3 + 5.x^4 + \dots \infty) \\ \Rightarrow \int \frac{E}{x} \cdot dx &= \frac{x^2}{1 - x - x^2} \\ \Rightarrow \frac{E}{x} &= \frac{d}{dx} \left[ \frac{x^2}{1 - x - x^2} \right] \\ \Rightarrow \frac{E}{x} &= \frac{2x(1 - x - x^2) + (1 + 2x)x^2}{(1 - x - x^2)^2} \\ \Rightarrow E &= x \cdot \left\{ \frac{2x(1 - x - x^2) + (1 + 2x)x^2}{(1 - x - x^2)^2} \right\} \\ \Rightarrow E &= \frac{1}{2} \cdot \left\{ \frac{2 \cdot \frac{1}{2}(1 - \frac{1}{2} - \frac{1}{4}) + (1 + 2 \cdot \frac{1}{2}) \cdot \frac{1}{4}}{(1 - \frac{1}{2} - \frac{1}{4})^2} \right\} \\ \Rightarrow E &= 6 \end{aligned}$$

Similar Kind of Question as a Reference

- <http://gateoverflow.in/3778/gate2005-it-32>

4 votes

-- Debashish Deka (51.4k points)

**7.5****Exponential Distribution(1)** [top](#)**7.5.1 Exponential Distribution: GATE2004-IT-33** [top](#)<http://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.  $(1/(\alpha + \beta))$
- B.  $\min(\alpha, \beta)$
- C.  $(\alpha\beta/(\alpha + \beta))$
- D.  $\alpha + \beta$

[gate2004-it](#) [probability](#) [exponential-distribution](#) [random-variable](#) [normal](#)

[Answer](#)

**Answers: Exponential Distribution****7.5.1 Exponential Distribution: GATE2004-IT-33** [top](#)<http://gateoverflow.in/3676>

Selected Answer

$X$  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,

$$P\{X > a\} = e^{-\frac{1}{\alpha}a}$$

$$P\{Y > a\} = e^{-\frac{1}{\beta}a}$$

$$P\{Z > a\} = P\{X > a\} P\{Y > a\} (\because X \text{ and } Y \text{ are independent events and } Z > \min(X, Y))$$

$$= e^{-\frac{1}{\alpha}a} e^{-\frac{1}{\beta}a}$$

$$= e^{-(\frac{1}{\alpha} + \frac{1}{\beta})a}$$

$$= e^{-(\frac{\alpha+\beta}{\alpha\beta})a}$$

This shows that  $Z$  is also exponentially distributed with parameter  $\frac{\alpha+\beta}{\alpha\beta}$  and mean  $\frac{\alpha\beta}{\alpha+\beta}$ .

Reference : [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)

9 votes

-- Arjun Suresh (294k points)

## 7.6

## Normal Distribution(1) top

### 7.6.1 Normal Distribution: GATE2008-29 top

<http://gateoverflow.in/427>

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](#) [random-variable](#) [normal-distribution](#) [probability](#) [normal](#)

Answer

## Answers: Normal Distribution

### 7.6.1 Normal Distribution: GATE2008-29 top

<http://gateoverflow.in/427>



Selected Answer

$P(X \leq -1) = P(Y \geq 2)$   
we can compare their values using standard normal distribution

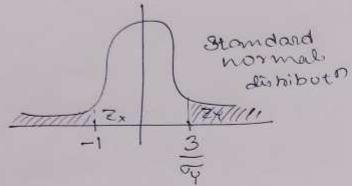
$$\begin{array}{ll} X & Y \\ \mu_X = +1 & \mu_Y = -1 \\ \sigma_X^2 = 4 & \sigma_Y^2 = ? \end{array}$$

$$Z_X = \frac{X - \mu_X}{\sigma_X} \quad Z_Y = \frac{Y - \mu_Y}{\sigma_Y}$$

$$2Z_X + 1 = X \quad Y = \sigma_Y Z_Y + \mu_Y$$

$$P(2Z_X + 1 \leq -1) = P(\sigma_Y Z_Y + \mu_Y \geq 2)$$

$$P(Z_X \leq -1) = P(Z_Y \geq \frac{2 - \mu_Y}{\sigma_Y})$$



$$-(-1) = \frac{3 - \mu_Y}{\sigma_Y}$$

$$\sigma_Y = 3$$

The random variables  $X$  and  $Y$  can be written as  $X = 2U + 1$  and  $Y = \sigma V - 1$  where  $U$  and  $V$  both have standard normal distribution.

$$P\{U \geq 1\} = P\{U \leq -1\} = P\{X \leq -1\} = P\{Y \geq 2\} = P\{V \geq \frac{3}{\sigma}\} = P\{U \geq \frac{3}{\sigma}\}$$

The first equality is a consequence of the fact that the standard normal distribution is symmetric.  
The last equality is a consequence of the fact that  $U$  and  $V$  have the same distribution.

So  $1 = \frac{3}{\sigma}$ , so that  $\sigma^2 = 9$ .

[share](#) [cite](#) [edit](#) [flag](#)

edited Jan 23 at 11:36

answered Jan 23 at 11:30



drhab

35.3k 3 15 53

answer = **option A**

12 votes

-- Amar Vashishth (28.7k points)

First lets convert both  $X$  and  $Y$  to Standard normal distribution.

$$Z = X - 1/2$$

$$Z = Y + 1/\sigma$$

Now replace  $X$  and  $Y$  in  $P(X \leq -1) = P(Y \geq 2)$  we get  $P(Z \leq -1) = P(Z \geq 3/\sigma)$

Since the Standard Normal Curve is symmetric about the mean( i.e, zero)  $-(-1) = 3/\sigma \Rightarrow \sigma = 3$ .

Answer is Option A

11 votes

-- Mari Ganesh Kumar (2.2k points)

## 7.7

## Poisson Distribution(4) [top](#)

### 7.7.1 Poisson Distribution: GATE2007-IT-57 [top](#)

<http://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

### 7.7.2 Poisson Distribution: GATE2013\_2 [top](#)

<http://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)  $8/(2e^3)$
- (B)  $9/(2e^3)$
- (C)  $17/(2e^3)$
- (D)  $26/(2e^3)$

[gate2013](#) [probability](#) [poisson-distribution](#) [normal](#)

Answer

### 7.7.3 Poisson Distribution: GATE2017-2-48 [top](#)

<http://gateoverflow.in/118513>

If a random variable  $X$  has a Poisson distribution with mean 5, then the expectation  $E[(X+2)^2]$  equals \_\_\_\_.

[gate2017-2](#) | [expectation](#) | [poisson-distribution](#) | [numerical-answers](#)
**Answer**

### 7.7.4 Poisson Distribution: ISI 2015 MMA 7 [top](#)

<http://gateoverflow.in/129269>

Suppose  $X$  is distributed as Poisson with mean  $\lambda$ . Then  $E(1/(X + 1))$  is

- (A)  $\frac{e^\lambda - 1}{\lambda}$
- (B)  $\frac{e^\lambda - 1}{\lambda + 1}$
- (C)  $\frac{1 - e^{-\lambda}}{\lambda}$
- (D)  $\frac{1 - e^{-\lambda}}{\lambda + 1}$

[isi2015](#) | [engineering-mathematics](#) | [poisson-distribution](#)
**Answer**

## Answers: Poisson Distribution

### 7.7.1 Poisson Distribution: GATE2007-IT-57 [top](#)

<http://gateoverflow.in/3499>

Selected Answer

20 request in 1 hour.. so we can expect 15 request in 45 minutes...

So,  $\lambda = 15$ .. (expected value)

poission distribution formula:  $f(x, \lambda) = p(X = x) = (\lambda^x * e^{-\lambda}) / x!$

Therefore  $p(\text{one request}) + p(3 \text{ request}) + p(5 \text{ request})$

$$= p(1; 15) + p(3; 15) + p(5; 15)$$

$$= 6.9 * 10^3 * e^{-15}.$$

$$= 6.9 * 10^3 * e^{-15} = 6.9 * 10^3 * e^5 * e^{-20} = 1.02 * 10^6 * e^{-20}.. \text{ Ans is (B)}$$

**11 votes**

-- Vicky Bajoria (4.9k points)

### 7.7.2 Poisson Distribution: GATE2013\_2 [top](#)

<http://gateoverflow.in/62>

Selected Answer

Poisson Probability Density Function (with mean  $\lambda$ ) =  $\lambda^k / (e^\lambda k!)$ ,

We have to sum the probability density function for  $k = 0, 1$  and  $2$  and  $\lambda = 3$  (thus finding the cumulative mass function)

$$= (1/e^3) + (3/e^3) + (9/2e^3)$$

$$= 17/(2e^3)$$

**13 votes**

-- Arjun Suresh (294k points)

### 7.7.3 Poisson Distribution: GATE2017-2-48 [top](#)

<http://gateoverflow.in/118513>

Selected Answer

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 ,

$$\begin{aligned}E[(X+2)^2] &= E[X^2 + 4X + 4] \\ &= E(X^2) + 4E(X) + 4 \\ &= 30 + (4 * 5) + 4 \\ &= 54\end{aligned}$$

**Hence 54 should be the right answer..**

18 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

#### 7.7.4 Poisson Distribution: ISI 2015 MMA 7 top

<http://gateoverflow.in/129269>



Selected Answer

C.  $\frac{1-e^{-\lambda}}{\lambda}$

$$\begin{aligned}E\left(\frac{1}{1+x}\right) &= \sum_{k=0}^{\infty} \left(\frac{1}{1+k}\right) * \frac{\lambda^k * e^{-\lambda}}{k!} \\ &= \frac{1}{\lambda} * \sum_{k=0}^{\infty} \frac{\lambda^{k+1} * e^{-\lambda}}{(k+1)!} \\ &= \frac{e^{-\lambda}}{\lambda} * \sum_{k=1}^{\infty} \frac{\lambda^k}{k!} \\ &= \frac{e^{-\lambda}}{\lambda} * \left(\sum_{k=0}^{\infty} \frac{\lambda^k}{k!} - 1\right) \\ &= \frac{e^{-\lambda}}{\lambda} * (e^{\lambda} - 1) \\ &= \frac{1 - e^{-\lambda}}{\lambda}\end{aligned}$$

6 votes

-- Dhruv Patel (1.4k points)

#### 7.8

#### Probability(57) top

<http://gateoverflow.in/46536>

#### 7.8.1 Probability: CMI2012-A-07 top

A man has three cats. At least one is male. What is the probability that all three are male?

- A.  $\frac{1}{2}$
- B.  $\frac{1}{7}$
- C.  $\frac{1}{8}$
- D.  $\frac{3}{8}$

cmi2012 probability

Answer

## 7.8.2 Probability: CMI2014-A-02 [top](#)

<http://gateoverflow.in/46965>

The 12 houses on one side of a street are numbered with even numbers starting at 2 and going up to 24. A free newspaper is delivered on Monday to 3 different houses chosen at random from these 12. Find the probability that at least 2 of these newspapers are delivered to houses with numbers strictly greater than 14.

- A.  $\frac{7}{11}$
- B.  $\frac{5}{12}$
- C.  $\frac{4}{11}$
- D.  $\frac{5}{22}$

cmi2014 probability

Answer

## 7.8.3 Probability: CMI2015-A-07 [top](#)

<http://gateoverflow.in/47043>

You arrive at a snack bar and you can't decide whether to order a lime juice or a lassi. You decide to throw a fair 6-sided die to make the choice, as follows.

- If you throw 2 or 6 you order a lime juice.
- If you throw a 4, you order a lassi.
- Otherwise, you throw the die again and follow the same algorithm.

What is the probability that you end up ordering a lime juice?

- A.  $\frac{1}{3}$
- B.  $\frac{1}{2}$
- C.  $\frac{2}{3}$
- D.  $\frac{3}{4}$

cmi2015 probability

Answer

## 7.8.4 Probability: GATE 2016-1-04 [top](#)

<http://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 \_\_\_\_\_.

gate2016-1 probability normal numerical-ability numerical-answers

Answer

## 7.8.5 Probability: GATE 2016-1-29 [top](#)

<http://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) \_\_\_\_\_.

gate2016-1 probability normal numerical-answers

**Answer****7.8.6 Probability: GATE-2014-2-1** [top](#)<http://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  $100p = \underline{\hspace{2cm}}$ .

[gate2014-2](#) [probability](#) [numerical-answers](#) [normal](#)**Answer****7.8.7 Probability: GATE1994\_2.6** [top](#)<http://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  $\underline{\hspace{2cm}}$ .

[gate1994](#) [probability](#) [normal](#)**Answer****7.8.8 Probability: GATE1994\_2.8** [top](#)<http://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  $\underline{\hspace{2cm}}$ .

[gate1994](#) [probability](#) [normal](#)**Answer****7.8.9 Probability: GATE1995\_1.18** [top](#)<http://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) 16/25
- (b) (9/10)<sup>3</sup>
- (c) 27/75
- (d) 18/25

[gate1995](#) [probability](#) [normal](#)**Answer****7.8.10 Probability: GATE1995\_2.14** [top](#)<http://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****7.8.11 Probability: GATE1996\_1.5** [top](#)<http://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](#)

### 7.8.12 Probability: GATE1996\_2.7 top

<http://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](#)

### 7.8.13 Probability: GATE1997\_1.1 top

<http://gateoverflow.in/2211>

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](#)

### 7.8.14 Probability: GATE1998\_1.1 top

<http://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](#)

### 7.8.15 Probability: GATE1998\_3a top

<http://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

[Answer](#)

### 7.8.16 Probability: GATE1999\_2.1 [top](#)

<http://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.  $P_r\left[\frac{E_1}{E_2}\right] = \frac{4}{5}$

gate1999 | probability | normal

[Answer](#)

### 7.8.17 Probability: GATE2000-1.1 [top](#)

<http://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 | probability | easy

[Answer](#)

### 7.8.18 Probability: GATE2000-2.2 [top](#)

<http://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 | probability | easy

[Answer](#)

### 7.8.19 Probability: GATE2001-2.4 [top](#)

<http://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 probability normal

[Answer](#)

### 7.8.20 Probability: GATE2002-2.16 [top](#)

<http://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 probability easy

[Answer](#)

### 7.8.21 Probability: GATE2003-3 [top](#)

<http://gateoverflow.in/854>

Let  $P(E)$  denote the probability of the event  $E$ . Given  $P(A) = 1$ ,  $P(B) = 1/2$ , the values of  $P(A | B)$  and  $P(B | A)$  respectively are

- A.  $1/4, 1/2$
- B.  $1/2, 1/4$
- C.  $1/2, 1$
- D.  $1, 1/2$

gate2003 probability easy

[Answer](#)

### 7.8.22 Probability: GATE2003-60, ISRO2007-45 [top](#)

<http://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 probability normal isro2007

[Answer](#)

### 7.8.23 Probability: GATE2004-25 [top](#)

<http://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 probability easy

Answer

### 7.8.24 Probability: GATE2004-78 [top](#)

<http://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.  ${}^n C_d / 2^n$
- B.  ${}^n C_d / 2^d$
- C.  $d / 2^n$
- D.  $1 / 2^d$

gate2004 probability normal

Answer

### 7.8.25 Probability: GATE2004-IT-1 [top](#)

<http://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. 3/23
- B. 6/23
- C. 3/10
- D. 3/5

gate2004-it probability normal

Answer

### 7.8.26 Probability: GATE2005-IT-1 [top](#)

<http://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. 1/36
- B. 1/6
- C. 1/4
- D. 1/3

gate2005-it probability normal

Answer

### 7.8.27 Probability: GATE2006-IT-1 [top](#)

<http://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  $25^\circ\text{C}$ , the probability that it will rain in the afternoon is 0.4. The temperature at noon is equally likely to be above  $25^\circ\text{C}$ , or at/below  $25^\circ\text{C}$ . What is the probability that it will rain in the afternoon on a day when the temperature at noon is above  $25^\circ\text{C}$ ?

- A. 0.4
- B. 0.6
- C. 0.8
- D. 0.9

gate2006-it probability normal

Answer

**7.8.28 Probability: GATE2007-24** [top](#)<http://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.  $\frac{1}{2}$
- B.  $\frac{1}{10}$
- C.  $\frac{9!}{20!}$
- D. None of these

[gate2007](#) [probability](#) [easy](#)

[Answer](#)

**7.8.29 Probability: GATE2007-IT-1** [top](#)<http://gateoverflow.in/3432>

Suppose there are two coins. The first coin gives heads with probability  $5/8$  when tossed, while the second coin gives heads with probability  $1/4$ . One of the two coins is picked up at random with equal probability and tossed. What is the probability of obtaining heads ?

- A.  $7/8$
- B.  $1/2$
- C.  $7/16$
- D.  $5/32$

[gate2007-it](#) [probability](#) [normal](#)

[Answer](#)

**7.8.30 Probability: GATE2008-27** [top](#)<http://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](#) [probability](#) [normal](#)

[Answer](#)

**7.8.31 Probability: GATE2008-IT-2** [top](#)<http://gateoverflow.in/3224>

A sample space has two events A and B such that probabilities  $P(A \cap B) = 1/2$ ,  $P(A') = 1/3$ ,  $P(B') = 1/3$ . What is  $P(A \cup B)$ ?

- A.  $11/12$
- B.  $10/12$
- C.  $9/12$
- D.  $8/12$

[gate2008-it](#) [probability](#) [easy](#)

[Answer](#)

**7.8.32 Probability: GATE2008-IT-23** [top](#)<http://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.  $1 - \frac{365 \cdot 364 \dots (365-r+1)}{365^r}$
- 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.  $\frac{365 \cdot 364 \cdot \dots \cdot (365-r+1)}{365^r}$

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

[Answer](#)

### 7.8.33 Probability: GATE2009-21 [top](#)

<http://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](#) [probability](#) [normal](#)

[Answer](#)

### 7.8.34 Probability: GATE2010-26 [top](#)

<http://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.  $(1 - q)p$
- D.  $pq$

[gate2010](#) [probability](#) [easy](#)

[Answer](#)

### 7.8.35 Probability: GATE2010-27 [top](#)

<http://gateoverflow.in/1153>

What is the probability that divisor of  $10^{99}$  is a multiple of  $10^{96}$ ?

- A. 1/625
- B. 4/625
- C. 12/625
- D. 16/625

[gate2010](#) [probability](#) [normal](#)

[Answer](#)

### 7.8.36 Probability: GATE2011\_3 [top](#)

<http://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. 1/3
- B. 1/4
- C. 1/2
- D. 2/3

[gate2011](#) [probability](#) [easy](#)

[Answer](#)

### 7.8.37 Probability: GATE2011\_34 [top](#)

<http://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)  $1/5$
- (B)  $4/25$
- (C)  $1/4$
- (D)  $2/5$

[gate2011](#) [probability](#) [normal](#)

[Answer](#)

### 7.8.38 Probability: GATE2014-1-48 [top](#)

<http://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 \_\_\_\_\_

[gate2014-1](#) [probability](#) [numerical-answers](#) [normal](#)

[Answer](#)

### 7.8.39 Probability: GATE2014-2-48 [top](#)

<http://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 \_\_\_\_\_.

[gate2014-2](#) [probability](#) [numerical-answers](#) [normal](#)

[Answer](#)

### 7.8.40 Probability: GATE2014-3-48 [top](#)

<http://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\_\_\_\_\_.

[gate2014-3](#) [probability](#) [numerical-answers](#) [normal](#)

[Answer](#)

### 7.8.41 Probability: GATE2015-1\_29 [top](#)

<http://gateoverflow.in/8253>

Consider a LAN with four nodes  $S_1, S_2, S_3$  and  $S_4$ . Time is divided into fixed-size slots, and a node can begin its transmission only at the beginning of a slot. A collision is said to have occurred if more than one node transmit in the same slot. The probabilities of generation of a frame in a time slot by  $S_1, S_2, S_3$  and  $S_4$  are 0.1, 0.2, 0.3 and 0.4 respectively. The probability of sending a frame in the first slot without any collision by any of these four stations is\_\_\_\_\_.

[gate2015-1](#) [probability](#) [normal](#) [numerical-answers](#)

[Answer](#)

### 7.8.42 Probability: Gate-2006, CE [top](#)

<http://gateoverflow.in/106695>

There are 25 calculators in a box. Two of them are defective. Suppose 5 calculators are randomly picked for inspection (i.e., each has the same chance of being selected), what is the probability that only one of the defective calculators will be included in the inspection?

can we do it by both hypergeometric as well as by binomial distribution?

[gate-2006](#) [probability](#) [engineering-mathematics](#)

[Answer](#)

### 7.8.43 Probability: TIFR2010-A-10 [top](#)

<http://gateoverflow.in/26481>

A drawer contains 2 Blue, 4 Red and 2 Yellow balls. No two balls have the same radius. If two balls are randomly selected from the drawer, what is the probability that they will be of the same colour?

- A.  $2/7$
- B.  $2/5$
- C.  $3/7$

- D.  $\frac{1}{2}$   
E.  $\frac{3}{5}$

tifr2010 probability

Answer

### 7.8.44 Probability: TIFR2010-A-13 top

<http://gateoverflow.in/18392>

A cube whose faces are colored is split into 1000 small cubes of equal size. The cubes thus obtained are mixed thoroughly. The probability that a cube drawn at random will have exactly two colored faces is:

- a. 0.096  
b. 0.12  
c. 0.104  
d. 0.24  
e. None of the above

tifr2010 probability

Answer

### 7.8.45 Probability: TIFR2010-A-6 top

<http://gateoverflow.in/18222>

Given 10 tosses of a coin with probability of head = .4 = (1 - the probability of tail), the probability of at least one head is?

- a.  $(.4)^{10}$   
b.  $1 - (.4)^{10}$   
c.  $1 - (.6)^{10}$   
d.  $(.6)^{10}$   
e.  $10(.4)(.6)^9$

tifr2010 probability

Answer

### 7.8.46 Probability: TIFR2011-A-19 top

<http://gateoverflow.in/26479>

Three dice are rolled independently. What is the probability that the highest and the lowest value differ by 4?

- A.  $\frac{1}{3}$   
B.  $\frac{1}{6}$   
C.  $\frac{1}{9}$   
D.  $\frac{5}{18}$   
E.  $\frac{2}{9}$

tifr2011 probability

Answer

### 7.8.47 Probability: TIFR2011-A-3 top

<http://gateoverflow.in/20000>

The probability of three consecutive heads in four tosses of a fair coin is.

- a.  $\frac{1}{4}$   
b.  $\frac{1}{8}$   
c.  $\frac{1}{16}$   
d.  $\frac{3}{16}$   
e. None of the above.

tifr2011 probability

Answer

### 7.8.48 Probability: TIFR2011-A-9 [top](#)

<http://gateoverflow.in/20020>

You have to play three games with opponents A and B in a specified sequence. You win the series if you win two consecutive games. A is a stronger player than B. Which sequence maximizes your chance of winning the series?

- a. AAB
- b. ABA
- c. BAB
- d. BAA
- e. All are the same.

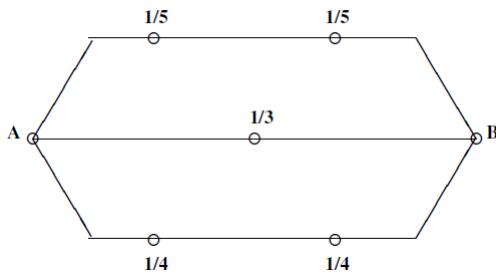
tifr2011 probability

Answer

### 7.8.49 Probability: TIFR2012-A-19 [top](#)

<http://gateoverflow.in/25044>

An electric circuit between two terminals  $A$  and  $B$  is shown in the figure below, where the numbers indicate the probabilities of failure for the various links, which are all independent.



What is the probability that  $A$  and  $B$  are connected?

- a.  $\frac{6}{25}$
- b.  $\frac{379}{400}$
- c.  $\frac{1}{1200}$
- d.  $\frac{1199}{1200}$
- e.  $\frac{59}{60}$

tifr2012 probability

Answer

### 7.8.50 Probability: TIFR2012-A-20 [top](#)

<http://gateoverflow.in/25045>

There are 1000 balls in a bag, of which 900 are black and 100 are white. I randomly draw 100 balls from the bag. What is the probability that the 101st ball will be black?

- a.  $9/10$
- b. More than  $9/10$  but less than 1.
- c. Less than  $9/10$  but more than 0.
- d. 0
- e. 1

tifr2012 probability

Answer

### 7.8.51 Probability: TIFR2012-A-9 [top](#)

<http://gateoverflow.in/21008>

The probability of throwing six perfect dices and getting six different faces is

- a.  $1 - 6!/6^6$
- b.  $6!/6^6$

- c.  $6^{-6}$
- d.  $1 - 6^{-6}$
- e. None of the above.

tifr2012 probability

Answer

### 7.8.52 Probability: TIFR2013-A-13 [top](#)

<http://gateoverflow.in/25435>

Doctors  $A$  and  $B$  perform surgery on patients in stages  $III$  and  $IV$  of a disease. Doctor  $A$  has performed a 100 surgeries (on 80 stage  $III$  and 20 stage  $IV$  patients) and 80 out of her 100 patients have survived (78 stage  $III$  and 2 stage  $IV$  survivors). Doctor  $B$  has also performed 100 surgeries (on 50 stage  $III$  and 50 stage  $IV$  patients). Her success rate is  $60/100$  (49 stage  $III$  survivors and 11 stage  $IV$  survivors). A patient has been advised that she is equally likely to be suffering from stage  $III$  or stage  $IV$  of this disease. Which doctor would you recommend to this patient and why?

- a. Doctor  $A$  since she has a higher success rate
- b. Doctor  $A$  since she specializes in stage  $III$  patients and the success of surgery in stage  $IV$  patients is anyway too low
- c. Doctor  $B$  since she has performed more stage  $IV$  surgeries
- d. Doctor  $B$  since she appears to be more successful
- e. There is not enough data since the choice depends on the stage of the disease the patient is suffering from.

tifr2013 probability

Answer

### 7.8.53 Probability: TIFR2013-A-14 [top](#)

<http://gateoverflow.in/25437>

An unbiased die is thrown  $n$  times. The probability that the product of numbers would be even is

- a.  $1/(2n)$
- b.  $1/[(6n)!]$
- c.  $1 - 6^{-n}$
- d.  $6^{-n}$
- e. None of the above.

tifr2013 probability

Answer

### 7.8.54 Probability: TIFR2013-A-4 [top](#)

<http://gateoverflow.in/25386>

A biased coin is tossed repeatedly. Assume that the outcomes of different tosses are independent and probability of heads is  $2/3$  in each toss. What is the probability of obtaining an even number of heads in 5 tosses, zero being treated as an even number?

- a.  $121/243$
- b.  $122/243$
- c.  $124/243$
- d.  $125/243$
- e.  $128/243$

tifr2013 probability

Answer

### 7.8.55 Probability: TIFR2013-A-6 [top](#)

<http://gateoverflow.in/25390>

You are lost in the National park of Kabrastan. The park population consists of tourists and Kabrastanis. Tourists comprise two-thirds of the population the park, and give a correct answer to requests for directions with probability  $3/4$ . The air of Kabrastan has an amnesiac quality however, and so the answers to repeated questions to tourists are independent, even if the question and the person are the same. If u ask a Kabrastani for directions, the answer is always wrong.

Suppose you ask a randomly chosen passer by whether the exit from the park is East or West. The answer is East. You then ask the same person again, and the reply is again East. What is the probability of East being correct?

- a.  $1/4$

- b.  $1/3$
- c.  $1/2$
- d.  $2/3$
- e.  $3/4$

[tifr2013](#) | [probability](#)

[Answer](#)

### 7.8.56 Probability: TIFR2015-A-1 [top](#)

<http://gateoverflow.in/29156>

Consider a 6-sided die with all sides not necessarily equally likely such that probability of an even number is  $P(\{2,4,6\}) = 1/2$ , probability of a multiple of 3 is  $P(\{3,6\}) = 1/3$  and probability of 1 is  $P(\{1\}) = 1/6$ . Given the above conditions, choose the strongest (most stringent) condition of the following that must always hold about  $P(\{5\})$ , the probability of 5.

- A.  $P(\{5\}) = 1/6$
- B.  $P(\{5\}) \geq 1/6$
- C.  $P(\{5\}) \leq 1/6$
- D.  $P(\{5\}) \leq 1/3$
- E. None of the above.

[tifr2015](#) | [probability](#)

[Answer](#)

### 7.8.57 Probability: TIFR2017-A-9 [top](#)

<http://gateoverflow.in/95042>

Consider the *majority* function on three bits,  $\text{maj}: \{0,1\}^3 \rightarrow \{0,1\}$  where  $\text{maj}(x_1, x_2, x_3) = 1$  if and only if  $x_1 + x_2 + x_3 \geq 2$ . Let  $p(\alpha)$  be the probability that the output is 1 when each input is set to 1 independently with probability  $\alpha$ . What is  $p'(\alpha) = \frac{d}{d\alpha} p(\alpha)$ ?

- A.  $3\alpha$
- B.  $\alpha^2$
- C.  $6\alpha(1 - \alpha)$
- D.  $3\alpha^2(1 - \alpha)$
- E.  $6\alpha(1 - \alpha) + \alpha^2$

[tifr2017](#) | [probability](#)

[Answer](#)

## Answers: Probability

### 7.8.1 Probability: CMI2012-A-07 [top](#)

<http://gateoverflow.in/46536>



Selected Answer

Given that A man has three cats and At least one is male.

Possible combination for atleast one cat is male=(M,F,F),(F,M,F),(F,F,M),(M,F,M),(M,M,F),(F,M,M),(M,M,M)

Probability that all three are male= $\frac{1}{7}$

Hence, Option(B)

$\frac{1}{7}$  is the correct Choice.

3 votes

-- Leen Sharma (32.2k points)

### 7.8.2 Probability: CMI2014-A-02 [top](#)

<http://gateoverflow.in/46965>



Selected Answer

There are 12 houses on one side of a street are numbered with even numbers.

In which 5 houses are strictly greater than Number 14.

And remaining 7 houses are numbered smaller than 14 (i.e. including 14)

No of way of choosing at least 2 of these newspapers are delivered to houses with numbers strictly greater than 14.

$$5C_3 + 5C_2 * 7C_1 = 80$$

Total way of choosing 3 houses =  $12C_3 = 220$

**So Required probability =  $80/220 = 4/11$**

3 votes

-- Manoj Kumar (37.5k points)

### 7.8.3 Probability: CMI2015-A-07 [top](#)

<http://gateoverflow.in/47043>

If we want lime juice then we need to throw {2 or 6}. And If we don't get {2 or 6} in first go, then we need to throw {1 or 3 or 5} in first go and again we will try to get {2 or 6} in 2nd throw and so on.

Note - If we throw 4 in any go then we will end up getting lassi. But we want lime juice.

So probability of getting lime juice =  $(2/6) + (3/6) * (2/6) + (3/6)^2 * (2/6) + \dots \text{ to infinity.}$

$$\begin{aligned} &= (2/6) + (3/6) * (2/6) \{ 1 + 3/6 + (3/6)^2 \dots \} \\ &= 2/6 + (3/6) * (2/6) * 2 \\ &= 2/3. \end{aligned}$$

2 votes

-- Dhananjay Kumar Sharma (25.2k points)

### 7.8.4 Probability: GATE 2016-1-04 [top](#)

<http://gateoverflow.in/39661>



Selected Answer

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.

$$\text{Hence, } \int_a^1 \frac{1}{x^2} dx = 1$$

$$\left[ -\frac{1}{x} \right]_a^1 = 1$$

$$-1 + \frac{1}{a} = 1$$

Hence **a = 0.5**

11 votes

-- ryan sequeira (3k points)

Integrate  $1/x^2$  in the limits a to 1.. and equate it to 1.. solving we get a=0.5

18 votes

-- Abhilash Panicker (8.8k points)

### 7.8.5 Probability: GATE 2016-1-29 [top](#)

<http://gateoverflow.in/39709>



Selected Answer

Answer is 0.33

1st time it is 0.25( 1/4 ), when tail tail comes, entire process gets repeated, so next time probability of Y to happen is 0.25\*0.25 ( (1/4)\*(1/4) ), likewise it goes on as infinite GP

Sum of infinite GP =  $a/(1-r)$

here  $a = 1/4$  and  $r = 1/4$

so answer becomes  $1/3$  i.e 0.33

16 votes

-- Sreyas S (1.7k points)

Answer should be 0.33

$P(TH)=1/4$

$P(HH + HT)=1/2$

now if TT comes then toss again,

So,  $P(TTTH)= 1/16$  . and so on....  $P(TH+TTTH+.....) = 1/4 + 1/16 + \dots = 1/3$

18 votes

-- Deepak Sharma (691 points)

## 7.8.6 Probability: GATE-2014-2-1 [top](#)

<http://gateoverflow.in/1953>



Selected Answer

Initially  $P(\text{working computer}) = 4/10$ ,  $P(\text{non-working computer}) = 6/10$ .

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

$$P(WWWN) = \frac{4}{10} * \frac{3}{9} * \frac{2}{8} * \frac{6}{7} = \frac{144}{5040}$$

In all other 3 sub-cases, we get same numerators and denominators (in different order), so total prob in this case is  $4 * 144 / 5040 = 576 / 5040$ .

Case 2 : all 4 are working

$$P(WWWW) = \frac{4}{10} * \frac{3}{9} * \frac{2}{8} * \frac{1}{7} = \frac{24}{5040}$$

$P(\text{atleast 3 are working}) = 600 / 5040$

So  $100 * p = 11.90$

14 votes

-- Happy Mittal (10.9k points)

all are working + 3 Working and 1 not working

$$\Rightarrow (1/10C4) + (4C3 * 6C1)/10C4$$

17 votes

-- Saumya (707 points)

## 7.8.7 Probability: GATE1994\_2.6 [top](#)

<http://gateoverflow.in/2473>



Selected Answer

$$P(A \cap B') = P(A) - P(A \cap B)$$

$$\Rightarrow P(A) = P_2 + P_3$$

7 votes

-- Saumya (707 points)

### 7.8.8 Probability: GATE1994\_2.8 [top](#)

<http://gateoverflow.in/2475>



Selected Answer

$$P(A) = 0.8 \implies P(A') = 1 - 0.8 = .2$$

$$P(B) = 0.5 \implies P(B') = 1 - 0.5 = .5$$

$$P(C) = 0.3 \implies P(C') = 1 - 0.3 = .7$$

$$P(\text{No event will occur}) = .2 \cdot .5 \cdot .7 = .07$$

$$P(\text{at least 1 event will occur}) = 1 - .07 = .93$$

16 votes

-- Manu Thakur (6k points)

### 7.8.9 Probability: GATE1995\_1.18 [top](#)

<http://gateoverflow.in/780>



Selected Answer

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 =  $8 \cdot 9 \cdot 9$

Total no. of ways including 7 =  $9 \cdot 10 \cdot 10$

So, ans =  $(8 \cdot 9 \cdot 9) / (9 \cdot 10 \cdot 10) = 18/25$

16 votes

-- gatecse (13.4k points)

### 7.8.10 Probability: GATE1995\_2.14 [top](#)

<http://gateoverflow.in/2626>



Selected Answer

answer - C

probability of first ball white and second one black =  $(10/25) \times (15/24)$

probability of first ball black and second one white =  $(15/25) \times (10/24)$

probability = sum of above two probabilities =  $1/2$

9 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.11 Probability: GATE1996\_1.5 [top](#)

<http://gateoverflow.in/2709>



Selected Answer

$$1 - (\text{no 6 in both the dice}) = 1 - (5/6 \cdot 5/6) = 11/36$$

8 votes

-- Bhagirathi Nayak (13.3k points)

### 7.8.12 Probability: GATE1996\_2.7 [top](#)

<http://gateoverflow.in/2736>



Selected Answer

There are 52 cards including 4 aces so the probability must be  $4/52 \cdot 3/51$

7 votes

-- Bhagirathi Nayak (13.3k points)

### 7.8.13 Probability: GATE1997\_1.1 [top](#)

<http://gateoverflow.in/2217>



Selected Answer

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,  $.7 = .5 + .6 - P(\text{it will rain today and tomorrow})$

$\Rightarrow P(\text{it will rain today and tomorrow}) = .4$

10 votes

-- Rajarshi Sarkar (35k points)

### 7.8.14 Probability: GATE1998\_1.1 [top](#)

<http://gateoverflow.in/1638>



Selected Answer

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

10 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.15 Probability: GATE1998\_3a [top](#)

<http://gateoverflow.in/1694>



Selected Answer

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 = 5/6

Probability that one friend arrives between 4:00 and 4:50 and meets the other arriving in the next 10 minutes =  $5/6 * 1/6 * 2 = 10/36 = 5/18$

(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 =  $1/6 * 1/6 = 1/36$

This covers all possibility of a meet. So, required probability of non-meet

$$\begin{aligned} &= 1 - (5/18 + 1/36) \\ &= 1 - 11/36 \\ &= 25/36 \end{aligned}$$

7 votes

-- Arjun Suresh (294k points)

### 7.8.16 Probability: GATE1999\_2.1 [top](#)

<http://gateoverflow.in/1479>



Selected Answer

answer - C

if events E1 and E2 are independent then  $P[\text{E1 and E2}] = P[\text{E1}] \times P[\text{E2}]$  which is not the case here.

4 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.17 Probability: GATE2000-1.1 [top](#)

<http://gateoverflow.in/824>



Selected Answer

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.

 14 votes

-- gatecse (13.4k points)

### 7.8.18 Probability: GATE2000-2.2 [top](#)



Selected Answer

answer - D

let probability of Event E1 = x = prob of E2

$\text{prob}(E1 \cup E2) = \text{prob}(E1) + \text{prob}(E2) - \text{prob}(E1 \cap E2)$

$1 = x + x - x^2$  ( $\text{prob}(E1 \cap E2) = \text{prob}(E1) * \text{prob}(E2)$  as events are independent)

$x = 1$

 11 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.19 Probability: GATE2001-2.4 [top](#)



Selected Answer

answer - B [EDIT]

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 =  $1/7^7$

we can choose a day in 7 ways

hence probability =  $7/7^7 = 1/7^6$

 11 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.20 Probability: GATE2002-2.16 [top](#)



Selected Answer

answer - C

probability of getting all heads =  $1/16$

probability of getting all tails =  $1/16$

probability of getting at least one head and one tail =  $1 - 1/16 - 1/16 = 7/8$

 8 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.21 Probability: GATE2003-3 [top](#)



Selected Answer

It immediately follows from the monotonicity property that ,  
 $0 \leq P(E) \leq 1$ ,

probability of atleast 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 atleast one of event have probability 1 (here ,  $P(A) = 1$ ) , then union of both should be 1 .

so ,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$1 = 1 + 1/2 - P(A \cap B) ,$$

$$P(A \cap B) = 1/2 ,$$

now ,

$$P(A/B) = P(A \cap B) / P(B) = (1/2) / (1/2) = 1 ,$$

$$P(B/A) = P(A \cap B) / P(A) = (1/2) / (1) = 1/2 .$$

hence option (D) ,

NOTE :- if atleast one of the two events has/have the probability 1 . then both events should be independent events but vise - versa not true .

13 votes

-- Mithlesh Upadhyay (5.4k points)

## 7.8.22 Probability: GATE2003-60, ISRO2007-45 [top](#)

<http://gateoverflow.in/948>

We assume the total time to be 't' units and f1 executes for 'x' units.

Since, f1(t) and f2(t) are executed sequentially.

So, f2 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.

$$f_1(t) * f_2(t - x)$$

7 votes

-- Pranabesh Ghosh (3.4k points)

## 7.8.23 Probability: GATE2004-25 [top](#)

<http://gateoverflow.in/1022>



Selected Answer

answer - A

out of 4 times 2 times head should be present

ways of selecting these 2 places  ${}^4C_2$

probability of getting 2 heads and 2 tails =  $(1/2)^2(1/2)^2$

$$\text{probability} = {}^4C_2/2^4 = 3/8$$

3 votes

-- ankitrokdeonsns (9.1k points)

## 7.8.24 Probability: GATE2004-78 [top](#)

<http://gateoverflow.in/1072>



Selected Answer

answer - A

there n binary bits that can differ but only d should differ in this case

ways of choosing these d bits =  ${}^nC_d$

probability of d bits differ but, n - d bits do not differ =  $(1/2)^d(1/2)^{(n-d)}$

$$\text{no of ways} = {}^nC_d/2^n$$

9 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.25 Probability: GATE2004-IT-1 [top](#)

<http://gateoverflow.in/3642>



Selected Answer  
Answer is B) 6/23

Let N be the total number of families.

Number of children in a family of 3 children =  $(N/2) * 3$

Number of children in a family of 2 children =  $(3N/10) * 2$

Number of children in a family of 1 child =  $(N/5) * 1$

Probability = Favorable case / Total cases

$$= \frac{(3/10)*2}{(1/2)*3 + (3/10)*2 + 1/5}$$

$$= 6/23$$

8 votes

-- Prateeksha Keshari (2.1k points)

### 7.8.26 Probability: GATE2005-IT-1 [top](#)

<http://gateoverflow.in/3745>



Selected Answer  
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.

Now, probability of getting a Blue first, Green second and Red third =  $10/60 * 20/60 * 30/60$

Required probability =  $6 * 10/60 * 20/60 * 30/60 = 1/6$

8 votes

-- Arjun Suresh (294k points)

### 7.8.27 Probability: GATE2006-IT-1 [top](#)

<http://gateoverflow.in/3538>



Selected Answer  
Answer is C) 0.8

$P(\text{rain in afternoon}) = 0.5 * P(\text{rain when temp} \leq 25) + 0.5 * P(\text{rain when temp} > 25)$   
 $0.6 = 0.5 * 0.4 + 0.5 * P(\text{rain when temp} > 25)$

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/>)

12 votes

-- Prateeksha Keshari (2.1k points)

### 7.8.28 Probability: GATE2007-24 [top](#)

<http://gateoverflow.in/1222>



Selected Answer  
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  $\frac{1}{10}$ .

20 votes

-- Arjun Suresh (294k points)

### 7.8.29 Probability: GATE2007-IT-1 [top](#)

<http://gateoverflow.in/3432>



Answer is C) 7/16

Probability of obtaining head = Probability of picking first coin \* Probability of getting head on first coin + Probability of picking second coin \* Probability of getting head on second coin =  $(1/2)*(5/8) + (1/2)*(1/4) = 7/16$

10 votes

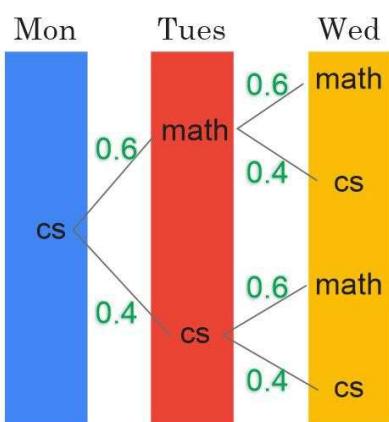
-- Prateeksha Keshari (2.1k points)

### 7.8.30 Probability: GATE2008-27 [top](#)

<http://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

14 votes

-- Amar Vashishth (28.7k points)

### 7.8.31 Probability: GATE2008-IT-2 [top](#)

<http://gateoverflow.in/3224>



$$\begin{aligned}
 P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\
 &= (1 - P(A')) + (1 - P(B')) - P(A \cap B) \\
 &= (1 - 1/3) + (1 - 1/3) - 1/2 \\
 &= 4/3 - 1/2 \\
 &= 5/6 = 10/12
 \end{aligned}$$

8 votes

-- Arjun Suresh (294k points)

### 7.8.32 Probability: GATE2008-IT-23 [top](#)

<http://gateoverflow.in/3284>



Answer: C

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 and Selecting these 2 persons in  $C(r,2)$  ways. 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,

$$P_{\text{at least } 3 \text{ with same birthday}} = 1 - [P_{\text{no two having same birthday}} + P_{\text{exactly 2 having same birthday}}]$$

Hence,

$$P_{\text{at least } 3 \text{ with same birthday}} = 1 - \left[ \frac{365 \cdot 364 \cdots (365-(r-1))}{365^r} + C(r,2) \cdot 365 \cdot \frac{364 \cdot 363 \cdots (365-(r-2))}{364^{r-2}} \right]$$

$$= 1 - \frac{365 \cdot 364 \cdots (365-(r-1))}{365^r} - C(r,2) \cdot 365 \cdot \frac{364 \cdot 363 \cdots (365-(r-2))}{364^{r-2}}$$

12 votes

-- Rajarshi Sarkar (35k points)

### 7.8.33 Probability: GATE2009-21 [top](#)

<http://gateoverflow.in/798>



Selected Answer

$P(\{1,3,5\}) = 0.9P(\{2,4,6\})$  and their sum must be 1. So,

$$P(\{1,3,5\}) = \frac{0.9}{1.9} = 0.4736 \text{ and}$$

$$P(\{2,4,6\}) = \frac{1}{1.9} = 0.5263$$

Given that probability of getting 2 or 4 or 6 is same.

$$\text{So, } P(2) = P(4) = P(6) = \frac{0.5263}{3} = 0.1754$$

$$P(\{4,6\}) \mid x > 3 = 0.75 \implies P(5 \mid x > 3) = 0.25 \implies P(5) = \frac{1}{3}(P(4) + P(6)) \because x > 3 \implies x \in \{4,5,6\} \implies P(5)$$

$$\text{So, } P(x > 3) = P(4) + P(5) + P(6) = \frac{8}{3} \times 0.1754 = 0.468$$

17 votes

-- Arjun Suresh (294k points)

### 7.8.34 Probability: GATE2010-26 [top](#)

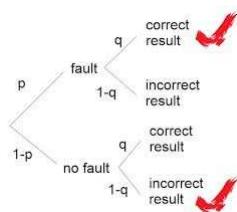
<http://gateoverflow.in/1152>



Selected Answer

answer = option A

in image below the ticks shows those branch where the result is declared as faulty.



so required probability = sum of those two branches =  $pq + (1-p)(1-q)$

11 votes

-- Amar Vashishth (28.7k points)

### 7.8.35 Probability: GATE2010-27 [top](#)

<http://gateoverflow.in/1153>



Selected Answer

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 =  $\frac{16}{10000}$

$$= \frac{1}{625}$$

How 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  $a_1^{m_1} \cdot a_2^{m_2} \cdots \cdot a_n^{m_n}$ , number of factors of  $n = (m_1 + 1) \times (m_2 + 1) \times \cdots \times (m_n + 1)$ ,

the extra one in each factor term coming for power being 0.

31 votes

-- Arjun Suresh (294k points)

### 7.8.36 Probability: GATE2011\_3 top

<http://gateoverflow.in/2105>



Selected Answer

answer - A

prob(at least one head) = 3/4

prob(both heads) = 1/4

using bayes' theorem =  $(1/4)/(3/4) = 1/3$

9 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.37 Probability: GATE2011\_34 top

<http://gateoverflow.in/2138>



Selected Answer

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**

15 votes

-- Amar Vashishth (28.7k points)

### 7.8.38 Probability: GATE2014-1-48 [top](#)



Selected Answer

There are only two possible sets whose elements sum to 22 : {6,6,6,4}, {6,6,5,5}

Number of permutations for 1st set :  $4!/3! = 4$

Number of permutations for 2nd set :  $4!/(2!*2!) = 6$

So total number of ways to sum 22 = 10

So X = 10.

19 votes

-- Happy Mittal (10.9k points)

### 7.8.39 Probability: GATE2014-2-48 [top](#)



Selected Answer

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]

8 votes

-- ankitrokdeonsns (9.1k points)

### 7.8.40 Probability: GATE2014-3-48 [top](#)



Selected Answer

$$1/2 * 1/2 = 1/4$$

$P(A) + P(B) = 1$ , 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. So,  $P(A) = P(B) = 1/2$

8 votes

-- Saumya (707 points)

### 7.8.41 Probability: GATE2015-1\_29 [top](#)

<http://gateoverflow.in/8253>



Selected Answer

$$\begin{aligned}
 P &= P(S1) P(\sim S2) P(\sim S3) P(\sim S4) + P(\sim S1) P(S2) P(\sim S3) P(\sim S4) + P(\sim S1) P(\sim S2) P(S3) P(\sim S4) + P(\sim S1) P(\sim S2) \\
 &\quad P(\sim S3) P(S4) \\
 &= 0.1 * 0.8 * 0.7 * 0.6 \\
 &+ 0.9 * 0.2 * 0.7 * 0.6 \\
 &+ 0.9 * 0.8 * 0.3 * 0.6 \\
 &+ 0.9 * 0.8 * 0.7 * 0.4 \\
 &= 0.4404
 \end{aligned}$$

1 26 votes

-- Arjun Suresh (294k points)

### 7.8.42 Probability: Gate-2006, CE [top](#)

<http://gateoverflow.in/10689>



Selected Answer

Binomial used for----->

- a) In such trial we have either success or failure ..
  - b) Sampling should be from infinite population(here it is referred to no of calculator)
  - c) Sampling from finite population but with replacement
- 
- 

here B and C condition is false because its finite . and default we take without replacement so here Hypergeometric is apply

we get

$$({}^2C_1 * {}^{23}C_4) / {}^{25}C_5$$

1 1 votes

-- Hradesh patel (6.6k points)

### 7.8.43 Probability: TIFR2010-A-10 [top](#)

<http://gateoverflow.in/26481>



Selected Answer

If any 2 balls selected from 8 balls then we can choose  $8C2$  ways=28 ways

If selected 2 balls are same color then  $2C2 + 4C2 + 2C2$  ways=1+6+1 ways=8 ways

So, required probability=  $8/28 = 2/7$

Ans (A)

1 6 votes

-- srestha (58.3k points)

### 7.8.44 Probability: TIFR2010-A-13 [top](#)

<http://gateoverflow.in/18392>



Selected Answer

0.096 should be the correct answer, i.e. option a)

Suppose that the side of larger cube is 10m then volume of the larger cube will be  $10 \times 10 \times 10 = 1000m^3$ .

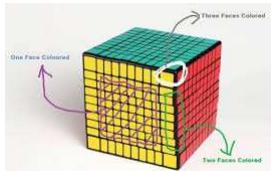
After dividing the cube into 1000 equal sized small cubes, volume of each smaller cube will be  $((10 \times 10 \times 10)/1000) \text{ m}^3 = 1 \text{ m}^3$ .

So the sides of the each of the smaller cube will be 1 m, which is 10 times less than the side length of larger cube.

so each EDGE of the larger larger cube will contain 10 smaller cube edges.

each FACE of the larger cube will contain  $10 \times 10 = 100$  smaller cube faces.

each CORNER of the larger cube will contain 1 smaller cube corner.



Position of each of the smaller cube can be as follows:

A) It can be in the corners of the larger cube, In this case it would have three of its faces colored.

There are total  $8(\text{number of corners}) \times 1(\text{number of smaller cubes per corner}) = 8$  such cubes.

B) It can be in the edges of the larger cube, In this case it would have two of its faces colored.

There are total  $12(\text{number of edges}) \times 8(\text{number of smaller cubes per edge excluding corner cubes of the edge}) = 96$ .

C) It can be on the face of the larger cube but not in the edges of a face, in this case it would have one face colored.

There are total  $6(\text{number of faces}) \times 64(\text{number of smaller cubes per face excluding the edge & corner cubes}) = 384$ .

D) It can be inside the core of the larger cube, in this case it will be uncolored.

There will be  $512 (= 1000 - (384 + 96 + 8))$  cubes.

Now since there are 96 cubes out of 1000 which have 2 colored faces, so required probability =  $96/1000 = 0.096$

Now, since total number of edges in the larger cube = 12, so total number of smaller cubes with two colored faces =  $12 \times 8 = 96$ .

7 votes

-- Anurag Pandey (13.1k points)

## 7.8.45 Probability: TIFR2010-A-6 [top](#)

<http://gateoverflow.in/18222>



10 tosses of coin are there.

Probability of head = 0.4

Probability of tail = 0.6

Probability of at least one head =  $1 - P_{\text{no head occur}} = 1 - (0.6)^{10}$

3 votes

-- Digvijay (47k points)

## 7.8.46 Probability: TIFR2011-A-19 [top](#)

<http://gateoverflow.in/26479>



Case 1: largest is 5, smallest 1 and middle is 2 or 3 or 4 :  $3*3!$

Case 2: largest is 5, smallest 1 and middle is 1 or 5 :  $3!*2/2!$

Case 3: largest is 6, smallest 2 and middle is 3 or 4 or 5 :  $3*3!$

Case 4: largest is 6, smallest 2 and middle is 6 or 2:  $3!*2/2!$

So probability the highest and the lowest value differ by  $4 = (3*3! + 3!*2/2! + 3*3! + 3!*2/2!) / 6^3 = 2/9$

2 votes

-- Shreya Roy (3.7k points)

### 7.8.47 Probability: TIFR2011-A-3 [top](#)



Selected Answer

Let the 4 tosses be named  $P, Q, R$  and  $S$

**To have 3 consecutive heads:**

- $Q, R$  must be both heads.
- At least one of  $\{P, S\}$  must be a head.

**Thus, the probability of getting 3 consecutive heads is given by:**

$$\begin{aligned} P &= P_q \times P_r \times \underbrace{(P_p + P_s - P_p P_s)}_{\text{atleast one}} \\ &= \frac{1}{2} \times \frac{1}{2} \times \left( \frac{1}{2} + \frac{1}{2} - \frac{1}{2} \cdot \frac{1}{2} \right) \\ P &= \frac{3}{16} \end{aligned}$$

**Hence, option D is the correct answer.**

Another way of looking at it is:

$$P = P_{HHHT} + P_{THHH} + P_{HHHH} = \frac{1}{16} + \frac{1}{16} + \frac{1}{16} = \frac{3}{16}$$

 2 votes

-- Pragy Agarwal (19.5k points)

### 7.8.48 Probability: TIFR2011-A-9 [top](#)



Selected Answer

Let the three games in a series be called  $G_1, G_2$  and  $G_3$  respectively, and the probability of winning the game  $x$  be denoted as  $P(x)$

**You can win the series if and only if: You win  $G_2$  and you win atleast one of  $\{G_1, G_3\}$ .**

$$P\left(\begin{array}{c} \text{winning} \\ \text{the series} \\ G_1 G_2 G_3 \end{array}\right) = P(G_2) \times \left( \left( P(G_1) + P(G_3) - P(G_1) \times P(G_3) \right) \right)$$

Let the probability of winning against player  $A$  be  $a$  and the probability of winning against player  $B$  be  $b$ .

**Then,**

$a < b$ .

**$A$  is a stronger player than  $B$ , so probability of winning against  $A$  is smaller compared to  $B$ .**

Let  $P(xyz)$  be the probability of winning the series in which the games played are against  $x, y$  and  $z$  in order.

- $P(AAB) = a(a + b - ab) = a^2 + ab - a^2b$
- $P(ABA) = b(a + a - aa) = 2ab - a^2b$
- $P(BAB) = a(b + b - b^2) = 2ab - ab^2$

d.  $P(BAA) = a(b + a - ba) = a^2 + ab - a^2b$

We can see that **not all probabilities are equal, so option E is not correct**

We can also see that options **A and D result in the same value, so they are not correct either.**

**Comparing option B and option C.**

Since  $a < b$  and  $a, b \geq 0$ , we have that  $2ab - a^2b > 2ab - ab^2$

**Hence, option B is the correct answer.**

7 votes

-- Pragy Agarwal (19.5k points)

### 7.8.49 Probability: TIFR2012-A-19 [top](#)

<http://gateoverflow.in/25044>



Selected Answer

Lets define the following events:

$P$  : Uppermost link is working.

$Q$  : Middle link is working.

$R$  : Lowermost link is working.

$W$  : Terminals  $A$  &  $B$  are connected.

From the given information, we can calculate the probabilities of events  $P$ ,  $Q$  and  $R$  as follow:

(as I already consumed letter (capital)  $P$  denoting an event so here by I will use letter (small)  $p$  to denote probabilities,

e.g.  $p(X)$  denotes probability of happening of event  $X$ ).

$$p(P) = \frac{4}{5} \times \frac{4}{5} = \frac{16}{25},$$

$$\Rightarrow p(\hat{P}) = 1 - \frac{16}{25} = \frac{9}{25},$$

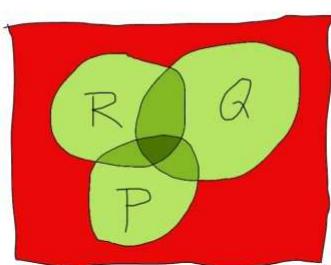
$$p(Q) = \frac{2}{3},$$

$$\Rightarrow p(\hat{Q}) = \frac{1}{3},$$

$$p(R) = \frac{3}{4} \times \frac{3}{4} = \frac{9}{16},$$

$$\Rightarrow p(\hat{R}) = 1 - \frac{9}{16} = \frac{7}{16}.$$

The situation here can be represented using the following Venn Diagram:



Here Red region denotes the event  $\hat{W}$  in which  $A$  &  $B$  are disconnected.

Different gradients of Green colour represent the  $\hat{W}$  in which terminals

$A$  &  
 $B$  are connected.

We have to find  
 $p(W)$

Events  $W$  and  $\widehat{W}$  are mutually exclusive & totally exhaustive, since either terminals  $A$  and  $B$  will be connected or they will be disconnected.

So we can write  
 $p(W)$  in terms of  
 $p(\widehat{W})$  as follow:

$$p(W) = 1 - p(\widehat{W}).$$

Also it can be seen that

$$p(\widehat{W}) = p(\widehat{P}) \cap (\widehat{Q}) \cap (\widehat{R}) \text{ where } \widehat{P}, \widehat{Q} \text{ and } \widehat{R} \text{ are independent events.}$$

That is terminals  $A$  &  $B$  will be disconnected only when all of the links will fail simultaneously.

Using independence we can write,

$$p(\widehat{W}) = p(W) = p(\widehat{P}) \times (\widehat{Q}) \times (\widehat{R}),$$

$$\Rightarrow p(\widehat{W}) = \frac{9}{25} \times \frac{1}{3} \times \frac{7}{16} = \frac{21}{400}$$

$$\Rightarrow p(W) = 1 - \frac{21}{400} = \frac{379}{400}.$$

7 votes

-- Anurag Pandey (13.1k points)

## 7.8.50 Probability: TIFR2012-A-20 [top](#)

<http://gateoverflow.in/25045>

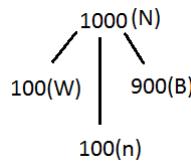


Selected Answer

Here we are having a **total of 1000** Balls, out of which we firstly **draw 100 balls**, and **then 101st ball..**

Firstly we have to **find expected number of white and black balls in drawn 100 balls**, as both can occur in 100 balls..

We have a situation like this:



**Expected number of white balls =  $n \cdot W/N = 100 \cdot (100/1000) = 10$**

**Expected number of black balls =  $n \cdot B/N = 100 \cdot (900/1000) = 90$**

So, we have drawn 100 balls(90 black, 10 white)

Left balls = (810 Black , 90 white) = 900 total

Now,

**probability for 101st ball to be black =  $810/900 = 9/10$**

**So, option (A) is Correct**

5 votes

-- Himanshu Agarwal (16.2k points)

## 7.8.51 Probability: TIFR2012-A-9 [top](#)

<http://gateoverflow.in/21008>



Selected Answer

B) for all the 6 different faces 1,2,3,4,5,6 the probability is  $1/6^6$  and then for 6! different permutations :  $6!/6^6$

4 votes

-- Shaun Patel (6.9k points)

### 7.8.52 Probability: TIFR2013-A-13 [top](#)



Selected Answer

Ans will be d

As, % of Doctor A successful for stage III  $78/80 * 100 = 97.5$

for stage IV  $2/20 * 100 = 10$

As, % of Doctor B successful for stage III  $49/50 * 100 = 98$

stage IV  $11/50 * 100 = 22$

In both cases Doc B is more successful

5 votes

-- srestha (58.3k points)

### 7.8.53 Probability: TIFR2013-A-14 [top](#)



Selected Answer

Even number = 2,4,6  
odd number = 1,3,5

Product will come even when even one time even number comes  
odd product will be if every time odd comes

$$\text{so } P(\text{Even}) = 1 - P(\text{odd}) = 1 - nCn * \left(\frac{3}{6}\right)^0 * \left(\frac{3}{6}\right)^n \\ = 1 - \left(\frac{1}{2}\right)^n$$

So I think option E

10 votes

-- Umang Raman (15.1k points)

### 7.8.54 Probability: TIFR2013-A-4 [top](#)



Selected Answer

probability of obtaining an even number of heads in 5 tosses, zero being treated as an even number  
number of event = 0 head or 2 head or 4 head

Probability of head =  $2/3$

Probability of tail = 1/3

$$\text{Probability} = 5C0\left(\frac{2}{3}\right)^0\left(\frac{1}{3}\right)^5 + 5C2\left(\frac{2}{3}\right)^2\left(\frac{1}{3}\right)^3 + 5C4\left(\frac{2}{3}\right)^4\left(\frac{1}{3}\right)^1$$

=

$$\frac{121}{243}$$

Option A

7 votes

-- Umang Raman (15.1k points)

### 7.8.55 Probability: TIFR2013-A-6 [top](#)



Selected Answer

Ans should be 1/2

Tourists are 2/3 of population of the park

Among them probability of correct answer is 3/4

$$\text{so, } 2/3 \times 3/4 = 1/2$$

0 votes

-- srestha (58.3k points)

### 7.8.56 Probability: TIFR2015-A-1 [top](#)

Given,

$$\begin{aligned} P(2,4,6) &= 1/2 \\ P(3,6) &= 1/3 \end{aligned}$$

$$P(1) = 1/6$$

So,

$$\begin{aligned} P(1,3,5) &= 1/2 \\ P(3,5) &= P(1,3,5) - P(1) \end{aligned}$$

$$= 1/2 - 1/6$$

$$\begin{aligned} &= 1/3 \\ P(3,5) &= 1/3 \end{aligned}$$

For P(5) to have the maximum probability, P(3) should be 0

$$P(5) \leq 1/3$$

5 votes

-- admin (2.4k points)

### 7.8.57 Probability: TIFR2017-A-9 [top](#)



Selected Answer

$$\begin{aligned}
 \Rightarrow [\mathbf{maj}\{x_i\} = 1] &\Leftrightarrow \left( \left[ \sum_{i=1}^3 x_i \right] \geq 2 \right) \\
 \Rightarrow \text{Prob} \left( \left[ \sum_{i=1}^3 x_i \right] \geq 2 \right) &= \text{Prob} \left( \left[ \sum_{i=1}^3 x_i \right] = 2 \right) + \text{Prob} \left( \left[ \sum_{i=1}^3 x_i \right] = 3 \right) \\
 \Rightarrow \text{Prob} \left( \left[ \sum_{i=1}^3 x_i \right] \geq 2 \right) &= \binom{3}{2} * \{\alpha, \alpha, (1-\alpha)\} + \alpha^3 \\
 \Rightarrow \text{Prob} \left( \left[ \sum_{i=1}^3 x_i \right] \geq 2 \right) &= 3\alpha^2(1-\alpha) + \alpha^3 \\
 \Rightarrow \text{Prob} \left( \left[ \sum_{i=1}^3 x_i \right] \geq 2 \right) &= 3\alpha^2 - 2\alpha^3 \\
 \Rightarrow P'(\alpha) &= \frac{d}{d\alpha}[3\alpha^2 - 2\alpha^3] \\
 \Rightarrow P'(\alpha) &= 6\alpha(1-\alpha)
 \end{aligned}$$

6 votes

-- Debashish Deka (51.4k points)

**7.9****Random Variable(8)** [top](#)**7.9.1 Random Variable: GATE2005-12, ISRO2009-64** [top](#)<http://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.  $\int_a^b f(x)dx$
- C.  $\int_a^b xf(x)dx$
- D.  $\int_a^b x^2 f(x)dx$

[gate2005](#) [probability](#) [random-variable](#) [easy](#) [isro2009](#)
**Answer****7.9.2 Random Variable: GATE2011\_18** [top](#)<http://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](#) [probability](#) [random-variable](#) [expectation](#) [normal](#)
**Answer****7.9.3 Random Variable: GATE2011\_33** [top](#)<http://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](#) [probability](#) [random-variable](#) [normal](#)

[Answer](#)

#### 7.9.4 Random Variable: GATE2012\_21 [top](#)

<http://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](#) [probability](#) [random-variable](#) [easy](#)

[Answer](#)

#### 7.9.5 Random Variable: GATE2015-3\_37 [top](#)

<http://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  $Pr[Y = 0 | X_3 = 0] = \underline{\hspace{2cm}}$ .

[gate2015-3](#) [probability](#) [random-variable](#) [normal](#) [numerical-answers](#)

[Answer](#)

#### 7.9.6 Random Variable: GATE2017-1-19 [top](#)

<http://gateoverflow.in/116299>

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  $\underline{\hspace{2cm}}$ .

[gate2017-1](#) [probability](#) [random-variable](#) [numerical-answers](#)

[Answer](#)

#### 7.9.7 Random Variable: GATE2017-2-31 [top](#)

<http://gateoverflow.in/116373>

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

gate2017-2 probability random-variable

Answer

### 7.9.8 Random Variable: TIFR2011-A-7 [top](#)

<http://gateoverflow.in/20012>

Let  $X$  and  $Y$  be two independent and identically distributed random variables. Then  $P(X > Y)$  is.

- a.  $\frac{1}{2}$
- b. 1
- c. 0
- d.  $\frac{1}{3}$
- e. Information is insufficient.

tifr2011 probability random-variable

Answer

## Answers: Random Variable

### 7.9.1 Random Variable: GATE2005-12, ISRO2009-64 [top](#)

<http://gateoverflow.in/1162>



Selected Answer

- A) This is difference between probabilities don't know what it is !
- B) This is cumulative distribution function . 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 - >[https://en.wikipedia.org/wiki/Expected\\_value](https://en.wikipedia.org/wiki/Expected_value)

Ans => C

4 votes

-- Akash (43.8k points)

### 7.9.2 Random Variable: GATE2011\_18 [top](#)

<http://gateoverflow.in/2120>



Selected Answer

$$V(x) = E(x^2) - [E(x)]^2 = R$$

where  $V(x)$  is the Variance of  $x$ , Since Variance is Square and Hence Never be Negative,  $R \geq 0$

4 votes

-- aman.anand (447 points)

### 7.9.3 Random Variable: GATE2011\_33 [top](#)

<http://gateoverflow.in/2133>



## Selected Answer

answer - D

mean, median and mode are linear functions over a random variable.

so multiplying by constants or adding constants won't change their relative position.

standard deviation is not a linear function over a random variable.

9 votes

-- ankitrokdeonsns (9.1k points)

#### 7.9.4 Random Variable: GATE2012\_21 top

<http://gateoverflow.in/1577>



## Selected Answer

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

$$F(1) = P(-1) + 0 + 0 + \dots + P(1)$$

$$= 0.5 + 0.5 = 1$$

12 votes

-- Arjun Suresh (294k points)

#### 7.9.5 Random Variable: GATE2015-3\_37 top

<http://gateoverflow.in/8496>



## Selected Answer

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  $= \frac{3}{4} = 0.75$ .

19 votes

-- Srijay Deshpande (377 points)

#### 7.9.6 Random Variable: GATE2017-1-19 top

<http://gateoverflow.in/11829>



## Selected Answer

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  $P(X < c) = 1 - P(X < c) \Rightarrow P(X < c) = 0.5 \Rightarrow c = 0$ .

Hence 0 is the answer.

6 votes

-- Happy Mittal (10.9k points)

### 7.9.7 Random Variable: GATE2017-2-31 [top](#)

<http://gateoverflow.in/118373>



Notice that the derivative of  $g_X(z)$  evaluated at  $z=1$  gives expectation  $E(X)$  of  $X$

Therefore, take derivative of  $g_Y(z)$  with respect to  $z$ , and plug in  $z=1$

Derivative is  $N\beta(1 - \beta + \beta z)^{(N-1)}$ , plug in  $z=1$ , gives  $N\beta$

So, Answer is option (B)

4 votes

-- madan123456789 (147 points)

### 7.9.8 Random Variable: TIFR2011-A-7 [top](#)

<http://gateoverflow.in/20012>



Let the probability

$P(X = Y) > 0$ . This can happen if

$X$  and

$Y$  are discrete random variables. Also, if

$X$  and

$Y$  are continuous random variables, it could be that some values have a non-zero probability of getting selected.

Then

$$P(X > Y) = P(Y > X) = \frac{1 - P(X = Y)}{2}$$

**Since nothing is said about the value of  $P(X = Y)$ , the correct answer will be option e. Information is insufficient.**

4 votes

-- Pragy Agarwal (19.5k points)

## 7.10

### Uniform Distribution(2) [top](#)

#### 7.10.1 Uniform Distribution: GATE2004-80 [top](#)

<http://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.  $\frac{2}{3}$
- B. 1
- C.  $\frac{4}{3}$
- D.  $\frac{5}{3}$

[gate2004](#) [probability](#) [uniform-distribution](#) [expectation](#) [normal](#)

[Answer](#)

#### 7.10.2 Uniform Distribution: GATE2014-1-2 [top](#)

<http://gateoverflow.in/1711>

Suppose you break a stick of unit length at a point chosen uniformly at random. Then the expected length of the shorter stick is \_\_\_\_\_.

[gate2014-1](#) [probability](#) [uniform-distribution](#) [expectation](#) [numerical-answers](#) [normal](#)

[Answer](#)

## Answers: Uniform Distribution

### 7.10.1 Uniform Distribution: GATE2004-80 [top](#)



Selected Answer

See Q.80 here : [http://www.cse.iitd.ac.in/~mittal/gate/gate\\_math\\_2004.html](http://www.cse.iitd.ac.in/~mittal/gate/gate_math_2004.html)

10 votes

-- Happy Mittal (10.9k points)

<http://gateoverflow.in/1074>

### 7.10.2 Uniform Distribution: GATE2014-1-2 [top](#)



Selected Answer

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.

Now expected value of

$$L = \int_0^{0.5} L * p(L) dL = \int_0^{0.5} L * 2dL = 2 * \left[ \frac{L^2}{2} \right]_0^{0.5} = 0.25$$

21 votes

-- Happy Mittal (10.9k points)

<http://gateoverflow.in/1711>

## 8 General Aptitude: Numerical Ability (197) [top](#)

8.1

2017(1) [top](#)

### 8.1.1 2017: ISI 2017 MMA [top](#)

<http://gateoverflow.in/132734>

The area lying in the first quadrant and bounded by the circle

$$x^2 + y^2 = 4$$

and lines

$$x=0 \text{ and } x=1$$

is given by?

[isi](#) [2017](#) [mathematical-logic](#)

[Answer](#)

### Answers: 2017

### 8.1.1 2017: ISI 2017 MMA [top](#)

<http://gateoverflow.in/132734>

Selected Answer

We know

$$\int \sqrt{4-x^2} dx = \frac{\pi}{2} \sqrt{4-x^2} + \frac{x}{2} \sin^{-1} \frac{x}{2} + C$$

$$\text{So Area} = \left[ \frac{\pi}{2} \sqrt{4-x^2} + \frac{x}{2} \sin^{-1} \frac{x}{2} \right]_0^1$$

$$= \frac{\pi}{2} + \frac{2\pi}{6} + 0$$

$$= \frac{\pi}{3} + \frac{\pi}{2}$$

Hope this help.

3 votes

-- Rupendra Choudhary (2.4k points)

8.2

Absolute Value(5) [top](#)

### 8.2.1 Absolute Value: GATE-2013-AE-GA-8 [top](#)

<http://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](#) [numerical-ability](#) [absolute-value](#)

[Answer](#)

### 8.2.2 Absolute Value: GATE2013-CE-7 [top](#)

<http://gateoverflow.in/40275>

If  $| 4X - 7 | = 5$  then the values of  $2 | X | - | -X |$  is:

- A.  $2, \frac{1}{3}$
- B.  $\frac{1}{2}, 3$
- C.  $\frac{3}{2}, 9$
- D.  $\frac{2}{3}, 9$

[gate2013-ce](#) [numerical-ability](#) [absolute-value](#)

[Answer](#)

### 8.2.3 Absolute Value: GATE2014-2-GA-8 [top](#)

<http://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

[gate2014-2](#) [numerical-ability](#) [normal](#) [absolute-value](#)

[Answer](#)

### 8.2.4 Absolute Value: GATE2016-Session-8-GA-5 [top](#)

<http://gateoverflow.in/111286>

If  $|9y - 6| = 3$ , then  $y^2 - 4y/3$  is .

- A. 0
- B.  $+1/3$
- C.  $-1/3$
- D. undefined

[gate2016session8aptitude](#) [numerical-ability](#) [absolute-value](#)

[Answer](#)

### 8.2.5 Absolute Value: GATE2017-1-GA-8 [top](#)

<http://gateoverflow.in/111411>

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          |

[gate2017-1](#) [numerical-ability](#) [maxima-minima](#) [absolute-value](#)

[Answer](#)

## Answers: Absolute Value

### 8.2.1 Absolute Value: GATE-2013-AE-GA-8 [top](#)

<http://gateoverflow.in/40249>



Selected Answer

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.

4 votes

-- Anurag Pandey (13.1k points)

### 8.2.2 Absolute Value: GATE2013-CE-7 [top](#)

<http://gateoverflow.in/40275>



Selected Answer

A).  $|4X - 7| = 5$ , 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.

3 votes

-- ibia (3.5k points)

### 8.2.3 Absolute Value: GATE2014-2-GA-8 [top](#)

<http://gateoverflow.in/1950>



Selected Answer

$$x^2 - 2x + 3 = 11 \text{ Or } x^2 - 2x + 3 = -11 \text{ (Any one of them can be correct because of Mod)}$$

Lets take first one

$$x^2 - 2x + 3 = 11$$

$$x^2 - 2x - 8 = 0.$$

After solving

$$(x-4)(x+2) = 0,$$

$$x = 4 \text{ & } x = -2.$$

Now put the values of x in given equation  $| -x^3 + x^2 - x |$

$$\text{for } x = 4, \text{ we will get } | -64 + 16 - 4 | = 52$$

$$\text{for } x = -2, \text{ we will get } | 8 + 4 + 2 | = 14.$$

So Answer => D.

6 votes

-- Akash (43.8k points)

### 8.2.4 Absolute Value: GATE2016-Session-8-GA-5 [top](#)

<http://gateoverflow.in/111286>



Selected Answer

$$|9y-6|=3$$

squaring both side

$$81y^2-108y+36=9$$

dividing both side by 9

$$9y^2-12y+4=1$$

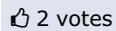
again dividing by 9

$$y^2-4/3y+4/9=1/9$$

$$\Rightarrow y^2-4/3y=1/9-4/9$$

$$=-(1/3)$$

Hence answer is option C .



2 votes

-- Aboveallplayer (18.5k points)

### 8.2.5 Absolute Value: GATE2017-1-GA-8 [top](#)

<http://gateoverflow.in/118411>

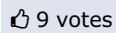
Selected Answer

when  $x > y$   $|x-y| = x-y$ , if we substitute it we get 'y'.

$x < y$   $|x-y| = -(x-y)$ , if we substitute it we get 'x'.

therefore in both the case we get minimum of (x,y).

ANS: B



9 votes

-- Vinay Rachapalli (1.1k points)

## 8.3

### Algebra(1) [top](#)

#### 8.3.1 Algebra: GATE\_MN\_2011\_61 [top](#)

<http://gateoverflow.in/31538>

If  $(2y+1)/(y+2) < 1$ , 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)  $-4 < y < 1$

[numerical-ability](#) [gate2011-mn](#) [algebra](#)

[Answer](#)

### Answers: Algebra

#### 8.3.1 Algebra: GATE\_MN\_2011\_61 [top](#)

<http://gateoverflow.in/31538>

Selected Answer

$$\frac{2y+1}{y+2} < 1 \\ \Rightarrow y < 1.$$

1. For any value of  $y < -2$ , Numerator become greater than Denominator.

2. But since in LHS, denominator cannot be zero

i.e.,  $y > -2$ .

Therefore,  $-2 < y < 1$

Option B.

6 votes

-- Monanshi Jain (8.4k points)

## 8.4

### Arithmetic Series(1) top

#### 8.4.1 Arithmetic Series: GATE2015-2\_GA\_6 top

<http://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

[gate2015-2](#) [numerical-ability](#) [normal](#) [arithmetic-series](#)

Answer

### Answers: Arithmetic Series

#### 8.4.1 Arithmetic Series: GATE2015-2\_GA\_6 top

<http://gateoverflow.in/8035>

answer is B because if we multiply by any no to AP than difference between them will b same and if we subtract any no in AP with every no then also difference will b same but if we make square of AP element then difference will not b same.

3 votes

-- Anoop Sonkar (4.8k points)

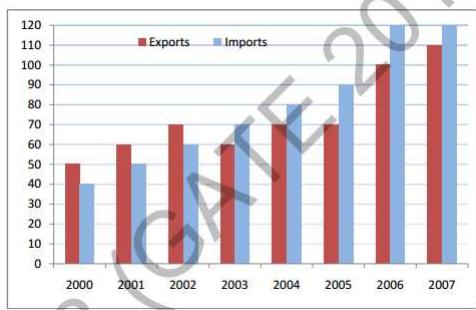
## 8.5

### Bar Charts(2) top

#### 8.5.1 Bar Charts: GATE2014-EC01-GA9 top

<http://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

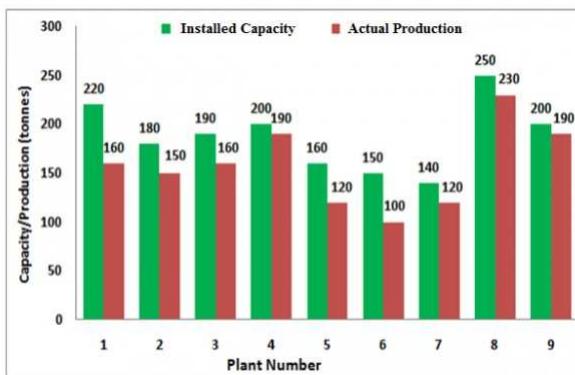
gate2014-ec01 numerical-ability data-interpretation bar-charts normal

[Answer](#)

## 8.5.2 Bar Charts: GATE2016-Session-8-GA-6 [top](#)

<http://gateoverflow.in/111289>

The following graph represents the installed capacity for cement production (in tonnes) and the actual production (in tonnes) of nine cement plants of a cement company. Capacity utilization of a plant is defined as ratio of actual production of cement to installed capacity. A plant with installed capacity of at least 200 tonnes is called a large plant and a plant with lesser capacity is called a small plant. The difference between total production of large plants and small plants, in tonnes is \_\_\_\_\_.



gate2016sessionBaptitude numerical-ability numerical-answers data-interpretation bar-charts

[Answer](#)

## Answers: Bar Charts

### 8.5.1 Bar Charts: GATE2014-EC01-GA9 [top](#)

<http://gateoverflow.in/41498>



Selected Answer

$(\frac{1}{5})^{th}$  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**

1 2 votes

-- Lokesh . (9.8k points)

## 8.5.2 Bar Charts: GATE2016-Session-8-GA-6 [top](#)

<http://gateoverflow.in/111289>

Total Production of large plants as evident from the graph(those with capacity 200 or more) is  $(160+190+230+190) = 770$ .

Total Production of small plants =  $150+160+120+100+120 = 650$ .

Difference =  $770 - 650 = 120$ .

1 2 votes

-- vishal76 (1.4k points)

## 8.6

## Bayes Theorem(2) [top](#)

<http://gateoverflow.in/2211>

### 8.6.1 Bayes Theorem: GATE2012\_63 [top](#)

<http://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](#) [numerical-ability](#) [probability](#) [normal](#) [bayes-theorem](#)

Answer

### 8.6.2 Bayes Theorem: GATE2013-AE-GA-10 [top](#)

<http://gateoverflow.in/40251>

In a factory, two machines M1 and M2 manufacture 60% and 40% of the autocomponents respectively. Out of the total production, 2% of M1 and 3% of M2 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 M2?

- A. 0.35
- B. 0.45
- C. 0.5
- D. 0.4

[gate2013-ae](#) [numerical-ability](#) [bayes-theorem](#)

Answer

## Answers: Bayes Theorem

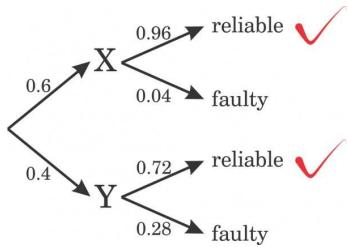
### 8.6.1 Bayes Theorem: GATE2012\_63 [top](#)

<http://gateoverflow.in/2211>



Selected Answer

B.



Then by using Bayes' Theorem :

$$\text{Probability of Y given R} = \frac{\text{Probability of Y and R}}{\text{Probability of R}}$$

$$= \frac{0.4 \times 0.72}{0.4 \times 0.72 + 0.6 \times 0.96}$$

$$= \frac{1}{3} = 0.33$$

13 votes

-- shreya ghosh (3.4k points)

## 8.6.2 Bayes Theorem: GATE2013-AE-GA-10 [top](#)

<http://gateoverflow.in/40251>



Selected Answer

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.

4 votes

-- Gaurav Sharma (2.6k points)

## 8.7

## Cartesian Coordinates(3) [top](#)

<http://gateoverflow.in/40220>

### 8.7.1 Cartesian Coordinates: GATE-2012-AE-9 [top](#)

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](#) [numerical-ability](#) [cartesian-coordinates](#) [geometry](#)

Answer

### 8.7.2 Cartesian Coordinates: GATE2014-ae-4 [top](#)

<http://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  $-1$

[gate-2014-ae](#)
[numerical-ability](#)
[geometry](#)
[cartesian-coordinates](#)

Answer

### 8.7.3 Cartesian Coordinates: TIFR2015-A-13 [top](#)

<http://gateoverflow.in/29586>

Imagine the first quadrant of the real plane as consisting of unit squares. A typical square has 4 corners:  $(i,j), (i+1,j), (i+1,j+1)$ , and  $(i,j+1)$ , where  $(i,j)$  is a pair of non-negative integers. Suppose a line segment  $l$  connecting  $(0,0)$  to  $(90,1100)$  is drawn. We say that  $l$  passes through a unit square if it passes through a point in the interior of the square. How many unit squares does  $l$  pass through?

- a. 98,990
- b. 9,900
- c. 1,190
- d. 1,180
- e. 1,010

[tifr2015](#)
[numerical-ability](#)
[cartesian-coordinates](#)

Answer

## Answers: Cartesian Coordinates

### 8.7.1 Cartesian Coordinates: GATE-2012-AE-9 [top](#)

<http://gateoverflow.in/40220>


Selected Answer

For two points  $(x_1, y_1)$  and  $(x_2, y_2)$  on a line, Slope of line  
 $= \frac{y_2 - y_1}{x_2 - x_1}$

so,  
 $\frac{q-p}{0-4} = \frac{3}{4}$

$\therefore (p-q) = 3$

1 3 votes

-- Praveen Saini (53.5k points)

### 8.7.2 Cartesian Coordinates: GATE2014-ae-4 [top](#)

<http://gateoverflow.in/40303>


Selected Answer

given,  $y=5x^2+3$

Slope  $dy/dx = 10x$

given point  $x=0, y=3 \dots (0,3)$

Now, at  $(0,3)$  we have the slope as

$dy/dx = 10 * 0 = 0$

which means line is parallel to x axis

Option B, D eliminated as slope is 0

Option A eliminated as given the tangent is at point  $(0,3)$  and we found slope=0, which means its 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)

1 4 votes

-- Abhilash Panicker (8.8k points)

### 8.7.3 Cartesian Coordinates: TIFR2015-A-13 [top](#)

<http://gateoverflow.in/29586>

Ans will be (d)1180

If a line segment passes through unit square from  $(0,0)$  to  $(i,j)$  the line intersects  $(i+j-\gcd(i,j))$  no of squares =  $(90+1100-10)=1180$

4 votes

-- srestha (58.3k points)

8.8

Circle(1) top8.8.1 Circle: TIFR2011-A-18 top<http://gateoverflow.in/20255>

The equation of the tangent to the unit circle at point  $(\cos \alpha, \sin \alpha)$  is.

- a.  $x \cos \alpha - y \sin \alpha = 1$
- b.  $x \sin \alpha - y \cos \alpha = 1$
- c.  $x \cos \alpha + y \sin \alpha = 1$
- d.  $x \sin \alpha - y \cos \alpha = 1$
- e. None of the above.

[tifr2011](#) [numerical-ability](#) [geometry](#) [circle](#)

Answer

## Answers: Circle

8.8.1 Circle: TIFR2011-A-18 top<http://gateoverflow.in/20255>

Selected Answer

**Assuming that the unit circle is centered at the origin, the equation of the unit circle is:**

$$x^2 + y^2 = 1$$

**The slope of the tangent to the unit circle at point  $(x, y)$  can be derived by implicit differentiation as follows:**

$$x^2 + y^2 = 1$$

$$\frac{d}{dx}(x^2 + y^2) = \frac{d}{dx}1$$

$$2x + 2y \frac{dy}{dx} = 0$$

$$\frac{dy}{dx} = -\frac{x}{y}$$

**Thus, the slope of the tangent at the point  $(\cos \alpha, \sin \alpha)$  is**  
 $-\frac{\cos \alpha}{\sin \alpha}$

**The equation of the tangent line then will be:**

$$\begin{aligned}y - y_1 &= m(x - x_1) \\y - \sin \alpha &= -\frac{\cos \alpha}{\sin \alpha}(x - \cos \alpha) \\y \sin \alpha - \sin^2 \alpha &= -x \cos \alpha + \cos^2 \alpha \\y \sin \alpha + x \cos \alpha &= \sin^2 \alpha + \cos^2 \alpha = 1\end{aligned}$$

Hence, option c is correct.

3 votes

-- Pragy Agarwal (19.5k points)

## 8.9

### Clock Time(3) top

#### 8.9.1 Clock Time: GATE2014-2-GA-10 top

<http://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.

[gate2014-2](#) [numerical-ability](#) [normal](#) [clock-time](#)

[Answer](#)

#### 8.9.2 Clock Time: TIFR2010-A-2 top

<http://gateoverflow.in/18206>

The hour hand and the minute hands of a clock meet at noon and again at mid-night. In between they meet  $N$  times, where  $N$  is.:

- a. 6
- b. 11
- c. 12
- d. 13
- e. None of the above.

[tifr2010](#) [numerical-ability](#) [clock-time](#)

[Answer](#)

#### 8.9.3 Clock Time: TIFR2014-A-10 top

<http://gateoverflow.in/25998>

A person went out between 4pm and 5pm to chat with her friend and returned between 5pm and 6pm. On her return, she found that the hour-hand and the minute-hand of her (well-functioning) clock had just exchanged their positions with respect to their earlier positions at the time of her leaving. The person must have gone out to chat at

- a. Twenty five minutes past 4pm.
- b. Twenty six and  $122/143$  minutes past 4pm.
- c. Twenty seven and  $1/3$  minutes past 4pm.
- d. Twenty eight minutes past 4pm.
- e. None of the above.

[tifr2014](#) [numerical-ability](#) [clock-time](#)

[Answer](#)

## Answers: Clock Time

#### 8.9.1 Clock Time: GATE2014-2-GA-10 top

<http://gateoverflow.in/1952>



Selected Answer

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.

9 votes

-- Arjun Suresh (294k points)

## 8.9.2 Clock Time: TIFR2010-A-2 [top](#)

<http://gateoverflow.in/18206>



Selected Answer

Let  $\delta$  be the difference in minutes between hour and minute hand at 1:05. So, the meeting times are

1 : 05 +  $\delta$

2 : 10 +  $2\delta$

3 : 15 +  $3\delta$

4 : 20 +  $4\delta$

5 : 25 +  $5\delta$

6 : 30 +  $6\delta$

7 : 35 +  $7\delta$

8 : 40 +  $8\delta$

9 : 45 +  $9\delta$

10 : 50 +  $10\delta$

11 : 55 +  $11\delta$

We have  $11\delta = 5 \implies \delta = \frac{5}{11}$

minutes as the meeting time is 0:00. So, we have  $N = 10$ .

Alternatively,

Speed of minute hand = 360 degrees per 60 minutes = 6 degrees per minute.

Speed of hour hand = 360 degree per 12 \* 60 minutes = 0.5 degree per minute.

For first meeting, distance traveled by minute hand = 360 + distance traveled by hour hand

Let,  $x$  be the minutes after which the hands intersect.

So,  $6x = 360 + 0.5x \implies 5.5x = 360 \implies x = 720/11$

In 12 hours we have  $12 \times 60$  minutes.

So, no. of intersections =  $\frac{12 \times 60}{720/11} = 11$ .

But the last intersection is at midnight and must be excluded as er given question. So,  $N = 10$ .

2 votes

-- Arjun Suresh (294k points)

**8.9.3 Clock Time: TIFR2014-A-10** [top](#)<http://gateoverflow.in/25998>

Let the time of departure be  $4 : x$  and time of arrival be  $5 : y$ .

$$\text{Angle made by hour hand during departure} = \frac{4}{12} \times 360 + x \frac{360}{12 \times 60} = 120 + \frac{x}{2}.$$

This angle is equal to the angle made by the minute hand on arrival which is  $6y$ . So,

$$240 + x = 12y \rightarrow (1)$$

Similarly, the angle made by the hour hand on arrival is equal to the angle made by the minute hand on departure, which gives

$$\frac{5}{12} \times 360 + \frac{y}{2} = 6x \implies 300 + y = 12x \rightarrow (2).$$

Eliminating  $y$  from (1) and (2),

$$240 + x = 12(12x - 300) \implies 143x = 3840 \implies x = 26\frac{122}{143}$$

5 votes

-- Arjun Suresh (294k points)

**8.10****Complex Number(1)** [top](#)**8.10.1 Complex Number: TIFR2011-A-13** [top](#)<http://gateoverflow.in/20223>

If  $z = \frac{\sqrt{3}-i}{2}$  and  $(z^{95} + i^{67})^{97} = z^n$ , then the smallest value of  $n$  is?

- a. 1
- b. 10
- c. 11
- d. 12
- e. None of the above.

[tifr2011](#) [numerical-ability](#) [complex-number](#)

Answer

**Answers: Complex Number****8.10.1 Complex Number: TIFR2011-A-13** [top](#)<http://gateoverflow.in/20223>

Selected Answer

$$\begin{aligned}
 z &= \frac{1}{2}(\sqrt{3} - i) \\
 z^2 &= \frac{1}{4}(3 - 1 - 2\sqrt{3}i) = \frac{1}{2}(1 - \sqrt{3}i) \\
 z^4 &= \frac{1}{4}(1 - 3 - 2\sqrt{3}i) = \frac{1}{2}(-1 - \sqrt{3}i) \\
 z^8 &= \frac{1}{4}(1 - 3 + 2\sqrt{3}i) = \frac{1}{2}(-1 + \sqrt{3}i) \\
 z^{16} &= \frac{1}{4}(1 - 3 - 2\sqrt{3}i) = \frac{1}{2}(-1 - \sqrt{3}i) = z^4 \\
 z^{32} &= z^{16} \times z^{16} = z^4 \times z^4 = z^8 \\
 z^{64} &= z^{32} \times z^{32} = z^8 \times z^8 = z^{16} = z^4
 \end{aligned}$$


---

$$\begin{aligned}
 z^{95} &= z^{64} \times z^{16} \times z^{15} \\
 &= z^4 \times z^4 \times z^{15} \\
 &= z^{16} \times z^7 \\
 &= z^4 \times z^7 \\
 &= z^8 \times z^2 \times z \\
 &= \frac{1}{2}(-1 + \sqrt{3}i) \times \frac{1}{2}(1 - \sqrt{3}i) \times \frac{1}{2}(\sqrt{3} - i) \\
 &= \frac{1}{2}(\sqrt{3} + i)
 \end{aligned}$$


---

$$\begin{aligned}
 i^{67} &= i^{64} \times i^3 \\
 &= 1 \times (-i) \\
 &= -i
 \end{aligned}$$


---

$$\begin{aligned}
 z^{95} + i^{67} &= \frac{1}{2}(\sqrt{3} + i) - i \\
 &= \frac{1}{2}(\sqrt{3} - i) \\
 &= z
 \end{aligned}$$


---

$$\begin{aligned}
 (z^{95} + i^{67})^{97} &= z^{97} = z^{95} \times z^2 \\
 &= \frac{1}{2}(\sqrt{3} + i) \times \frac{1}{2}(1 - \sqrt{3}i) \\
 &= \frac{1}{2}(\sqrt{3} - i) \\
 &= z
 \end{aligned}$$


---

Hence, option a is the correct answer.

6 votes

-- Pragy Agarwal (19.5k points)

## 8.11

## Compound Interest(1) top

### 8.11.1 Compound Interest: GATE2014-AG-GA5 top

<http://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](#) [numerical-ability](#) [growth-rate](#) [compound-interest](#) [normal](#)

[Answer](#)

## Answers: Compound Interest

### 8.11.1 Compound Interest: GATE2014-AG-GA5 [top](#)



Selected Answer

Initial population P=5m

After 1 year  $P=5m \times 1.2 = 6m$

Now 2nd year Current P=6m

Now after inc= $6m \times 1.2 = 7.2$

After 3 year = $8.65m$

After 4 year= $10.38m$

So ans should be A.

2 votes

-- Manoj Kumar (37.5k points)

## 8.12

## Conditional Probability(1) [top](#)

### 8.12.1 Conditional Probability: GATE2014-AG-GA10 [top](#)

[http://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](#) [numerical-ability](#) [probability](#) [conditional-probability](#) [normal](#) [numerical-answers](#)

[Answer](#)

## Answers: Conditional Probability

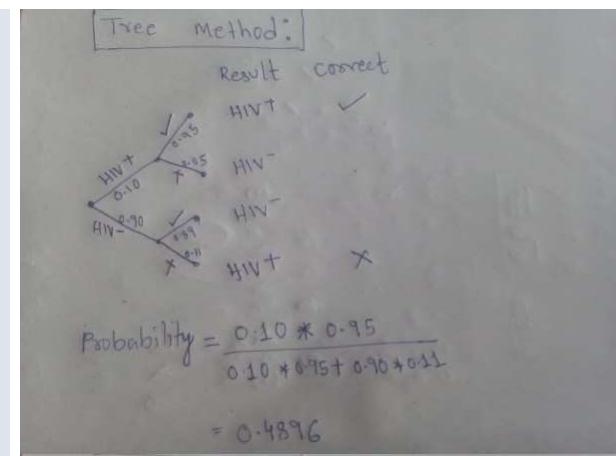
### 8.12.1 Conditional Probability: GATE2014-AG-GA10 [top](#)

[http://gateoverflow.in/41674](#)



Selected Answer

If you don't like Bayes theorem then use this



7 votes

-- Bhagirathi Nayak (13.3k points)

## 8.13

### Cost Market Price(3) top

#### 8.13.1 Cost Market Price: GATE2011\_63 top

<http://gateoverflow.in/2173>

The variable cost ( $V$ ) of manufacturing a product varies according to the equation

$$V = 4q, \text{ where}$$

$q$  is the quantity produced. The fixed cost

( $F$ ) of production of same product reduces with

$q$  according to the equation

$F = 100/q$ . How many units should be produced to minimize the total cost ( $V + F$ )?

- (A) 5
- (B) 4
- (C) 7
- (D) 6

[gate2011](#) [numerical-ability](#) [cost-market-price](#) [normal](#)

**Answer**

#### 8.13.2 Cost Market Price: GATE2012\_56 top

<http://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](#) [numerical-ability](#) [cost-market-price](#) [normal](#)

**Answer**

#### 8.13.3 Cost Market Price: gate-2014-ae-5 top

<http://gateoverflow.in/40304>

A foundry has a fixed daily cost of ₹ 50,000 whenever it operates and a variable cost of ₹  $800Q$ , where  $Q$  is the daily production in tonnes. What is the cost of production in ₹ per tonne for a daily production of 100 tonnes.

[gate-2014-ae](#) [numerical-ability](#) [cost-market-price](#) [numerical-answers](#)

**Answer**

## Answers: Cost Market Price

### 8.13.1 Cost Market Price: GATE2011\_63 [top](#)

<http://gateoverflow.in/2173>



Total Cost,  $T = 4q + 100/q$

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,

$4 - 100/q^2 = 0 \Rightarrow q = +5$  or  $-5$ . Since, we can't have negative number of product,  $q = 5$ .

Taking second derivative, at  $q = 5$  gives  $200/125 = 8/5 > 0$ , and hence 5 is the minimum point.

8 votes

-- Arjun Suresh (294k points)

### 8.13.2 Cost Market Price: GATE2012\_56 [top](#)

<http://gateoverflow.in/2193>



Answer is A. The equation for profit is Profit=SP-CP, here  $SP=Q*50$  and  $CP=5Q^2$  so when a function attains its maximum value its first order differentiation is zero. Hence  $50-5*2*Q=0$ . therefore  $Q=5$ .

12 votes

-- kireeti (1.1k points)

### 8.13.3 Cost Market Price: gate-2014-ae-5 [top](#)

<http://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 =  $\frac{130,000}{100} = Rs\ 1,300$ .

1 votes

-- Anurag Pandey (13.1k points)

## 8.14

## Currency Money(1) [top](#)

### 8.14.1 Currency Money: GATE2012-CY-GA-10 [top](#)

<http://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](#) [numerical-ability](#) [numerical-computation](#) [currency-money](#)

Answer

## Answers: Currency Money

### 8.14.1 Currency Money: GATE2012-CY-GA-10 [top](#)

<http://gateoverflow.in/40241>



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)5**

4 votes

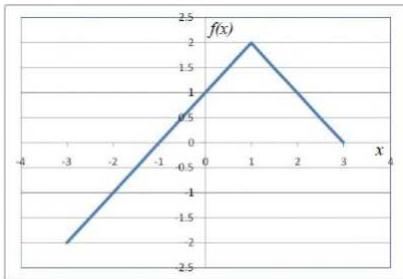
-- Abhilash Panicker (8.8k points)

## 8.15

## Data Interpretation(17) top

### 8.15.1 Data Interpretation: GATE 2016-2-GA-10 top

<http://gateoverflow.in/39535>



- A.  $f(x) = 1 - |x - 1|$
- B.  $f(x) = 1 + |x - 1|$
- C.  $f(x) = 2 - |x - 1|$
- D.  $f(x) = 2 + |x - 1|$

gate2016-2 numerical-ability data-interpretation normal

**Answer**

### 8.15.2 Data Interpretation: GATE-2013-AE-GA-7 top

<http://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

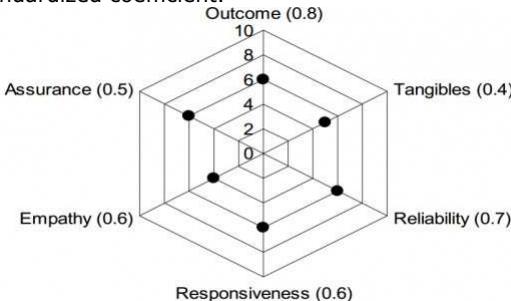
gate2013-ae numerical-ability data-interpretation

**Answer**

### 8.15.3 Data Interpretation: GATE2011-GG-GA\_9 [top](#)

<http://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%

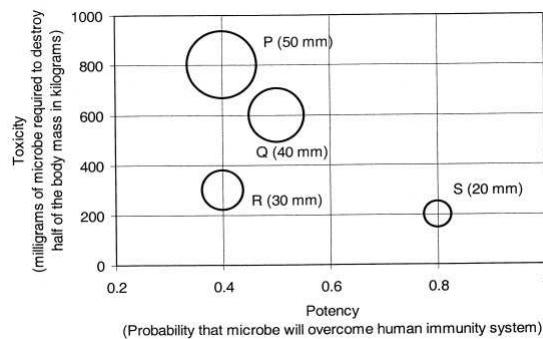
[gate2011-gg](#) [difficult](#) [numerical-ability](#) [data-interpretation](#)

**Answer**

### 8.15.4 Data Interpretation: GATE2011\_62 [top](#)

<http://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](#) [numerical-ability](#) [data-interpretation](#) [normal](#)

**Answer**

### 8.15.5 Data Interpretation: GATE2013-CE-8 [top](#)

<http://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 & Developement	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.

[numerical-ability](#) [gate2013-ce](#) [data-interpretation](#)

[Answer](#)

### 8.15.6 Data Interpretation: GATE2014-1-GA-9 [top](#)

<http://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
	Scooter	30	20
	Both	60	46
Do not own vehicle		20	50

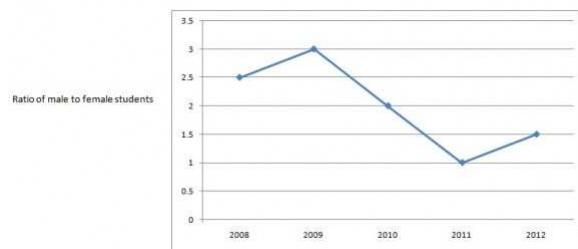
[gate2014-1](#) [numerical-ability](#) [normal](#) [numerical-answers](#) [data-interpretation](#)

[Answer](#)

### 8.15.7 Data Interpretation: GATE2014-2-GA-9 [top](#)

<http://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?



[gate2014-2](#) [numerical-ability](#) [data-interpretation](#) [numerical-answers](#) [normal](#)

[Answer](#)

### 8.15.8 Data Interpretation: GATE2014-3-GA-5 [top](#)

<http://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

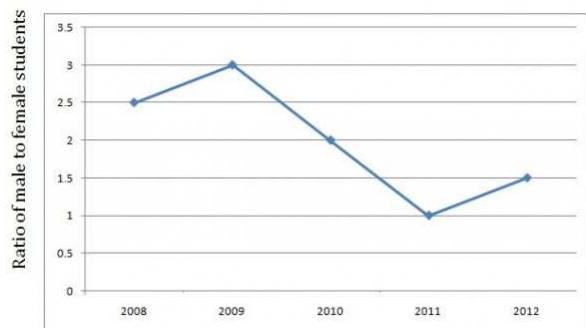
[gate2014-3](#) [numerical-ability](#) [normal](#) [data-interpretation](#)

**Answer**

### 8.15.9 Data Interpretation: GATE2014-3-GA-9 [top](#)

<http://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

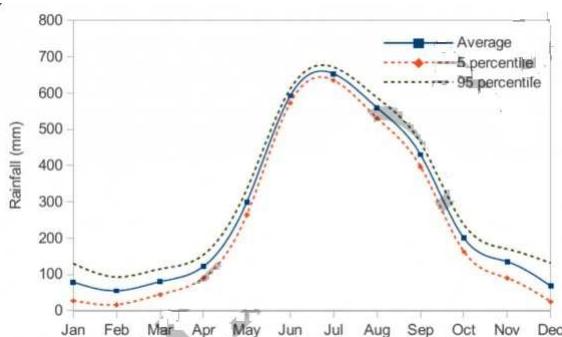
[gate2014-3](#) [numerical-ability](#) [data-interpretation](#) [normal](#)

**Answer**

### 8.15.10 Data Interpretation: GATE2014-ae-10 [top](#)

<http://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)

[gate-2014-ae](#) [numerical-ability](#) [data-interpretation](#)

[Answer](#)

### 8.15.11 Data Interpretation: GATE2015-1\_GA\_6 [top](#)

<http://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

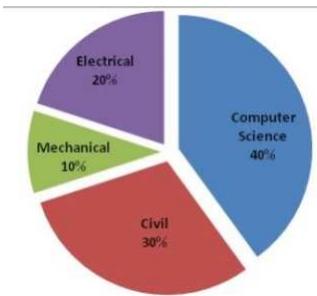
[gate2015-1](#) [numerical-ability](#) [easy](#) [data-interpretation](#)

[Answer](#)

### 8.15.12 Data Interpretation: GATE2015-1\_GA\_9 [top](#)

<http://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?



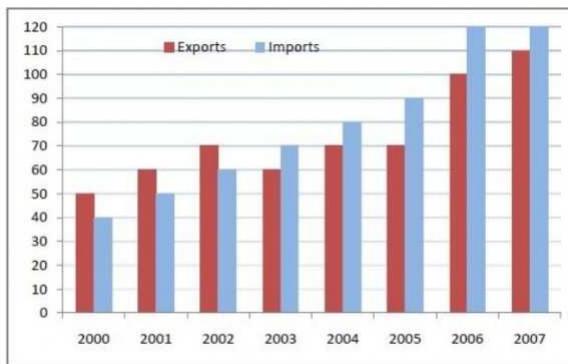
[gate2015-1](#) [numerical-ability](#) [data-interpretation](#) [numerical-answers](#)

[Answer](#)

### 8.15.13 Data Interpretation: GATE2015-3\_GA\_10 [top](#)

<http://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?


[gate2015-3](#) [numerical-ability](#) [data-interpretation](#) [normal](#) [numerical-answers](#)

Answer

### 8.15.14 Data Interpretation: GATE2016-1-GA06 [top](#)

<http://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

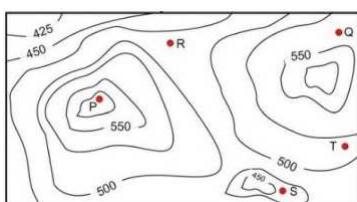
[gate2016-1](#) [numerical-ability](#) [data-interpretation](#) [easy](#)

Answer

### 8.15.15 Data Interpretation: GATE2017-1-GA-10 [top](#)

<http://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, R, T

(C) R, S, T

(D) Q, R, S

[gate2017-1](#) | [numerical-ability](#) | [data-interpretation](#) | [normal](#)

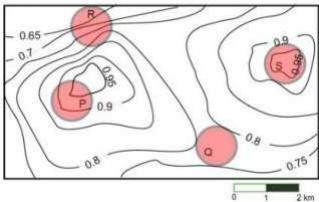
Answer

### 8.15.16 Data Interpretation: GATE2017-2-GA-10 [top](#)

<http://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

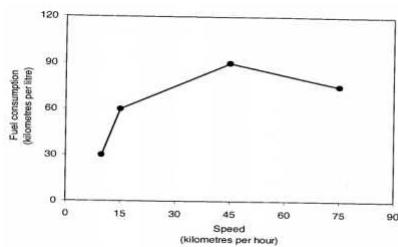
[gate2017-2](#) | [numerical-ability](#) | [data-interpretation](#)

Answer

### 8.15.17 Data Interpretation: GATE\_IN\_61 [top](#)

<http://gateoverflow.in/31386>

The fuel consumed by a motor cycle during a journey while travelling at various speeds is indicated in the graph below:



The distance covered during four laps of the journey are listed in the table below:

Lap	Distance (Kilometeres)	Average Speed (kilometeres per hour)
P	15	15
Q	74	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

[gate2011-in](#) | [numerical-ability](#) | [data-interpretation](#)

Answer

## Answers: Data Interpretation

### 8.15.1 Data Interpretation: GATE 2016-2-GA-10 [top](#)

<http://gateoverflow.in/39535>



Selected Answer

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

$$|x - 1| = -(x - 1)$$

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

$$y = x + 1$$

$$y = 2 - (-(x - 1))$$

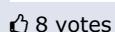
$$y = 2 - |x - 1|$$

Note : Equation of line when two coordinates

( $x_2, y_2$ ) and

( $x_1, y_1$ ) are given is

$$(y - y_1) = \frac{(y_2 - y_1)}{(x_2 - x_1)}(x - x_1)$$



-- Praveen Saini (53.5k points)

### 8.15.2 Data Interpretation: GATE-2013-AE-GA-7 [top](#)

<http://gateoverflow.in/40248>

Total Number of tourists who visited India in 2011 = 13500

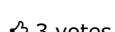
one third of total tourists =  $13500 \div 3 = 4500$

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 ans



-- sonam vyas (13.2k points)

### 8.15.3 Data Interpretation: GATE2011-GG-GA\_9 [top](#)

<http://gateoverflow.in/40210>



Selected Answer

Ans 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 \* standardized coefficient

1) contribution of outcome factor =  $Q \cdot \text{factor score} \cdot \text{standardized coefficient} = Q \cdot 6 \cdot 0.8 = 4.8$   $Q = 4.8$

( Here let  $Q$  is proportional constant and assume it is 1 .. )

similar

2) contribution of tangibles =  $5 \cdot 0.4 = 2$

3) contribution of reliability =  $6 \cdot 0.7 = 4.2$

4) contribution of responsiveness =  $6 \cdot 0.6 = 3.6$

5) contribution of empathy =  $4 \cdot 0.6 = 2.4$

6) contribution of assurance =  $6 \cdot 0.5 = 3$

so we can see here lowest contribution is " 2" and total contribution is "  $4.8+2+4.2+3.6+2.4+3= 20$ "

SO The lowest contribution among all the above factors to the overall quality of services delivered by

the company is =  $(2/20) \cdot 100 = 10\%$  ans

1 votes

-- sonam vyas (13.2k points)

#### 8.15.4 Data Interpretation: GATE2011\_62 [top](#)

<http://gateoverflow.in/2172>



Selected Answer

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)

$\propto$  Toxicity (T)

$$D = KGP/T$$

where K is contant of proportionality.

So level of danger will be maximum for S.

Given by,

$$D_S = 0.8 * \pi(10)^2 / 200$$

$$= 1.256$$

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.

16 votes

-- Gate Keeda (19.1k points)

#### 8.15.5 Data Interpretation: GATE2013-CE-8 [top](#)

<http://gateoverflow.in/40278>



Selected Answer

Ans is D.

% increase in Raw material=  $6240 - 5200 / 5200$

=20%

% increase in Power & fuel=  $9450 - 7000 / 7000$

=35%

% increase in Salary & wages=  $9000 - 12600 / 9000$

40%

% increase in Plant & machinery=  $20000 - 25000 / 20000$

25%

% increase in Advertising=  $19500 - 15000 / 15000$

30%

% increase in Research & Development=  $26400 - 22000 / 22000$

20%

2 votes

-- richa07 (949 points)

## 8.15.6 Data Interpretation: GATE2014-1-GA-9 [top](#)

<http://gateoverflow.in/777>



Selected Answer

Not having scooter from Men (40 (car owner) + 20 (nothing owns))=60

Not having scooter from Women (34 (car owner) + 50 (nothing owns))=84

percentage =  $(60+84)/300 = .48$  i.e. 48%

11 votes

-- Palash Nandi (1.5k points)

## 8.15.7 Data Interpretation: GATE2014-2-GA-9 [top](#)

<http://gateoverflow.in/1951>



Selected Answer

In 2008 M/F ratio is 2.5.

Assume 250 Males, 100 Females.

In 2009 M/F ratio is 3. Also total no of females doubled

Females =  $100 * 2 = 200$ .

So

M/F = 3

$M / 200 = 3$

$M = 200 * 3 = 600$ .

Increase in Male Students =  $600 - 250 = 350$

increase =  $(350 / 250) * 100 \% = 140\%$

4 votes

-- Akash (43.8k points)

## 8.15.8 Data Interpretation: GATE2014-3-GA-5 [top](#)

<http://gateoverflow.in/2028>



Selected Answer

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 ,  $21+17+6 = 44$ .

$$\begin{aligned} \text{Average marks obtained by the class in the examination} &= (\text{Total marks}(Q1)+\text{Total marks}(Q2)+\text{Total marks}(Q3)) / \text{Total strength of class} \\ &= ((2 \times 21) + (3 \times 15) + (2 \times 23)) / 44 \\ &= 133/44 = 3.02 \end{aligned}$$

Note : There is no negative or partial marking for the wrongly attempted and the non-attempted questions.

9 votes

-- Srinath Jayachandran (3.7k points)

### 8.15.9 Data Interpretation: GATE2014-3-GA-9 [top](#)

<http://gateoverflow.in/2033>



Selected Answer

C) 1.5 : 1

2011

$m_1$  = no of male students  
 $f_1$  = no of female students

$$m_1/f_1 = 1$$

2012

$m_2$  = no of male students  
 $f_2$  = no of female students

$$m_2/f_2 = 1.5$$

Given :  $f_1=f_2=f$

$$\begin{aligned} \text{So , } m_1/f_1 &= 1 \quad \text{and } m_2/f_2 = 1.5 \\ f &= m_1/1 \quad \text{and } f = m_2/1.5 \end{aligned}$$

Both the equations can be equated..

$$m_1/1 = m_2/1.5$$

Ratio of male students in 2012 to male students in 2011  $\Rightarrow m_2/m_1 = 1.5/1 = 1.5 : 1$

6 votes

-- Srinath Jayachandran (3.7k points)

### 8.15.10 Data Interpretation: GATE2014-ae-10 [top](#)

<http://gateoverflow.in/40310>

1st statement true since avg of july is more than that of dec

2nd statement - not true since, we have data till 95% only- notice--- 95 % as i understand---in all data of 50 years, amount of rainfall is below the value presented by graph in 95% cases . so we have 5% of years for which we dont have surely of which month had more rainfall.

3rd statement true- since difference between 5% corresponding y value and 95% corresponding y value indicates that this was range for 90% of years. in Feb this range is bigger.

4th - clearly false. refer 2

thus ans B. ....pinch me if i am wrong :P

3 votes

-- Pavan Dongare (57 points)

### 8.15.11 Data Interpretation: GATE2015-1\_GA\_6 [top](#)

<http://gateoverflow.in/8010>

Selected Answer

$$\begin{aligned}\text{Avg. mark} &= (21 * 2 + 15 * 3 + 11 * 1 + 23 * 2 + 31 * 5) / (21 + 17 + 6) \\ &= (42 + 45 + 11 + 46 + 155) / 44 \\ &= 299/44 \\ &= 6.795\end{aligned}$$

5 votes

-- Arjun Suresh (294k points)

### 8.15.12 Data Interpretation: GATE2015-1\_GA\_9 [top](#)

<http://gateoverflow.in/8013>

Selected Answer

Number of female students in Electrical =  $40 * 4/5 = 32$

Number of female students in Civil =  $32 * 30/20 = 48$  (Since proportion of male students to female students is same, the breakup chart is the same for number of female students)

Number of female students in Mechanical =  $32 * 10/20 = 16$

So, answer =  $48 - 16 = 32$

8 votes

-- Arjun Suresh (294k points)

### 8.15.13 Data Interpretation: GATE2015-3\_GA\_10 [top](#)

<http://gateoverflow.in/8389>

Selected Answer

Ans 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.

10 votes

-- Rohan Mundhey (4.2k points)

### 8.15.14 Data Interpretation: GATE2016-1-GA06 [top](#)

<http://gateoverflow.in/39616>

Selected Answer

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.**

4 votes

-- ryan sequeira (3k points)

b executive

We have to find the product  $x$  which has  $\max \left( \sum_{i=1}^4 n_{x_i} \times P_x \right)$ , where  $P_x$  is the selling price of  $x$  and  $n_{x_i}$  is the number of items of type  $x$  sold in quarter  $i$ .

13 votes

-- Pooja Palod (32.4k points)

### 8.15.15 Data Interpretation: GATE2017-1-GA-10 [top](#)

<http://gateoverflow.in/118413>



Selected Answer

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 is  $< 525$

**Hence most suitable answer will be (c) R,S,T**

These places will be definitely submerged if water level rises to 525 m

8 votes

-- Does a name matter here, Really?? (28.5k points)

### 8.15.16 Data Interpretation: GATE2017-2-GA-10 [top](#)

<http://gateoverflow.in/118424>



Selected Answer

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.

3 votes

-- Debashish Deka (51.4k points)

### 8.15.17 Data Interpretation: GATE\_IN\_61 [top](#)

<http://gateoverflow.in/31386>



Selected Answer

This is not very hard question, You just got to do table like the below (IT is 2 mark question )

Lap	Distance	Speed	Mileage	Total Petrol Used	Fuel Consumed Per KM
P	15	15	60	250ml	16.66ml
Q	75	45	90	833ml	11.11ml
R	40	75	75	533ml	13.33ml
S	10	10	30	333ml	33.33ml

So Answer = Q

You get speed, Mileage, Distance from given diagram. You can easily calculate

Total Petrol used in ltr = Distance / Mileage

Per Km => Petrol Used / Mileage.

3 votes

-- Akash (43.8k points)

8.16

## Direction Sense(3) top

### 8.16.1 Direction Sense: GATE2014-AG-GA9 top

<http://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](#) [numerical-ability](#) [direction-sense](#) [normal](#)

[Answer](#)

### 8.16.2 Direction Sense: GATE2015-2\_GA\_7 top

<http://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 4 km; P is south of O at a distance of 2 km; N is southeast of O by 1 km. What is the distance between M and P in km?

- A. 5.34
- B. 6.74
- C. 28.5
- D. 45.49

[gate2015-2](#) [numerical-ability](#) [normal](#) [direction-sense](#)

[Answer](#)

### 8.16.3 Direction Sense: GATE2017-2-GA-3 top

<http://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

[gate2017-2](#) [numerical-ability](#) [direction-sense](#) [normal](#)

[Answer](#)

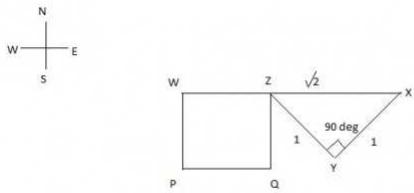
## Answers: Direction Sense

### 8.16.1 Direction Sense: GATE2014-AG-GA9 top

<http://gateoverflow.in/41673>



Selected Answer



distance between XQ is  $\sqrt{1^2 + (\sqrt{2})^2} = \sqrt{3}$

4 votes

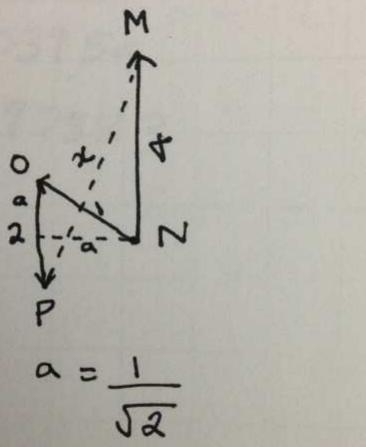
-- srestha (58.3k points)

### 8.16.2 Direction Sense: GATE2015-2\_GA\_7 [top](#)

<http://gateoverflow.in/9036>



Selected Answer



$$a = \frac{1}{\sqrt{2}}$$

$$x = \sqrt{[4 + (2-a)]^2 + a^2}$$

Solving we get  $x = 5.34$ .

7 votes

-- Arjun Suresh (294k points)

### 8.16.3 Direction Sense: GATE2017-2-GA-3 [top](#)

<http://gateoverflow.in/116417>



Ans: A. V

Given order:  
VW, XZ, ZV, WY

Considering them together:

XZ <-> ZV => XZV .....(1)

VW <-> WY => VWY.....(2)

XZV <-> VWY => XZVWY ...from (1) and (2)

So, V is the building in the middle

5 votes

-- Orochimaru (345 points)

8.17

Factors(6) top

### 8.17.1 Factors: GATE2013-62 top

<http://gateoverflow.in/1568>

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. 13/90
- B. 12/90
- C. 78/90
- D. 77/90

[gate2013](#) [numerical-ability](#) [easy](#) [probability](#) [factors](#)

Answer

### 8.17.2 Factors: GATE2014-2-GA-4 top

<http://gateoverflow.in/1941>

What is the average of all multiples of 10 from 2 to 198?

- A. 90
- B. 100
- C. 110
- D. 120

[gate2014-2](#) [numerical-ability](#) [easy](#) [numerical-computation](#) [factors](#)

Answer

### 8.17.3 Factors: ISI2012-A-1b top

<http://gateoverflow.in/47823>

How many 0's are there at the end of  $50!$ ?

[descriptive](#) [isi2012](#) [numerical-ability](#) [factors](#) [numerical-computation](#)

Answer

### 8.17.4 Factors: TIFR2010-A-20 top

<http://gateoverflow.in/18500>

How many integers from 1 to 1000 are divisible by 30 but not by 16?

- a. 29
- b. 31
- c. 32
- d. 33
- e. 25

[tifr2010](#) [numerical-ability](#) [factors](#)

Answer

### 8.17.5 Factors: TIFR2011-A-15 top

<http://gateoverflow.in/20228>

The exponent of 3 in the product  $100!$  is

- a. 27
- b. 33
- c. 44
- d. 48
- e. None of the above.

[tifr2011](#) [numerical-ability](#) [factors](#)

Answer

### 8.17.6 Factors: TIFR2013-A-12 top

<http://gateoverflow.in/25434>

Among numbers 1 to 1000 how many are divisible by 3 or 7?

- a. 333
- b. 142
- c. 475
- d. 428
- e. None of the above.

[tifr2013](#) [numerical-ability](#) [factors](#)

[Answer](#)

## Answers: Factors

### 8.17.1 Factors: GATE2013-62 [top](#)



Selected Answer

The number of 2 digit multiples of 7 = 13

not divisible by 7=(90-13)/90=[77/90](#)

10 votes

-- Bhagirathi Nayak ([13.3k points](#))

### 8.17.2 Factors: GATE2014-2-GA-4 [top](#)



Selected Answer

$a=10, l=190$

$s=n(a+l)/2=19(200)/2=1900$

average=  $1900/19=100$

ans. is 100

6 votes

-- aditi ([381 points](#))

### 8.17.3 Factors: ISI2012-A-1b [top](#)



Selected Answer

We get a 0 at end of a number if the number is divisible by 10. In terms of prime numbers this means a number being divisible by each pair of (2, 5) we get a 0 at end of it. When we consider factorial, number of 2's will always be greater than number of 5's. So, we just need to count the no. of powers of 5.

$$\begin{aligned} \text{Number of 0 at the end of } 50! \text{ will be} &= \frac{50}{5} + \frac{50}{25} + \frac{50}{125} \\ &= 10 + 2 + 0 \\ &= 12 \end{aligned}$$

4 votes

-- Muktinath Vishwakarma ([34.1k points](#))

### 8.17.4 Factors: TIFR2010-A-20 [top](#)



Selected Answer

Option A) i.e. 29 should be the answer.

Number of integers between 1 to 1000 that are divisible by 30 = floor of  $1000/30 = 33$ .

Now since LCM of 30 & 16 = 240, only the numbers that are divisible by 240 between 1 to 1000 will be divisible by both 30 & 16.

so number of integers between 1 to 1000 that are divisible by 240(i.e divisible by both 30 & 16) = floor of  $1000/240 = 4$ .

So total number of integers that are divisible by 30 but not divisible by 16 =  $33 - 4 = 29$ .

5 votes

-- Anurag Pandey (13.1k points)

### 8.17.5 Factors: TIFR2011-A-15 top

<http://gateoverflow.in/20226>



Selected Answer

Exponent of  $p$  in  $n!$ , where  $p$  is a prime number, and  $n$  is an integer greater than  $p$  is:

$$E_p(n!) = \left\lfloor \frac{n}{p} \right\rfloor + \left\lfloor \frac{n}{p^2} \right\rfloor + \left\lfloor \frac{n}{p^3} \right\rfloor + \dots + \left\lfloor \frac{n}{p^S} \right\rfloor$$

where  $S$  is the largest positive integer such that  $p^S \leq n \leq p^{S+1}$

So,

$$\begin{aligned} E_3(100!) &= \left\lfloor \frac{100}{3} \right\rfloor + \left\lfloor \frac{100}{3^2} \right\rfloor + \left\lfloor \frac{100}{3^3} \right\rfloor + \left\lfloor \frac{100}{3^4} \right\rfloor \\ &= 33 + 11 + 3 + 1 \\ &= 48 \end{aligned}$$

5 votes

-- Sonu (2.4k points)

### 8.17.6 Factors: TIFR2013-A-12 top

<http://gateoverflow.in/25434>



Selected Answer

Divisible by 3 =  $\frac{1000}{3} = 333$

Divisible by 7 =

$\frac{1000}{7} = 142$

Divisible by both =

$\frac{1000}{\text{LCM OF } 3 \& 7} =$   
 $\frac{1000}{21} = 47$

$$\begin{aligned} P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\ &= 333 + 142 - 47 = 428 \end{aligned}$$

3 votes

-- Umang Raman (15.1k points)

## 8.18

### Fractions(3) top

#### 8.18.1 Fractions: GATE2016-Session-1-GA-9 top

<http://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.  $r + q + s$

**Answer****8.18.2 Fractions: TIFR2014-A-11** [top](#)<http://gateoverflow.in/26329>

A large community practices birth control in the following peculiar fashion. Each set of parents continues having children until a son is born; then they stop. What is the ratio of boys to girls in the community if, in the absence of birth control, 51% of the babies are born male?

- a. 51 : 49
- b. 1 : 1
- c. 49 : 51
- d. 51 : 98
- e. 98 : 51

[tifr2014](#) [numerical-ability](#) [fractions](#)**Answer****8.18.3 Fractions: TIFR2017-A-1** [top](#)<http://gateoverflow.in/94931>

A suitcase weighs one kilogram plus half of its weight. How much does the suitcase weigh?

- A. 1.3333... kilograms
- B. 1.5 kilograms
- C. 1.666... kilograms
- D. 2 kilograms
- E. cannot be determined from the given data

[tifr2017](#) [numerical-ability](#) [fractions](#)**Answer****Answers: Fractions****8.18.1 Fractions: GATE2016-Session-1-GA-9** [top](#)<http://gateoverflow.in/100093>

Selected Answer

Given that,

$$\begin{aligned} q^{-a} &= \frac{1}{r}, \\ r^{-b} &= \frac{1}{s}, \\ s^{-c} &= \frac{1}{q} \end{aligned}$$

Now,  
 $q^{-a} = \frac{1}{r}$

$$\Rightarrow \frac{1}{q^a} = \frac{1}{r}$$

$$\Rightarrow q^a = r$$

Similarly,  
 $r^b = s$  and  
 $s^c = q$

In  
 $q^a = r$ , we replace  
 $q$  by  
 $s^c$  and  
 $r$  by  
 $s^{\frac{1}{b}}$

We get,  
 $s^{ca} = s^{\frac{1}{b}}$

Since, the bases are equal, we can work with the exponents.

So, we get,  
 $ac = \frac{1}{b}$   
 $\Rightarrow abc = 1$

0 votes

-- Samujjal Das (8.1k points)

## 8.18.2 Fractions: TIFR2014-A-11 [top](#)

<http://gateoverflow.in/26329>



Selected Answer

A) should be the correct choice.

In the community we know that each set of parents will have exactly 1 boy.

The number of girls might differ.

To find the ratio of boys to girls in the community, we are going to find the expected number of girls that each parent set can have.

Henceforth in this question we are going to use the word "family" to denote a "parent set".

### Calculation of expected number of girls in any family

Let  $X$  be a random variable that denotes the number of girls that any family. Each family will have exactly 1 boy.

$P(X = 0)$  will denote : Probability that a family has 0 girls and 1 boy.

$$P(X = 0) = (0.49)^0 (0.51)$$

$P(X = 3)$  will denote : Probability that a family has 3 girls and 1 boy.

$$P(X = 3) = (0.49)^3 (0.51) .$$

and so on.

In general we can say that

$P(X = i)$  will denote the probability that a family has  $i$  girls and 1 boy, and

$$P(X = i) = (0.49)^i (0.51) .$$

Now the expected number of girls in any family will be denoted by  $E[X]$ .

Here

$$E[X] = \sum_{i=0}^{\infty} i \cdot P(X = i) .$$

but

$$P(X = i) = (0.49)^i (0.51) . \text{ so we get,}$$

$$E[X] = \sum_{i=0}^{\infty} i \cdot (0.49)^i (0.51) .$$

This implies

$$E[X] = (0.51) \sum_{i=0}^{\infty} i \cdot (0.49)^i .$$

The formula for summation of series of type  $\sum_{k=0}^{\infty} k \cdot x^k$  can be found by differentiating

$\sum_{k=0}^{\infty} x^k$  with respect to  $x$ . (See the reference below).

This gives

$$\sum_{k=0}^{\infty} k \cdot x^k = \frac{x}{(x-1)^2}$$

$$\text{So } \sum_{i=0}^{\infty} i \cdot (0.49)^i = \frac{0.49}{(0.49-1)^2}$$

Hence

$$E[X] = (0.51) \cdot \frac{0.49}{(0.51)^2} = \frac{0.49}{0.51}$$

Now the ratio of boys to girls can be given by number of boys in each family/expected number of girls in each family.

$$\text{that is } \text{Ratio}(B \text{ to } G) = \frac{1}{E[X]}$$

$$\text{So } \text{Ratio}(B \text{ to } G) = \frac{\frac{1}{0.49}}{\frac{1}{0.51}} = \frac{51}{49}$$

Reference for series summation:

<http://math.stackexchange.com/questions/629589/converge-of-the-sum-sum-k-1n-k-xk>

5 votes

-- Anurag Pandey (13.1k points)

### 8.18.3 Fractions: TIFR2017-A-1 [top](#)

<http://gateoverflow.in/94831>



Selected Answer

#### D.2 Kg

Let  $x$  be weight of suitcase then

A suitcase weighs one kilogram plus half of its weight

$$1 + \frac{x}{2} = x \text{ by solving } x=2$$

4 votes

-- Prajwal Bhat (11.9k points)

### 8.19

### Functions(3) [top](#)

<http://gateoverflow.in/40228>

### 8.19.1 Functions: GATE2012-AR-7 [top](#)

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 numerical-ability functions

Answer

### 8.19.2 Functions: GATE2015-3\_GA\_5 [top](#)

<http://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

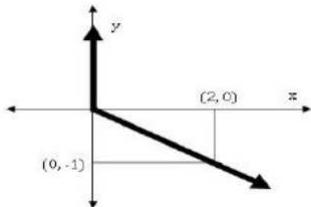
gate2015-3 | numerical-ability | normal | functions

**Answer**

### 8.19.3 Functions: GATE2015-3\_GA\_8 [top](#)

<http://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.  $x = -(y + |y|)$

gate2015-3 | numerical-ability | normal | functions

**Answer**

## Answers: Functions

### 8.19.1 Functions: GATE2012-AR-7 [top](#)

<http://gateoverflow.in/40228>



Selected Answer

$$f(x) = x - [x]$$

$f(x)$  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

7 votes

-- Abhilash Panicker (8.8k points)

### 8.19.2 Functions: GATE2015-3\_GA\_5 [top](#)

<http://gateoverflow.in/8303>



Selected Answer

$f(x)$  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

9 votes

-- Sankaranarayanan P.N (11.2k points)

### 8.19.3 Functions: GATE2015-3\_GA\_8 [top](#)

<http://gateoverflow.in/8385>



## Selected Answer

When  $y$  is  $-1$ ,  $x$  is  $2$ .

When  $y$  is positive  $x$  is  $0$ .

$$\text{So, } x = -(y - |y|)$$

12 votes

-- Arjun Suresh (294k points)

**8.20****Geometry(8) top****8.20.1 Geometry: GATE 2016-1-GA05 top**

<http://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

[gate2016-1](#) [numerical-ability](#) [geometry](#) [normal](#)

Answer

**8.20.2 Geometry: GATE2014-1-GA-10 top**

<http://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?

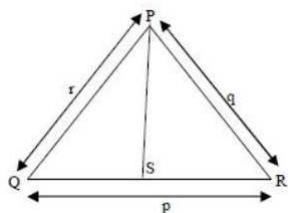
[gate2014-1](#) [numerical-ability](#) [geometry](#) [permutations-and-combinations](#) [normal](#) [numerical-answers](#)

Answer

**8.20.3 Geometry: GATE2015-2\_GA\_8 top**

<http://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.  $\frac{(q+r)}{qr}$
- B.  $\frac{qr}{q+r}$
- C.  $\sqrt{(q^2 + r^2)}$
- D.  $\frac{(q+r)^2}{qr}$

[gate2015-2](#) [numerical-ability](#) [geometry](#) [difficult](#)

Answer

**8.20.4 Geometry: GATE2016-Session-2-GA-5 top**

<http://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

[gate2016session2aptitude](#) [numerical-ability](#) [geometry](#)

[Answer](#)

### 8.20.5 Geometry: TIFR2010-A-17 [top](#)

<http://gateoverflow.in/1849>

Suppose there is a sphere with diameter **at least** 6 inches. Through this sphere we drill a hole along a diameter. The part of the sphere lost in the process of drilling the hole looks like two caps joined to a cylinder, where the cylindrical part has length 6 inches. It turns out that the volume of the remaining portion of the sphere does not depend on the diameter of the sphere. Using this fact, determine the volume of the remaining part.

1.  $24\pi$  cu. inches
2.  $36\pi$  cu. inches
3.  $27\pi$  cu. inches
4.  $32\pi$  cu. inches
5.  $35\pi$  cu. inches

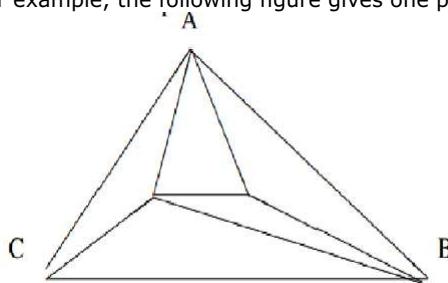
[tifr2010](#) [numerical-ability](#) [geometry](#)

[Answer](#)

### 8.20.6 Geometry: TIFR2012-A-4 [top](#)

<http://gateoverflow.in/20984>

Let  $\triangle ABC$  be a triangle with  $n$  distinct points inside. A triangulation of  $\triangle ABC$  with respect to the  $n$  points is obtained by connecting as many points as possible, such that no more line segments can be added without intersecting other line segments. In other words  $\triangle ABC$  has been partitioned into triangles with end points at the  $n$  points or at the vertices  $A, B, C$ . For example, the following figure gives one possible triangulation of  $\triangle ABC$  with two points inside it.



Although there are many different ways to triangulate  $\triangle ABC$  with the  $n$  points inside, the number of triangles depends only on  $n$ . In the above figure it is five. How many triangles are there in a triangulation of  $\triangle ABC$  with  $n$  points inside it?

- a).  $3n - 1$
- b).  $n^2 + 1$
- c).  $n + 3$
- d).  $2n + 1$
- e).  $4n - 3$

[tifr2012](#) [numerical-ability](#) [geometry](#)

[Answer](#)

### 8.20.7 Geometry: TIFR2015-A-2 [top](#)

<http://gateoverflow.in/29158>

Consider a circle with a circumference of one unit length. Let  $d < 1/6$ . Suppose that we independently throw two arcs, each of length  $d$ , randomly on this circumference so that each arc is uniformly distributed along the circle circumference. The arc attaches itself exactly to the circumference so that arc of length  $d$  exactly covers length  $d$  of the circumference. What can be said about the probability that the two arcs do not intersect each other?

- a. It equals  $(1 - d)$
- b. It equals  $(1 - 3d)$
- c. It equals  $(1 - 2d)$
- d. It equals 1
- e. It equals  $(1 - d) (1 - d)$

[tifr2015](#) [geometry](#)

[Answer](#)

### 8.20.8 Geometry: TIFR2017-A-8 [top](#)

<http://gateoverflow.in/95039>

In a tutorial on geometrical constructions, the teacher asks a student to construct a right-angled triangle ABC where the hypotenuse BC is 8 inches and the length of the perpendicular dropped from A onto the hypotenuse is  $h$  inches, and offers various choices for the value of  $h$ . For which value of  $h$  can such a triangle NOT exist?

- A. 3.90 inches
- B.  $2\sqrt{2}$  inches
- C.  $2\sqrt{3}$  inches
- D. 4.1 inches
- E. none of the above

[tifr2017](#) [numerical-ability](#) [geometry](#)

[Answer](#)

## Answers: Geometry

### 8.20.1 Geometry: GATE 2016-1-GA05 [top](#)

<http://gateoverflow.in/39610>



Selected Answer

Cube is built using 64 cubic blocks of side one unit. then it means it's a  $4 * 4 * 4$  Cube.

Surface area of each face =  $4 * 4$  sq. units

And number of faces in a cube = 6, Thus total surface area =  $6 * 4 * 4 = 96$  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 1sq. unit are visible and thus removal doesn't change surface area.

Hence, Option (D) is correct.

19 votes

-- [The\\_cake](#) (247 points)

### 8.20.2 Geometry: GATE2014-1-GA-10 [top](#)

<http://gateoverflow.in/778>



Selected Answer

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 =  $10 - 4 = 6$ .

14 votes

-- [Palash Nandi](#) (1.5k points)

### 8.20.3 Geometry: GATE2015-2\_GA\_8 [top](#)

<http://gateoverflow.in/8039>



Selected Answer

As per Angle Bisector theorem,

$$\frac{QS}{SR} = \frac{r}{q}$$

$$\frac{QS}{(p-QS)} = \frac{r}{q}$$

$$QS = pr/(q+r) \rightarrow (1)$$

We have in a triangle  $a/\sin A = b/\sin B = c/\sin C$

So, from triangle QPS,  $QS/\sin 60 = PS/\sin Q$   
 $PS = QS * \sin Q / \sin 60 \rightarrow (2)$

From triangle PQR,  $p/\sin 120 = q/\sin Q$   
 $p = q \sin 120 / \sin Q = \sin 60 / \sin Q \rightarrow (3)$

So from (1), (2) and (3),

$$PS = qr/(q+r)$$

B choice.

[http://en.wikipedia.org/wiki/Angle\\_bisector\\_theorem](http://en.wikipedia.org/wiki/Angle_bisector_theorem)

15 votes

-- Arjun Suresh (294k points)

Area of a  $\Delta = 1/2 * ac \sin B = 1/2 * bc \sin A = 1/2 ab \sin C$

so, Here area ( $\Delta PQR$ ) = area ( $\Delta PQS$ ) + area ( $\Delta PRS$ )  
 $1/2 rq \sin 120 = 1/2 PS * r \sin 60 + 1/2 PS * q \sin 60$   
 $\Rightarrow PS = rq/(r+q)$   
 so, choice (B) is correct..

19 votes

-- Himanshu Agarwal (16.2k points)

#### 8.20.4 Geometry: GATE2016-Session-2-GA-5 [top](#)

<http://gateoverflow.in/108289>



Selected Answer

perimeter is 6 so side length is  $6/5 = 1.2$  m

so area of square is  $1.2 * 1.2 = 1.44$

area of equilateral triangle =  $\sqrt{3}/4 * 1.2 * 1.2 = 0.62352$

so total area is  $0.62352 + 1.44 = 2.06352$  so answer is B

1 votes

-- Pavan Kumar Munnam (10k points)

#### 8.20.5 Geometry: TIFR2010-A-17 [top](#)

<http://gateoverflow.in/18493>



Selected Answer

This is the napkin ring problem.

The volume of the remaining part is  $\pi * h^3 / 6$

Here  $h=6$

Hence the answer is  $36\pi$

1 votes

-- admin (2.4k points)

#### 8.20.6 Geometry: TIFR2012-A-4 [top](#)

<http://gateoverflow.in/20984>

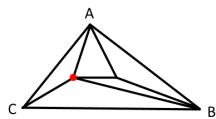


Selected Answer

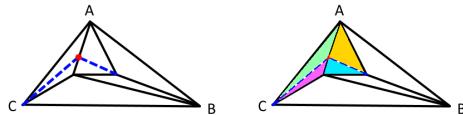
Any polygon can be split into triangles, so any  $n$ -triangulate for any  $n$  will always be composed of triangles.

Given an  $(n - 1)$  triangulate, we can add the point in the following three ways:

- I. **The point lies on a point that is already there.** In this case, the point has already been connected to all possible vertices that it can be connected to (since we started with a  $(n - 1)$  triangulate). Example:

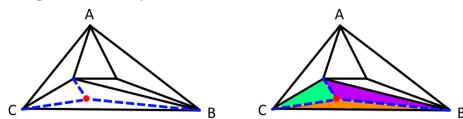


- II. **The point lies on a line that is already there, but not on a point.** In this case, since the line is the common edge of at most 2 triangles, the point can only be connected to 2 vertices (the opposite ends of the triangles). For example:



This creates 4 new triangles, but destroys the original 2 triangles. Thus, the number of triangles increase by 2. This is an optimal case.

- III. **The point lies inside of a triangle.** The new point can then be connected to exactly 3 vertices of the bounding triangle. Example:



This creates 3 new triangles, but destroys the original triangle. So, the number of triangles increase by 2. So, this is also an optimal case.

We can see that the  $n^{th}$  triangulate has exactly 2 more triangles than the  $(n - 1)^{th}$  triangulate.

**This gives us the following recurrence:**

$$T(n) = T(n - 1) + 2, T(2) = 5$$

Which solves to:

$$T(n) = 2n + 1$$

**Hence, option d is the correct answer.**

1 votes

-- Pragy Agarwal (19.5k points)

## 8.20.7 Geometry: TIFR2015-A-2 top

<http://gateoverflow.in/29158>

$(1 - 2d)$  will be the correct answer.

Two points on the circumference of any circle divides the circle in two arcs, the length of smaller arc must be less than or equal to half of the circumference, & length of the larger arc must be greater than or equal to half the circumference.

but since here given length of the arc under consideration is strictly less than  $\frac{1}{2}$ , so henceforth in this answer, whenever I will use the term "arc", I'll be referring to the smaller of those two arcs.

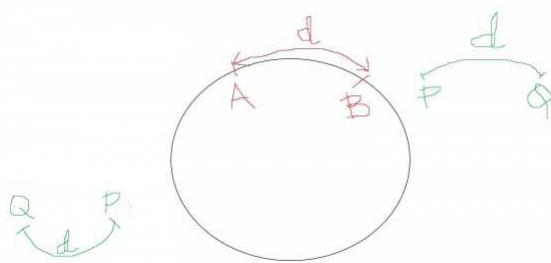
**Process of Arc drawing:** I am going to follow a specific procedure for drawing any arc of length  $d$ , which is as follows:

1) Pick any point on the circumference of the circle, this will be the starting point.

2) Move  $d$  units CLOCKWISE on the circumference of the circle & mark that point as the finishing point.

Suppose we choose our first arc  $AB$  of length  $d$ , randomly anywhere on the circumference on the circle.

Here  $A$  is the starting point &  $B$  is the end point.



After drawing the arc  $AB$ , we have to draw another arc  $PQ$  on the circle of length  $d$ , where  $P$  will be the starting point &  $Q$  will be the end point.

Now if we have to make sure that arc  $PQ$  does not intersect with arc  $AB$ , we have to keep following things in mind while choosing our starting point  $P$ :

- 1)  $P$  can not lie within arc  $AB$ , otherwise  $AB$  and  $PQ$  will intersect each other.
- 2)  $P$  can not lie anywhere within the anticlockwise distance  $d$  from the point  $A$  otherwise, end part of arc  $PQ$  will intersect with starting part of arc  $AB$ .

So we can conclude that **If**

**$P$  lies anywhere on the circumference of the circle within a distance  $d$  from  
A then the arc  
 $PQ$  &  
 $AB$  will intersect.**

So  $\text{Probability}(\text{Arc } PQ \text{ does not intersect with Arc } AB) = \frac{\text{P lies atleast } d \text{ distance away from A}}{\text{P lies anywhere in the circumference}}$

$$\Rightarrow \text{Probability}(\text{Arc } PQ \text{ does not intersect with Arc } AB) = \frac{1-2d}{1} = (1 - 2d).$$

3 votes

-- Anurag Pandey (13.1k points)

## 8.20.8 Geometry: TIFR2017-A-8 top

<http://gateoverflow.in/95039>

### D. 4.1 inches

Theorem: Length of Perpendicular drawn to the hypotenuse can't be **greater than half of length of hypotenuse**.

Ref: <https://goo.gl/CaL4sc>

2 votes

-- Prajwal Bhat (11.9k points)

8.21

## Inference(1) top

### 8.21.1 Inference: GATE2010-62 top

<http://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 numerical-ability inference normal

**Answer****Answers: Inference****8.21.1 Inference: GATE2010-62** [top](#)<http://gateoverflow.in/2370>

Correct answer is B. Though, its a hit-n-trial method.

option A: There is no such possibility, as it is given that there are no twins, so S and G must be consecutive.

option B. For some combination of ages of SGHI we can satisfy (1) condition like taking ages as, S=5 G=5 H=3 I=1, (2) and (3) are also satisfied. So, all the 3 conditions are satisfied.

option C: IGSH, so I > G and S > H (as there are no twins) and so I + S > G + H - violates condition 1.

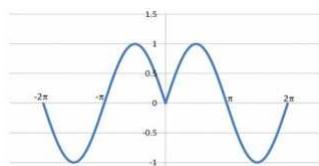
option D: IHSG, so I > H and S > G and so I + S > H + G - violates condition 1.

4 votes

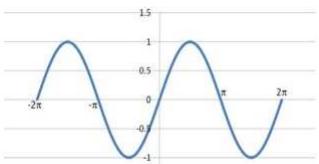
-- ujjwal saini (287 points)

**8.22****Limits(1)** [top](#)**8.22.1 Limits: GATE2016-Session-2-GA-10** [top](#)<http://gateoverflow.in/108309>

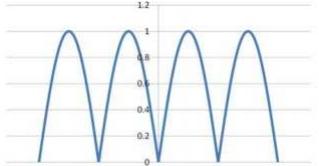
Which of the following curves represents the function  $y = \ln(|e^{|\sin(|x|)|}|)$  for  $|x| < 2\pi$ ? Here,  $x$  represents the abscissa and  $y$  represents the ordinate.



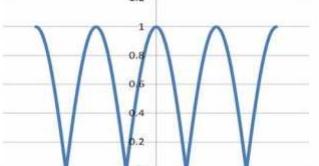
A.



B.



C.



D.

gate2016session2aptitude limits calculus numerical-ability

**Answer**

## Answers: Limits

### 8.22.1 Limits: GATE2016-Session-2-GA-10 [top](#)

<http://gateoverflow.in/108309>



Selected Answer

$$f(x) = \ln(|e^{[\sin(|x|)]}|)$$

1.  $|x| \rightarrow f(x)$  is Even  $\rightarrow$  option b not possible
2.  $m = |\sin(|x|)|$
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

2 votes

-- Debashish Deka (51.4k points)

## 8.23

## Logarithms(2)

[top](#)

<http://gateoverflow.in/40227>

### 8.23.1 Logarithms: GATE2012-AR-6 [top](#)

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](#) [numerical-ability](#) [numerical-computation](#) [logarithms](#)

Answer

### 8.23.2 Logarithms: TIFR2010-A-9 [top](#)

<http://gateoverflow.in/18385>

A table contains 287 entries. When any one of the entries is requested, it is encoded into a binary string and transmitted. The number of bits required is.

- a. 8
- b. 9
- c. 10
- d. Cannot be determined from the given information.
- e. None of the above.

[tifr2010](#) [numerical-ability](#) [theory-of-computation](#) [logarithms](#)

Answer

## Answers: Logarithms

### 8.23.1 Logarithms: GATE2012-AR-6 [top](#)

<http://gateoverflow.in/40227>



Selected Answer

$$\log m + \log n = \log mn$$

$$\text{So, } \log x + \log(x-7) = \log(x+11) + \log 2$$

$$\Rightarrow \log x(x-7) = \log 2(x+11)$$

$$\Rightarrow x(x-7) = 2(x+11)$$

$$\Rightarrow x^2 - 9x - 22 = 0$$

$$\Rightarrow (x-11)(x+2) = 0$$

$$\therefore x = 11$$

$\because x \neq -2$ , log is undefined for negative number.

4 votes

-- Praveen Saini (53.5k points)

## 8.23.2 Logarithms: TIFR2010-A-9 [top](#)



Selected Answer

D should be the correct answer.

Each Entry represents a row of table, in general.

In order to encode all the information of a row/entry, we must know what is the size of that information. But it is not mentioned in the question.

We can ADDRESS 287 entries by ceiling of  $\log_2(287) = 9$  bits.

but we CAN NOT ENCODE an entry, without knowing the size of that entry

So I don't think it is possible to tell how many bits are required to encode & transmit an entry unless any information is given about the data contained in entries.

2 votes

-- Anurag Pandey (13.1k points)

## 8.24

## Logical Reasoning(21) [top](#)

### 8.24.1 Logical Reasoning: CMI2012-A-05 [top](#)

<http://gateoverflow.in/46534>

Amma baked a cake and left it on the table to cool. Before going for her bath, she told her four children that they should not touch the cake as it was to be cut only the next day. However when she got back from her bath she found that someone had eaten a large piece of the cake. Since only her four children were present at home when this happened, she questioned them about who ate a piece of the cake. The four answers she got were:

- Lakshmi: Aruna ate the piece of cake.
- Ram: I did not eat the piece of cake.
- Aruna: Varun ate the cake.
- Varun: Aruna lied when she said I had eaten the piece of cake.

If exactly one of them was telling the truth and exactly one of them actually ate the piece of cake, who is the culprit that Amma is going to punish?

- A. Lakshmi
- B. Ram
- C. Aruna
- D. Varun

[cmi2012](#) [logical-reasoning](#)

Answer

### 8.24.2 Logical Reasoning: CMI2014-A-10 [top](#)

<http://gateoverflow.in/46978>

Avinash is taller than Abhay. Bharat is taller than Vinu and Vinay is taller than Bharat. Which of the following is a minimal set of additional information that can determine the tallest person?

- A. Vinay is taller than Avinash and Abhay is taller than Bharat.
- B. Avinash is taller than Vinay.
- C. Abhay is shorter than Vinay.
- D. None of the above.

[cmi2014](#) [logical-reasoning](#)

**Answer****8.24.3 Logical Reasoning: GATE2010-61** [top](#)<http://gateoverflow.in/2369>

If  $137 + 276 = 435$  how much is  $731 + 672$ ?

- A. 534
- B. 1403
- C. 1623
- D. 1513

[gate2010](#) [numerical-ability](#) [normal](#) [logical-reasoning](#)
**Answer****8.24.4 Logical Reasoning: GATE2011\_GG\_GA\_8** [top](#)<http://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](#)
**Answer****8.24.5 Logical Reasoning: GATE2012-CY-GA-9** [top](#)<http://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](#) [numerical-ability](#) [logical-reasoning](#)
**Answer****8.24.6 Logical Reasoning: GATE2014-AE-GA-7** [top](#)<http://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

[gate-2014-ae](#) [logical-reasoning](#) [numerical-ability](#)
**Answer****8.24.7 Logical Reasoning: GATE2014-AG-GA6** [top](#)<http://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](#) [numerical-ability](#) [logical-reasoning](#) [normal](#)

[Answer](#)

## 8.24.8 Logical Reasoning: GATE2014-EC01-GA7 [top](#)

<http://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-ec01](#) [numerical-ability](#) [logical-reasoning](#) [normal](#)

[Answer](#)

## 8.24.9 Logical Reasoning: GATE2014-EC03-GA5 [top](#)

<http://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-ec03](#) [logical-reasoning](#) [numerical-ability](#)

[Answer](#)

## 8.24.10 Logical Reasoning: GATE2015-3\_GA\_1 [top](#)

<http://gateoverflow.in/8298>

If ROAD is written as URDG, then SWAN should be written as:

- A. VXDQ
- B. VZDQ
- C. VZDP
- D. UXDQ

[gate2015-3](#) [numerical-ability](#) [easy](#) [logical-reasoning](#)

[Answer](#)

## 8.24.11 Logical Reasoning: GATE2015-3\_GA\_7 [top](#)

<http://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

[gate2015-3](#) [numerical-ability](#) [normal](#) [logical-reasoning](#)

[Answer](#)

### 8.24.12 Logical Reasoning: GATE2016-Session-7-GA-8 [top](#)

<http://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.

[gate2016session7aptitude](#) [logical-reasoning](#)[Answer](#)

### 8.24.13 Logical Reasoning: GATE2017-1-GA-3 [top](#)

<http://gateoverflow.in/118408>

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

[gate2017-1](#) [numerical-ability](#) [logical-reasoning](#)[Answer](#)

### 8.24.14 Logical Reasoning: GATE2017-1-GA-7 [top](#)

<http://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

[gate2017-1](#) [numerical-ability](#) [logical-reasoning](#)[Answer](#)

### 8.24.15 Logical Reasoning: GATE2017-2-GA-7 [top](#)

<http://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

[gate2017-2](#) [numerical-ability](#) [normal](#) [tricky](#) [logical-reasoning](#)[Answer](#)

## 8.24.16 Logical Reasoning: GATE\_2011\_MN\_63 [top](#)

<http://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

[numerical-ability](#) [gate2011-mn](#) [logical-reasoning](#)

[Answer](#)

## 8.24.17 Logical Reasoning: TIFR2013-A-10 [top](#)

<http://gateoverflow.in/25432>

Three men and three rakhsasas arrive together at a ferry crossing to find a boat with an oar, but no boatman. The boat can carry one or at the most two persons, for example, one man and one rakhsasas, and each man or rakhsasas can row. But if at any time, on any bank, (including those who maybe are in the boat as it touches the bank) rakhsasas outnumber men, the former will eat up the latter. If all have to go to the other side without any mishap, what is the minimum number of times that the boat must cross the river?

- a. 7
- b. 9
- c. 11
- d. 13
- e. 15

[tifr2013](#) [numerical-ability](#) [logical-reasoning](#)

[Answer](#)

## 8.24.18 Logical Reasoning: TIFR2013-A-11 [top](#)

<http://gateoverflow.in/25433>

Let there be a pack of 100 cards numbered 1 to 100. The  $i^{th}$  card states: "There are at most  $i - 1$  true cards in this pack". Then how many cards of the pack contain TRUE statements?

- a. 0
- b. 1
- c. 100
- d. 50
- e. None of the above.

[tifr2013](#) [logical-reasoning](#)

[Answer](#)

## 8.24.19 Logical Reasoning: TIFR2013-A-2 [top](#)

<http://gateoverflow.in/25383>

Consider the following two types of elections to determine which of two parties  $A$  and  $B$  forms the next government in the 2014 Indian elections. Assume for simplicity an Indian population of size 545545 ( $= 545 * 1001$ ). There are only two parties  $A$  and  $B$  and every citizen votes.

**TYPE C:** The country is divided into 545 constituencies and each constituency has 1001 voters. Elections are held for each constituency and a party is said to win a constituency if it receives a majority of the vote in that constituency. The party that wins the most constituencies forms the next government.

**TYPE P:** There are no constituencies in this model. Elections are held throughout the country and the party that wins the most votes (among 545545 voters) forms the government.

Which of the following is true?

- a. If the party forms the govt. by election TYPE C winning at least two-third of the constituencies, then it will also form the govt. by election TYPE P.
- b. If a party forms govt. by election TYPE C, then it will also form the govt. by election TYPE P.
- c. If a party forms govt. by election TYPE P, then it will also form the govt. by election TYPE C.
- d. All of the above
- e. None of the above.

[tifr2013](#) [logical-reasoning](#)

[Answer](#)

## 8.24.20 Logical Reasoning: TIFR2016-A-1 [top](#)

<http://gateoverflow.in/96822>

Suppose the following statements about three persons in a room are true.

*Chandni, Sooraj and Tara are in a room. Nobody else is in the room. Chandni is looking at Sooraj. Sooraj is looking at Tara. Chandni is married. Tara is not married. A married person in the room is looking at an unmarried person.*

Which of the following is necessarily true?

- A. Sooraj is married
- B. Sooraj is unmarried
- C. The situation described is impossible
- D. There is insufficient information to conclude if Sooraj is married or unmarried
- E. None of the above

[tifr2016](#) [logical-reasoning](#)

[Answer](#)

## 8.24.21 Logical Reasoning: TIFR2017-A-14 [top](#)

<http://gateoverflow.in/95657>

Consider the following game with two players, Aditi and Bharat. There are  $n$  tokens in a bag. The two players know  $n$ , and take turns removing tokens from the bag. In each turn, a player can either remove one token or two tokens. The player that removes the last token from the bag loses. Assume that Aditi always goes first. Further, we say that a player has a winning strategy if she or he can win the game, no matter what other player does. Which of the following statements is TRUE?

- A. For  $n = 3$ , Bharath has a winning strategy. For  $n = 4$ , Aditi has a winning strategy.
- B. For  $n = 7$ , Bharath has a winning strategy. For  $n = 8$ , Aditi has a winning strategy.
- C. For both  $n = 3$  and  $n = 4$ , Aditi has a winning strategy.
- D. For both  $n = 7$  and  $n = 8$ , Aditi has a winning strategy.
- E. Bharat never has a winning strategy.

[tifr2017](#) [numerical-ability](#) [logical-reasoning](#)

[Answer](#)

## Answers: Logical Reasoning

### 8.24.1 Logical Reasoning: CMI2012-A-05 [top](#)

<http://gateoverflow.in/46534>



Selected Answer

All telling lie except ,Varun telling truth

Ram ate the piece of cake

Ans B)

1 votes

-- srestha (58.3k points)

### 8.24.2 Logical Reasoning: CMI2014-A-10 [top](#)

<http://gateoverflow.in/46978>



Selected Answer

It has been given that

**1) Avinash > Abhay**

**2) Vinay > Bhart > Vinu**

Now come to Options

1) Vinay is taller than Avinash and Abhay is taller than Bharat.

**=> If we add Vinay is taller than Avinash, then it will complete our purpose of getting tallest person, i.e. Vinay is tallest.**

2) Avinash is taller than Vinay.

**==> It also complete our purpose. Because we can see then Avinash is tallest now.**

3) Abhay is shorter than Vinay.

**==> This will not help you to get the tallest person, Because you can not understand that which one is tallest either Vinay or Avinash.**

4) None of these.

**==> this can not be the answer, because option (1) and (2) already helps us to get the result.**

**Final Answer: Since in the question asked the minimal set of information. Hence option B will be the answer.**

4 votes

-- Muktinath Vishwakarma (34.1k points)

### 8.24.3 Logical Reasoning: GATE2010-61 [top](#)

<http://gateoverflow.in/2369>



Selected Answer

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.

14 votes

-- shreya ghosh (3.4k points)

### 8.24.4 Logical Reasoning: GATE2011\_GG\_GA\_8 [top](#)

<http://gateoverflow.in/40209>



Selected Answer

R. S. T

11. 7. 6

(ORIGINAL SITUATION..... GOT AFTER SOME HIT AND TRIAL)

4. 14. 6

4. 8. 12

8. 8. 8.....R HAVE 11 ORIGINALLY

2 votes

-- Deepesh Kataria (1.8k points)

### 8.24.5 Logical Reasoning: GATE2012-CY-GA-9 [top](#)

<http://gateoverflow.in/40240>



Selected Answer

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

7 votes

-- Piyush Kapoor (917 points)

### 8.24.6 Logical Reasoning: GATE2014-AE-GA-7 [top](#)

<http://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).

1 votes

-- Sumit Kumar Patel (503 points)

### 8.24.7 Logical Reasoning: GATE2014-AG-GA6 [top](#)

<http://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.**

3 votes

-- richa07 (949 points)

### 8.24.8 Logical Reasoning: GATE2014-EC01-GA7 [top](#)

<http://gateoverflow.in/41496>



I think its Option B

2 votes

-- saif ahmed (3.8k points)

### 8.24.9 Logical Reasoning: GATE2014-EC03-GA5 [top](#)

<http://gateoverflow.in/41144>



Answer D)

Here clearly P < M

as P = A

and A < R and R < M => A < M => P < M

1 votes

-- Abhilash Panicker (8.8k points)

### 8.24.10 Logical Reasoning: GATE2015-3\_GA\_1 [top](#)

<http://gateoverflow.in/8298>



option B.. VZDQ

(every letter is replaced by third letter in alphabetical order)

12 votes

-- Anoop Sonkar (4.8k points)

## 8.24.11 Logical Reasoning: GATE2015-3\_GA\_7 [top](#)



Selected Answer

"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.

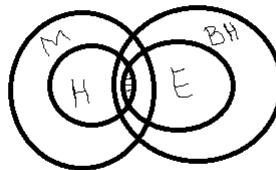
12 votes

-- Arjun Suresh (294k points)

## 8.24.12 Logical Reasoning: GATE2016-Session-7-GA-8 [top](#)



Selected Answer



We can draw 2 venn diagrams, one for Mammals another for Build Houses.

Mammals consists of Humans - as fact 1 said Humans are mammals means all humans are mammals.

fact 2 Some humans are engineers , see the intersect part, it represents this statement.

fact 3 says Engineers build houses means all engineers build houses . so Build Houses consists of Engineers.

Now From this diagram we try to get the meaning of given sentences

1. All mammals build houses.- clearly False , diagram says some mammals build houses.
2. Engineers are mammals - False again, diagram says not all engineers are mammals rather some engineers are mammals.
3. Some humans are not engineers - diagram says this is Correct . some part of H is not belongs to circle E .

so only statement III is correct , which is option B .

1 votes

-- Bikram (44.7k points)

### 8.24.13 Logical Reasoning: GATE2017-1-GA-3 [top](#)

<http://gateoverflow.in/118406>



Selected Answer

Arup and rahul will sit opposite to each other.

Murali and srinivas will sit opposite to each other in the square table.

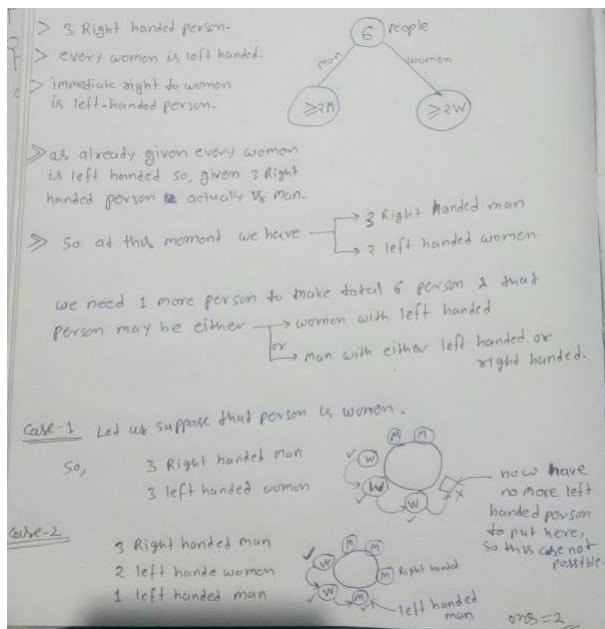
Ans: C

1 upvote

-- Arnabi (6.4k points)

### 8.24.14 Logical Reasoning: GATE2017-1-GA-7 [top](#)

<http://gateoverflow.in/118410>



case-3

3 right handed person (men)

2 left handed women

1 right handed man

this case is also not possible, as we have 2 left handed person (for this place we don't have any left handed person) so this arrangement is not valid.

1 upvote

-- 2018 (5.2k points)

### 8.24.15 Logical Reasoning: GATE2017-2-GA-7 [top](#)

<http://gateoverflow.in/118421>



Selected Answer

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.

7 votes

-- Dhruv Patel (1.4k points)

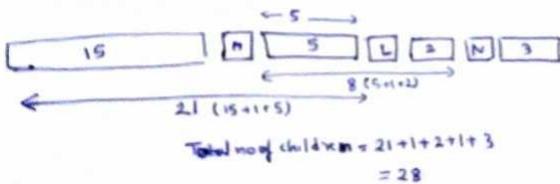
## 8.24.16 Logical Reasoning: GATE\_2011\_MN\_63 [top](#)

<http://gateoverflow.in/31543>



Selected Answer

L, M and N are waiting in queue that are meant for children, then L, M and N are also count in childs



7 votes

-- Praveen Saini (53.5k points)

## 8.24.17 Logical Reasoning: TIFR2013-A-10 [top](#)

<http://gateoverflow.in/25432>



Selected Answer

Please correct me if I am wrong.

I am denoting M as men and R as rakshas.

Step 1 : Two rakshas row the boat from one side to another. So , one rakshas will reach other side. and one rakshas will have to row back . So , first side now (3M + 2R) and second side (1R).

So , boat crosses 2 times.

Step 2 : 2 R row to other side. and leaves one R there and comes back to first side. So , now first side has (3M + 1R) and second side has (2R).

So , boat crosses 2 times.

Step 3: 2 M row to other side and gets down at other side. So , first side has (1R + 1M) and second side has (2M+2R). So , boat crosses 1 time.

Step 4: Now , 1M and 1R will have to row back from second side , and they will take 1M + 1M to other side. So , in the first side , we have now 2R.

So , boat crosses 2 times.

Step 5: Last step , 2R will row to other side.

So , boat crosses 1 time.

Total time boat crosses = 8 +1 = 9 times

1 votes

-- worst\_engineer (5.6k points)

## 8.24.18 Logical Reasoning: TIFR2013-A-11 [top](#)

<http://gateoverflow.in/25433>



Selected Answer

Option D should be the correct one.

that is 50 cards of the pack contain true statements.

Why?

Because if the statement written on card number  $x$  is true then all the statements written in card numbers  $x + 1$  to 100 must be true.

For Example if Card number 3 is true, then according to the statement written in this card, "There are at most  $3 - 1 (= 2)$  true cards in the pack".

This implies number of true cards must be less than 3.

Now the statement on card number 4 will imply that the number of true cards must be less than 4.

similarly the statement on card number 100 will imply that the number of true cards must be less than 100.

So if statement written on card number 3 is true then all the statements written on the card numbers 4 to 100 will vacuously be true.

But now the the number of true cards will be 98 (from card number 3 to 100) hence the statement on the card number 3 must be false.

Clearly this is inconsistent so card number 3 can not be a true card.

Conclusion:

If card number  $x$  is a true card then:

1. There are at least  $(100 - x) + 1$  true cards. and
2. Total Number of true cards must be less then or equal to  $x - 1$

(where  $x$  belongs to Integers between 1 and 100).

For any value of  $x \leq 50$  both of the above statements can not be true simultaneously, so none of the cards from 1 to 50 is a true card.

For any value of  $x \geq 51$  both of the above statements can be true at the same time, so all of the cards from 51 to 100 must be true cards & the total number of true cards will be 50.

It can be observed that comparing one of the boundary cases of each of the above two statements will give us of the boundary cases of our answer.

that is, on solving:

$$(100 - x) + 1 = x - 1$$

we get  $x = 51$  which indeed is our smallest true card.

8 votes

-- Anurag Pandey (13.1k points)

## 8.24.19 Logical Reasoning: TIFR2013-A-2 [top](#)

<http://gateoverflow.in/2538>



Selected Answer

**Minimum condition for Type C winning : if any wins 273 constituencies out of 545 and with vote 501 out of 1001 for each.**

**Minimum condition for Type P winning : if any wins 272773 votes out of 545545**

**option A : Type C : let A wins 2/3 of constituencies i.e 364 wins by 1 vote and 181 loss by all vote  
 $364*501 + 181*0 = 182364$**

**Type P : If A wins it should have more than half of vote i.e. 272773  
so its false since A got only 182364 votes**

**Option B : similar to option A**

**Option C: Type P: Let A wins by 272773 votes**

**Type C: If A wins 272 constituencies with 1001 votes and loss 272 with 1001 and 1 with 1000 votes then**  
 $272*1001+272*0+1*1= 272773$   
**so it loose the election since A won only 272 constituencies out of 545**  
**so i think option e**

3 votes

-- Umang Raman (15.1k points)

## 8.24.20 Logical Reasoning: TIFR2016-A-1 [top](#)



Selected Answer

*Chandni, Sooraj and Tara*

*Chandni -----> Sooraj -----> Tara  
 (married)               (married)               (unmarried)*

**"A married person in the room is looking at an unmarried person"** ---this is satisfied when sooraj is made **married**

*Chandni -----> Sooraj -----> Tara  
 (married)               (unmarried)               (unmarried)*

**"A married person in the room is looking at an unmarried person"** ---this is satisfied when sooraj is made **unmarried**

so as both are possible we cannot finalize it to A or B ---we need extra information **so answer should be D**

4 votes

-- Pavan Kumar Munnam (10k points)

## 8.24.21 Logical Reasoning: TIFR2017-A-14 [top](#)



Selected Answer

Point to be noted-

1. Always Aditi starts the game.
2. A player loses the game if he/she has to remove the last item.
3. A player always removes 1 or 2 items with a winning strategy.

Method 1: shortcut- time complexity- O(1)

n = total no of tokens.

If  $n \bmod 3 - 1 = 0$ , then Bharat has a winning strategy (1 is the last token being taken by the loser)

if  $n \bmod 3 - 1 = 1$  or 2, then Aditi has a winning strategy.

The trick here is with 4 tokens whoever plays next is not having a winning strategy. So, the strategy must be to ensure that the opponent always takes his turn with  $3n + 1$  tokens. This is possible because if the opponent takes 1, I take 2 and vice versa.

Let's check each option-

[Here my strategy of solving this would be just contradicting the each option by considering all the possibilities].

- A. **For n = 3.** // Here I am trying to make Bharat win, Let's see if he can win or not.

Aditi - removes 2 item ,  $n = 3-2 = 1$

Now only 1 item remains, so Bharat is forced to remove the last item and loses the game. **Hence for n=3, Aditi has a winning strategy.**

**The first part of A - False.**

For n = 4. // Here I am trying to make Aditi win, Let's see if she can win or not.

**Case -1:**

Aditi - removes 1 item , n = 4-1 = 3    Aditi - removes 2 item , n = 4-2 = 1  
 Bharat- removes 2,item , n = 3 -2 =1    Bharat- removes 1,item , n = 2 -1 =1

Now only 1 item remains in both the case, so Aditi is forced to remove the last item and loses the game. **Hence for n=4, Bharat has a winning strategy.**

**The 2nd part of A - True.****Hence, A- False.**

B. For n = 7. // Here I am trying to make Aditi win, Let's see if she can win or not.

**Case 1:**

Aditi - removes 1 item , n = 7- 1 = 6    Aditi - removes 2 item , n = 7- 2 = 5  
 Bharat- removes 2 item , n = 6 -2 = 4.    Bharat- removes 1 item , n = 5 -1 = 4.

Now remaining tokens in both the case, n = 4.

**case 1:****case 2:**

Aditi - removes 1 item ,n=4-1 = 3    Aditi - removes 2 item , n = 4-2= 2.

Bharat- removes 2,item ,n=3-2=**1**,    Bharat- removes 1,item , n = 2-1 =**1**.

Now in both the case, only 1 item remains, so Aditi is forced to remove the last item and loses the game. **Hence for n=7, Bharat has a winning strategy. Aditi could not win the game even taking all possibility of Aditi's turn.**

**For n = 8.** // Here I am trying to make Aditi win taking all possibility of Bharat's turn, Let's see if she can win or not.

Aditi - removes 1 item , remaining item n = 8 - 1 = 7

**Case 1:****case 2:**

Bharat- removes 1 item , n = 7 - 1 = 6.    Bharat- removes 2 item ,n = 7 - 2 = 5.

Aditi - removes 2 item , n = 6 - 2 = 4 ,    Aditi - removes 1 item , n = 5-1 = 4.

**Now In both cases, remaining items = 4.**

**case 1****case 2**

Bharat- removes 1,item , n = 4-1 = **3**    Bharat- removes 2,item , n = 4-2 = 2  
 Aditi - removes 2 item , n = 3-2 = 1 ,    Aditi - removes 1 item , n = 2-1 = 1.

Now in both the case, only 1 item is remaining so Bharat is forced to remove the last item and loses the game. **Hence for n=8, Aditi has a winning strategy.**

**B- True.**

C. For both n=3 and n=4, Aditi has a winning strategy.

See explanation for A. where Bharat has a winning strategy for both n=3 and n=4.

**Hence, False.**

D. For both n=7 and n=8, Aditi has a winning strategy.

See explanation for B. where Bharat has a winning strategy for both n=7.

**Hence, False.**

E. Bharat never has a winning strategy.

See explanation for B where Aditi has a winning strategy for both n=8.

**Hence, False.****Ans - B.**

7 votes

-- Dhananjay Kumar Sharma (25.2k points)

8.25

Maxima Minima(3) [top](#)8.25.1 Maxima Minima: GATE2012\_62 [top](#)<http://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](#) [numerical-ability](#) [normal](#) [maxima-minima](#)

Answer

8.25.2 Maxima Minima: GATE2013-CE-6 [top](#)<http://gateoverflow.in/40274>

Q.61 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) (4/3, 10/3)
- (B) (8/3, 20/3)
- (C) (8/3, 10/3)
- (D) (4/3, 20/3)

[gate2013-ce](#) [numerical-ability](#) [maxima-minima](#)

Answer

8.25.3 Maxima Minima: GATE2017-2-GA-9 [top](#)<http://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

[gate2017-2](#) [numerical-ability](#) [normal](#) [maxima-minima](#) [calculus](#)

Answer

## Answers: Maxima Minima

8.25.1 Maxima Minima: GATE2012\_62 [top](#)<http://gateoverflow.in/2210>

Selected Answer

B. 10

$$y = 2x - 0.1x^2$$

$$\frac{dy}{dx} = 2 - 2 \cdot 0.1x \Rightarrow \frac{dy}{dx} = 0 \Rightarrow x = 10$$

$$\text{so } y = 20 - 10 = 10$$

6 votes

-- shreya ghosh (3.4k points)

## 8.25.2 Maxima Minima: GATE2013-CE-6 [top](#)

<http://gateoverflow.in/40274>



Selected Answer

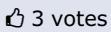
$$f(x,y) = 3x + 6y = 3(x+2y)$$

maximum value of  $x+2y$  is given by equation 2 which is 8 ( $x+2y \leq 8$ )

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)



-- Vivek Srivastava (667 points)

## 8.25.3 Maxima Minima: GATE2017-2-GA-9 [top](#)

<http://gateoverflow.in/118423>



Selected Answer

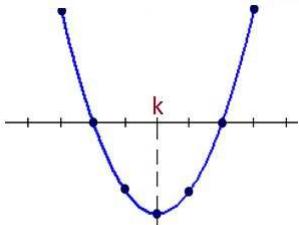
let  $f(x) = e^x + 0.5x^2 - 2$ , and we want to see if  $f(x) = 0$  has any solution in  $[-5,5]$

$f'(x) = e^x + x$  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 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

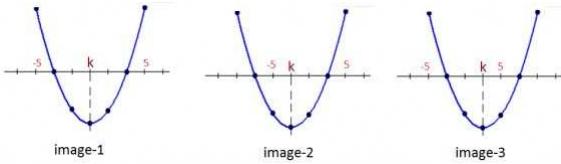


Plot of  $f(x)$

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  $[-5,5]$

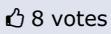


(in all three images  $k \in [-5,5]$ )

U wanna know which image is correct ? :O

just check sign of  $f(-5)$  and  $f(5)$ , u will get to know "Image-1" is correct one.

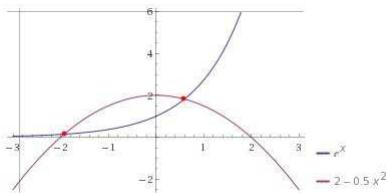
Hence, there are 2 solutions in between of  $[-5,5]$ . C is correct answer.



-- Sachin Mittal (7.1k 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.

14 votes

-- Manish Joshi (25.2k points)

## 8.26

### Mean(1) top

#### 8.26.1 Mean: GATE-2012-AE-5 top

<http://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 mean numerical-ability

Answer

### Answers: Mean

#### 8.26.1 Mean: GATE-2012-AE-5 top

<http://gateoverflow.in/40216>



Selected Answer

It is 50 obviously.

Total sum of 5 natural numbers =  $12 \times 5 = 60$

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 50 option C

2 votes

-- Sreyas S (1.7k points)

## 8.27

### Modular Arithmetic(1) top

#### 8.27.1 Modular Arithmetic: GATE2012-CY-GA-1 top

<http://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](#)
[numerical-ability](#)
[modular-arithmetic](#)
[Answer](#)

## Answers: Modular Arithmetic

### 8.27.1 Modular Arithmetic: GATE2012-CY-GA-1 [top](#)



Selected Answer

$$1259 + 2062 = 3321$$

So, Answer is  $3.52 * 7.85 = 27.64$  (Ans)

**Option (d) is correct.**

Up 2 votes

-- **Himanshu Agarwal** (16.2k points)

8.28

## No Of Digits(1) [top](#)

### 8.28.1 No Of Digits: GATE2017-2-GA-8 [top](#)

<http://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

[gate2017-2](#)
[numerical-ability](#)
[numerical-computation](#)
[no-of-digits](#)
[Answer](#)

## Answers: No Of Digits

### 8.28.1 No Of Digits: GATE2017-2-GA-8 [top](#)

<http://gateoverflow.in/118422>



Selected Answer

$$X = 4777\ldots \text{ (7 29 times)}$$

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... 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.

Up 17 votes

-- **Manish Joshi** (25.2k points)

8.29

## Number Representation(2) [top](#)

### 8.29.1 Number Representation: GATE2014-3-GA-10 [top](#)

<http://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

[gate2014-3](#) [numerical-ability](#) [number-representation](#) [normal](#) [digital-logic](#)
[Answer](#)

## 8.29.2 Number Representation: TIFR2012-A-11 [top](#)

<http://gateoverflow.in/25015>

Let  $N$  be the sum of all numbers from 1 to 1023 except the five prime numbers: 2, 3, 11, 17, 31. Suppose all numbers are represented using two bytes (sixteen bits). What is the value of the least significant byte (the least significant eight bits) of  $N$ ?

- a. 00000000
- b. 10101110
- c. 01000000
- d. 10000000
- e. 11000000

[tifr2012](#) [numerical-ability](#) [number-representation](#)
[Answer](#)

## Answers: Number Representation

### 8.29.1 Number Representation: GATE2014-3-GA-10 [top](#)

<http://gateoverflow.in/2034>

Selected Answer

C)

The given numbers are in octal representation. Digits range from 0 to 7.  
 $Y = 7526 - 4364$

7526

-4364

---

 3142
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.  $(7-4) = 3$

12 votes

-- Srinath Jayachandran (3.7k points)

### 8.29.2 Number Representation: TIFR2012-A-11 [top](#)

<http://gateoverflow.in/25015>

Selected Answer

This is another way of saying , what will be the remainder when  $N$  is divided by  $2^8=256$ ?

Here  $N = 1023*1024/2 - (2+3+11+17+31)$

$$= 1023*512 - 64$$

$$= 1022*512 + (512-64)$$

$$= 1022*512 + 448$$

Now  $448\%256 = 192 = 11000000$

So e. is correct.

6 votes

-- sudipta roy (379 points)

## 8.30

## Number Series(11) top

### 8.30.1 Number Series: GATE2013-58 top

<http://gateoverflow.in/1562>

What will be the maximum sum of  $44, 42, 40, \dots$  ?

- A. 502
- B. 504
- C. 506
- D. 500

[gate2013](#) [numerical-ability](#) [easy](#) [number-series](#)

Answer

### 8.30.2 Number Series: GATE2013-61 top

<http://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](#) [numerical-ability](#) [normal](#) [number-series](#)

Answer

### 8.30.3 Number Series: GATE2013-ee-10 top

<http://gateoverflow.in/4029>

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](#) [numerical-ability](#) [number-series](#)

Answer

### 8.30.4 Number Series: GATE2014-2-GA-5 top

<http://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

[gate2014-2](#) [numerical-ability](#) [easy](#) [number-series](#)

[Answer](#)

### 8.30.5 Number Series: GATE2014-3-GA-4 [top](#)

<http://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

[gate2014-3](#) [numerical-ability](#) [number-series](#) [easy](#)[Answer](#)

### 8.30.6 Number Series: GATE2014-EC01-GA5 [top](#)

<http://gateoverflow.in/41494>

What is the next number in the series?

12    35    81    173    357 \_\_\_\_\_.

[gate2014-ec01](#) [number-series](#) [numerical-ability](#) [numerical-answers](#)[Answer](#)

### 8.30.7 Number Series: GATE2014-EC02-GA5 [top](#)

<http://gateoverflow.in/41512>

Fill in the missing number in the series.

2    3    6    15    \_\_\_\_ 157.5    630

[gate2014-ec02](#) [number-series](#) [numerical-ability](#) [numerical-answers](#)[Answer](#)

### 8.30.8 Number Series: GATE2014-EC03-GA4 [top](#)

<http://gateoverflow.in/41143>

The next term in the series 81, 54, 36, 24, ... is\_\_\_\_\_.

[gate2014-ec03](#) [number-series](#) [numerical-ability](#)[Answer](#)

### 8.30.9 Number Series: GATE2014-EC03-GA6 [top](#)

<http://gateoverflow.in/41145>

Find the next term in the sequence: 7G, 11K, 13M, \_\_\_\_\_.

- A. 15Q
- B. 17Q
- C. 15P
- D. 17P

[gate2014-ec03](#) [number-series](#) [logical-reasoning](#) [numerical-ability](#)[Answer](#)

### 8.30.10 Number Series: TIFR2011-A-8 [top](#)

<http://gateoverflow.in/20014>

The sum of the first  $n$  terms of the series 1, 11, 111, 1111, ..., is.

- a.  $\frac{1}{81}(10^{n+1} - 9n - 10)$
- b.  $\frac{1}{81}(10^n - 9n)$
- c.  $\frac{1}{9}(10^{n+1} - 1)$
- d.  $\frac{1}{9}(10^{n+1} - n10^n)$
- e. None of the above.

[tifr2011](#) [numerical-ability](#) [number-series](#)

**Answer****8.30.11 Number Series: TIFR2013-A-8** [top](#)<http://gateoverflow.in/25430>

Find the sum of the infinite series

$$\frac{1}{1 \times 3 \times 5} + \frac{1}{3 \times 5 \times 7} + \frac{1}{5 \times 7 \times 9} + \frac{1}{7 \times 9 \times 11} + \dots$$

- a.  $\infty$
- b.  $\frac{1}{2}$
- c.  $\frac{1}{6}$
- d.  $\frac{1}{12}$
- e.  $\frac{1}{14}$

[tifr2013](#) | [numerical-ability](#) | [number-series](#)

**Answer****Answers: Number Series****8.30.1 Number Series: GATE2013-58** [top](#)<http://gateoverflow.in/1562>

Selected Answer

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:  $S_n = n/2[a+a_n] = 23/2[44+0] = 506$

Option C is correct!

5 votes

-- Monanshi Jain (8.4k points)

**8.30.2 Number Series: GATE2013-61** [top](#)<http://gateoverflow.in/1565>

Selected Answer

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  $\sqrt{81}-\sqrt{1}=8$

$$\frac{1}{\sqrt{1+\sqrt{2}}} + \frac{1}{\sqrt{2+\sqrt{3}}} + \frac{1}{\sqrt{3+\sqrt{4}}} + \dots + \frac{1}{\sqrt{80+\sqrt{81}}}$$

$$= \frac{1}{\sqrt{1+\sqrt{2}}} \times \left( \frac{\sqrt{1}-\sqrt{2}}{\sqrt{1}-\sqrt{2}} \right) + \frac{1}{\sqrt{2+\sqrt{3}}} \times \left( \frac{\sqrt{2}-\sqrt{3}}{\sqrt{2}-\sqrt{3}} \right) + \frac{1}{\sqrt{3+\sqrt{4}}} \times \left( \frac{\sqrt{3}-\sqrt{4}}{\sqrt{3}-\sqrt{4}} \right) + \dots + \frac{1}{\sqrt{80+\sqrt{81}}} \times \left( \frac{\sqrt{80}-\sqrt{81}}{\sqrt{80}-\sqrt{81}} \right)$$

$$= \frac{\sqrt{1}-\sqrt{2}}{(\sqrt{1})^2-(\sqrt{2})^2} + \frac{\sqrt{2}-\sqrt{3}}{(\sqrt{2})^2-(\sqrt{3})^2} + \frac{\sqrt{3}-\sqrt{4}}{(\sqrt{3})^2-(\sqrt{4})^2} + \dots + \frac{\sqrt{80}-\sqrt{81}}{(\sqrt{80})^2-(\sqrt{81})^2}$$

$$\begin{aligned}
 &= -(\sqrt{1} - \sqrt{2} + \sqrt{2} - \sqrt{3} + \sqrt{3} - \sqrt{4} + \dots + \sqrt{80} - \sqrt{81}) \\
 &= \sqrt{81} - \sqrt{1} \\
 &= 8
 \end{aligned}$$

16 votes

-- Bhagirathi Nayak (13.3k points)

### 8.30.3 Number Series: GATE2013-ee-10 [top](#)

<http://gateoverflow.in/4029>



Selected Answer

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.

$$\frac{9(9^2-1)}{8} + 2^2 = 94$$

Same procedure can used to find the sum of first three numbers in the sequence

The answer is option D

3 votes

-- ibia (3.5k points)

### 8.30.4 Number Series: GATE2014-2-GA-5 [top](#)

<http://gateoverflow.in/1942>



Selected Answer

$$\begin{aligned}
 x &= \sqrt{12+x} \\
 \implies x^2 &= 12+x \\
 \implies x^2 - x - 12 &= 0 \\
 \implies (x-4)(x+3) &= 0 \\
 \implies x &= 4 \text{ or } x = -3
 \end{aligned}$$

11 votes

-- Arjun Suresh (294k points)

### 8.30.5 Number Series: GATE2014-3-GA-4 [top](#)

<http://gateoverflow.in/2027>



Selected Answer

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.

7 votes

-- Srinath Jayachandran (3.7k points)

### 8.30.6 Number Series: GATE2014-EC01-GA5 [top](#)

<http://gateoverflow.in/4149>



Selected Answer

one way is this to getting answer as 725 bcz their diffrence is each time double

and other way is  $12 \times 2 + 11 = 35$

$$35 \times 2 + 11 = 81$$

$$81 \times 2 + 11 = 173 // \text{so mul by 2 and add 11}$$

and lastly we do  $357 \times 2 + 11 = 725$

1 votes

-- rajan (4k points)

### 8.30.7 Number Series: GATE2014-EC02-GA5 [top](#)



Selected Answer

$$2 \times 1.5 = 3$$

$$3 \times 2 = 6$$

$$6 \times 2.5 = 15$$

$$15 \times 3 = 45 \text{ is answer}$$

$45 \times 3.5 = 157.5$  means each time increase multiplication factor by 0.5

5 votes

-- rajan (4k points)

### 8.30.8 Number Series: GATE2014-EC03-GA4 [top](#)



Selected Answer

We get next term in sequence by  $(X/3) \times 2$

$$81/3 = 27 \times 2 = 54$$

$$54/3 = 18 \times 2 = 36$$

$$36/3 = 12 \times 2 = 24$$

$$24/3 = 8 \times 2 = 16$$

**Answer) 16**

3 votes

-- Abhilash Panicker (8.8k points)

### 8.30.9 Number Series: GATE2014-EC03-GA6 [top](#)



Selected Answer

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**

3 votes

-- Abhilash Panicker (8.8k points)

### 8.30.10 Number Series: TIFR2011-A-8 [top](#)



Selected Answer

$$\begin{aligned}
 S &= (1 + 11 + 111 + \dots n \text{ terms}) \\
 &= \frac{1}{9} \times (9 + 99 + 999 + \dots n \text{ terms}) \\
 &= \frac{1}{9} \quad \left( \begin{array}{l} ((10 - 1) + (100 - 1) + (1000 - 1) + \dots + (10^n - 1)) \\ = \frac{1}{9} \left( \frac{10^{n+1} - 10}{10 - 1} - n \right) \\ = \frac{1}{9} \left( \frac{10^{n+1} - 10 - 9n}{9} \right) \\ = \frac{10^{n+1} - 9n - 10}{81} \end{array} \right)
 \end{aligned}$$

So, the correct answer is option A.

5 votes

-- Pooja Palod (32.4k points)

### 8.30.11 Number Series: TIFR2013-A-8 top

<http://gateoverflow.in/25430>



Selected Answer

We note that:

$$\begin{aligned}
 \frac{1}{1 \times 3 \times 5} &= \frac{1}{4} \cdot \left( \frac{5 - 1}{1 \times 3 \times 5} \right) \\
 &= \frac{1}{4} \cdot \left( \frac{1}{1 \times 3} - \frac{1}{3 \times 5} \right)
 \end{aligned}$$

Now, we can rewrite the original series as a Telescoping series and simplify as follows:

$$\begin{aligned}
 &\left( \frac{1}{1 \times 3 \times 5} + \frac{1}{3 \times 5 \times 7} + \frac{1}{5 \times 7 \times 9} + \dots \right) \\
 &= \frac{1}{4} \cdot \left( \frac{1}{1 \times 3} - \frac{1}{3 \times 5} + \frac{1}{3 \times 5} - \frac{1}{5 \times 7} + \frac{1}{5 \times 7} - \frac{1}{7 \times 9} + \dots \right) \\
 &= \frac{1}{4} \cdot \left( \frac{1}{1 \times 3} - \cancel{\frac{1}{3 \times 5}} + \cancel{\frac{1}{3 \times 5}} - \cancel{\frac{1}{5 \times 7}} + \cancel{\frac{1}{5 \times 7}} - \cancel{\frac{1}{7 \times 9}} + \dots \right) \\
 &= \frac{1}{4} \cdot \left( \frac{1}{1 \times 3} \right) \\
 &= \frac{1}{12}
 \end{aligned}$$

Hence (D) is the Answer.

10 votes

-- Leen Sharma (32.2k points)

### 8.31

### Numerical Computation(14) top

### 8.31.1 Numerical Computation: CMI2010-A-07 [top](#)

<http://gateoverflow.in/46138>

For integer values of  $n$ , the expression  $\frac{n(5n+1)(10n+1)}{6}$

- A. Is always divisible by 5.
- B. Is always divisible by 3.
- C. Is always an integer.
- D. None of the above

[cmi2010](#) [numerical-ability](#) [numerical-computation](#)

[Answer](#)

### 8.31.2 Numerical Computation: GATE2011-65 [top](#)

<http://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](#) [numerical-ability](#) [normal](#) [numerical-computation](#)

[Answer](#)

### 8.31.3 Numerical Computation: GATE2011\_57 [top](#)

<http://gateoverflow.in/2168>

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](#) [numerical-ability](#) [normal](#) [numerical-computation](#)

[Answer](#)

### 8.31.4 Numerical Computation: GATE2013-CE-1 [top](#)

<http://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](#) [numerical-ability](#) [numerical-computation](#)

[Answer](#)

### 8.31.5 Numerical Computation: GATE2014-1-GA-4 [top](#)

<http://gateoverflow.in/773>

If  $(z + 1/z)^2 = 98$  , compute  $(z^2 + 1/z^2)$  .

[gate2014-1](#) [numerical-ability](#) [easy](#) [numerical-answers](#) [numerical-computation](#)

[Answer](#)

### 8.31.6 Numerical Computation: GATE2014-EC02-GA8 [top](#)

<http://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-ec02](#) [numerical-ability](#) [numerical-answers](#) [numerical-computation](#)

**Answer****8.31.7 Numerical Computation: GATE2014-EC04-GA4** [top](#)<http://gateoverflow.in/41468>

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-ec04](#) [numerical-ability](#) [easy](#) [numerical-computation](#)
**Answer****8.31.8 Numerical Computation: GATE2016-Session-7-GA-5** [top](#)<http://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

[gate2016session7aptitude](#) [numerical-ability](#) [numerical-computation](#)
**Answer****8.31.9 Numerical Computation: GATE2016-Session-8-GA-10** [top](#)<http://gateoverflow.in/111308>

The numeral in the units position of  $211^{870} + 146^{127} \times 3^{424}$  is \_\_\_\_\_.

[gate2016session8aptitude](#) [numerical-ability](#) [numerical-answers](#) [numerical-computation](#)
**Answer****8.31.10 Numerical Computation: GATE2017-1-GA-4** [top](#)<http://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

[gate2017-1](#) [numerical-ability](#) [numerical-computation](#)
**Answer****8.31.11 Numerical Computation: GATE2017-2-GA-4** [top](#)<http://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

[gate2017-2](#) [numerical-ability](#) [numerical-computation](#)
**Answer****8.31.12 Numerical Computation: TIFR2010-A-14** [top](#)<http://gateoverflow.in/18393>

A marine biologist wanted to estimate the number of fish in a large lake. He threw a net and found 30 fish in the net. He marked all these fish and released them into the lake. The next morning he again threw the net and this time caught 40 fish,

of which two were found to be marked. The (approximate) number of fish in the lake is:

- a. 600
- b. 1200
- c. 68
- d. 800
- e. 120

[tifr2010](#) | [numerical-ability](#) | [numerical-computation](#)

[Answer](#)

### 8.31.13 Numerical Computation: TIFR2015-A-3 [top](#)

<http://gateoverflow.in/29159>

Let  $|z| < 1$ . Define  $M_n(z) = \sum_{i=1}^{10} z^{10^n(i-1)}$ ? what is

$$\prod_{i=0}^{\infty} M_i(z) = M_0(z) \times M_1(z) \times M_2(z) \times \dots ?$$

- A. Can't be determined.
- B.  $1/(1-z)$
- C.  $1/(1+z)$
- D.  $1-z^9$
- E. None of the above.

[tifr2015](#) | [numerical-ability](#) | [numerical-computation](#) | [number-series](#)

[Answer](#)

### 8.31.14 Numerical Computation: TIFR2015-B-12 [top](#)

<http://gateoverflow.in/30046>

Let  $t_n$  be the sum of the first  $n$  natural numbers, for  $n > 0$ . A number is called triangular if it is equal to  $t_n$  for some  $n$ . Which of the following statements are true:

- (i) There exists three successive triangular numbers whose product is a perfect square.
- (ii) If the triangular number  $t_n$  is a perfect square, then so is  $t_{4n(n+1)}$ .
- (iii) The sum of the reciprocals of the first  $n$  triangular numbers is less than 2, i.e.

$$\frac{1}{1} + \frac{1}{3} + \frac{1}{6} + \dots + \frac{1}{t_n} < 2$$

- a. (i) only.
- b. (ii) only.
- c. (iii) only.
- d. All of the above.
- e. None of the above.

[tifr2015](#) | [numerical-ability](#) | [normal](#) | [numerical-computation](#)

[Answer](#)

## Answers: Numerical Computation

### 8.31.1 Numerical Computation: CMI2010-A-07 [top](#)

<http://gateoverflow.in/46138>



Selected Answer

$$\text{Let } X = \frac{n(5n+1)(10n+1)}{6}$$

$$\text{For } n=1 \quad X = \frac{6*11}{6} = 11$$

$$\text{For } n=2 \quad X = \frac{2*11*21}{6} = 77$$

$$\text{For } n=3 \quad X = \frac{3*16*31}{6} = 248$$

$$\text{For } n=4 \quad X = \frac{4 \times 21 \times 41}{6} = 574$$

Here we can see X is not divisible by 3 and 5 but X is always an Integer.

Hence, **Option(C) Is always an integer.**

1 votes

-- Leen Sharma (32.2k points)

### 8.31.2 Numerical Computation: GATE2011-65 [top](#)

<http://gateoverflow.in/2175>



Selected Answer

Quantity left after n operations =  $x(1 - y/x)^n$   
 where x = initial quantity  
 y = amount of mixture withdrawn each time (this should be same every time)  
 n = no of times operation performed  
 $= 10(1 - 1/10)^n = 10(9/10)^3 = 10 \cdot 0.9 \cdot 0.9 \cdot 0.9 = 10 \cdot 0.729 = 7.29$  liters  
 hence option D is correct.

Reference Video: <https://www.youtube.com/watch?v=YYg23Fm3qW0>

11 votes

-- Manu Thakur (6k points)

### 8.31.3 Numerical Computation: GATE2011\_57 [top](#)

<http://gateoverflow.in/2168>



Selected Answer

B.

Following Log formula, we get :

$$P = Q^{1/2} = R^{1/3}$$

$$\text{so, } Q^2 = P^4 = P \cdot P^3 = PR.$$

8 votes

-- shreya ghosh (3.4k points)

### 8.31.4 Numerical Computation: GATE2013-CE-1 [top](#)

<http://gateoverflow.in/40268>



Selected Answer

D. 96

Let the number be  $x$ . Writing equation,

$$x - 75 = 117 - x.$$

$$2 \times x = 192.$$

3 votes

-- Gaurav Sharma (2.6k points)

### 8.31.5 Numerical Computation: GATE2014-1-GA-4 [top](#)

<http://gateoverflow.in/773>



Selected Answer

$$\text{Ans: } (Z+1/Z)^2 = (z^2 + 2(z)(1/z) + (1/z)^2) = (z^2 + 1/z^2) + 2 = 98 \Rightarrow 98 - 2 = 96 \text{ is answer..}$$

9 votes

-- Jay (1.2k points)

### 8.31.6 Numerical Computation: GATE2014-EC02-GA8 [top](#)

<http://gateoverflow.in/41516>



Selected Answer

let eight consecutive odd numbers are  
 $n, n+2, n+4, n+6, n+8, n+10, n+12$  and  $n+14$

sum of these numbers is  
 656,  
 $8n + 56 = 656$ , so,  $n = 75$

And four consecutive even numbers are  
 $m, m+2, m+4$ , and  $m+6$

Average of these numbers is  
 87,  
 $\frac{(4m+12)}{4} = 87$ , so,  $m = 84$

Sum of smallest odd number and second largest even number is  
 $n + (m+4) = 75 + 88 = 163$

8 votes

-- Praveen Saini (53.5k points)

### 8.31.7 Numerical Computation: GATE2014-EC04-GA4 [top](#)

<http://gateoverflow.in/41468>



Selected Answer

$$f(x,y) = x^n y^m = P$$

Now,  $x$  is doubled so we substitute  $2x$  for  $x$  AND  
 $y$  is halved so we substitute  $y/2$  for  $y$

$$f(x,y) = (2x)^n (\frac{y}{2})^m$$

We get

$$f(x,y) = (2)^n (x)^n (y)^m (2)^{-m}$$

$$f(x,y) = 2^{n-m} x^n y^m = 2^{n-m} P$$

$$\text{Answer A) } 2^{n-m} P$$

4 votes

-- Abhilash Panicker (8.8k points)

### 8.31.8 Numerical Computation: GATE2016-Session-7-GA-5 [top](#)

<http://gateoverflow.in/110889>



Selected Answer

Let two digits are  $x$  and  $y$ .

$$x + y = 12 \quad \dots \quad (1)$$

Given that new number formed by reversing the digits is greater than the original number by 54,

$$y * 10 + x = 10 * x + y - 54$$

$$10y + x = 10x + y - 54$$

$$9x - 9y = 54$$

$$x - y = 6 \quad \dots \quad (2)$$

By equation (1) and (2)

$$2x = 18$$

$$x = 9$$

$$y = 3$$

Hence Original number = 39

0 votes

-- Muktinath Vishwakarma (34.1k points)

### 8.31.9 Numerical Computation: GATE2016-Session-8-GA-10 [top](#)



Selected Answer

$211^{\wedge} (870)$  has unit digit 1 and unit digit of  $146^{\wedge} 127$  is 6 and unit digit of  $3^{\wedge} 424$  is 1 because 424 repeats remainder pattern 3,9,7,1 so on remainder divisible by 4 cases unit digit is 1. So in multiplication part multiplication unit digit = 6 as  $6^{\wedge} 1$  which is added to 1 hence answer is 7.

1 votes

-- robin sharma (283 points)

### 8.31.10 Numerical Computation: GATE2017-1-GA-4 [top](#)



Selected Answer

$$y * 162 = y * 3 * 3 * 3 * 3 * 2$$

So for perfect cube we need to add two 3s and two 2s.

so answer is  $= 3*3*2*2 = 36$ .

6 votes

-- KAUSHAL DUBEY (325 points)

### 8.31.11 Numerical Computation: GATE2017-2-GA-4 [top](#)



Selected Answer

Ans: B.15

Let no. of MCQs be x and no. of Essay ques. be y.

Given MCQ worth 3 marks each and essay worth 11 marks each and Total questions are 20 worth 100 marks in total.

$$\Rightarrow x+y = 20 \text{ and } 3x+11y = 100.$$

$$\Rightarrow 3x+11(20-x) = 100$$

$$\Rightarrow 8x = 120$$

$$\Rightarrow x = 120/8 = 15$$

2 votes

-- Orochimaru (345 points)

### 8.31.12 Numerical Computation: TIFR2010-A-14 [top](#)



Selected Answer

I guess answer should be 600, i.e option a)

The problem given is equivalent to the problem in which an urn contains some number of white balls in it. We take out 30 balls out of it, mark them and put them back into the urn. Now we randomly take out 40 balls out of the urn, 2 of them are found to be marked, what is the approximate number of balls that were present in the urn initially?

Solution: Suppose the urn contained X balls initially, then

if we take n ball out of urn, probably  $n*(30/X)$  balls will be marked out of n balls.

Here  $n = 40$ ,

so Probably  $40*(30/X)$  out 40 balls will be marked.

But it is given that there are 2 marked balls,

so  $2 = 40*(30/X)$ , which gives  $X = (40 * 30)/2 = 600$ .

4 votes

-- Anurag Pandey (13.1k points)

### 8.31.13 Numerical Computation: TIFR2015-A-3 [top](#)

<http://gateoverflow.in/29159>



Selected Answer

$$M_n(z) = \sum_{i=1}^{10} z^{10^n(i-1)}$$

$$= z^{0*10^n} + z^{1*10^n} + z^{2*10^n} + \dots + z^{9*10^n}$$

$$= 1 + z^{1*10^n} + z^{2*10^n} + \dots + z^{9*10^n}$$

$$= \frac{1-(z^{10^n})^{10}}{1-z^{10^n}} = \frac{1-z^{10^{(n+1)}}}{1-z^{10^n}}$$

$$M_n(z) = \frac{1-z^{10^{(n+1)}}}{1-z^{10^n}}$$

Now,

$$\prod_{i=0}^{\infty} M_i(z) = M_0(z) \times M_1(z) \times M_2(z) \times \dots$$

$$= \left( \frac{1-z^{10^1}}{1-z^{10^0}} \right) \times \left( \frac{1-z^{10^2}}{1-z^{10^1}} \right) \times \left( \frac{1-z^{10^3}}{1-z^{10^2}} \right) \times \dots \times \left( \frac{1-z^{10^k}}{1-z^{10^{k-1}}} \right) \times \left( \frac{1-z^{10^{k+1}}}{1-z^{10^k}} \right) \times \dots$$

$$= \frac{1}{1-z}$$

for ending terms, As  $|z| < 1$ ,  $z^\infty$  tends to 0,  $1 - z^\infty$  tends to 1

4 votes

-- Praveen Saini (53.5k points)

### 8.31.14 Numerical Computation: TIFR2015-B-12 [top](#)

<http://gateoverflow.in/30046>



Selected Answer

Triangular number,  
 $t_n = \frac{n(n+1)}{2}$

Product of three consecutive Triangular numbers ,

$$t_m \times t_{m+1} \times t_{m+2}$$

$$= \frac{m(m+1)}{2} \times \frac{(m+1)(m+2)}{2} \times \frac{(m+2)(m+3)}{2}$$

$$= \left( \frac{m(m+1)}{2} \right)^2 \times \left( \frac{m(m+3)}{2} \right)$$

at m= 3,  
 $t_3 \times t_4 \times t_5$  is a perfect square.

(i) is **True**.

$$\begin{aligned} t_{4n(n+1)} &= t_{4n^2+4n} = \frac{(4n^2+4n)(4n^2+4n+1)}{2} \\ &= 4 \times (2n+1)^2 \times \frac{n(n+1)}{2} = 2^2 \times (2n+1)^2 \times t_n \end{aligned}$$

if  
 $t_n$  is a perfect square, then  
 $t_{4n(n+1)}$  is also a perfect square

(ii) is **True**

$$\begin{aligned} &\frac{1}{1} + \frac{1}{3} + \frac{1}{6} + \frac{1}{10} + \dots + \frac{1}{t_n} \\ &= \frac{2}{1(1+1)} + \frac{2}{2(2+1)} + \frac{2}{3(3+1)} + \frac{2}{4(4+1)} + \dots + \frac{2}{n(n+1)} \\ &= 2 \times \left( \frac{1}{1(1+1)} + \frac{1}{2(2+1)} + \frac{1}{3(3+1)} + \frac{1}{4(4+1)} + \dots + \frac{1}{n(n+1)} \right) \\ &= 2 \times \left( \frac{1}{1 \cdot 2} + \frac{1}{2 \cdot 3} + \frac{1}{3 \cdot 4} + \frac{1}{4 \cdot 5} + \dots + \frac{1}{n(n+1)} \right) \\ &= 2 \times \left( \left( \frac{1}{1} - \frac{1}{2} \right) + \left( \frac{1}{2} - \frac{1}{3} \right) + \left( \frac{1}{3} - \frac{1}{4} \right) + \left( \frac{1}{4} - \frac{1}{5} \right) + \dots + \left( \frac{1}{n} - \frac{1}{n+1} \right) \right) \\ &= 2 \times \left( 1 - \frac{1}{n+1} \right) \\ &= 2 \times \frac{n}{n+1} \end{aligned}$$

for any  
 $n > 0$ ,  
 $\frac{n}{n+1}$  will be  
 $< 1$ , so  
 $2 \times \frac{n}{n+1}$  will be  
 $< 2$ .

so  
 $\frac{1}{1} + \frac{1}{3} + \frac{1}{6} + \frac{1}{10} + \dots + \frac{1}{t_n} < 2$

(iii) is also **True**.

14 votes

-- Praveen Saini (53.5k points)

## 8.32

### Odd One(3) top

#### 8.32.1 Odd One: GATE 2016-2-GA-04 top

<http://gateoverflow.in/39528>

Pick the odd one from the following options.

- A. CADBE
- B. JHKIL
- C. XVYWZ
- D. ONPMQ

gate2016-2 | verbal-ability | odd-one | normal

Answer

#### 8.32.2 Odd One: GATE2016-Session-4-GA-4 top

<http://gateoverflow.in/110830>

The number that least fits this set: (324, 441, 97 and 64) is \_\_\_\_\_.

- A. 324

- B. 441  
C. 97  
D. 64

[gate2016session4aptitude](#) [odd-one](#) [numerical-ability](#)

[Answer](#)

### 8.32.3 Odd One: GATE2016-Session-8-GA-3 [top](#)

<http://gateoverflow.in/111280>

Pick the odd one out in the following:

13, 23, 33, 43, 53

- A. 23  
B. 33  
C. 43  
D. 53

[gate2016session8aptitude](#) [odd-one](#) [logical-reasoning](#)

[Answer](#)

## Answers: Odd One

### 8.32.1 Odd One: GATE 2016-2-GA-04 [top](#)

<http://gateoverflow.in/39528>



Selected Answer

Option D.

A)  
 $\overbrace{CADBE}^{3\ 1\ 4\ 2\ 5}$

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

15 votes

-- Praveen Saini (53.5k points)

### 8.32.2 Odd One: GATE2016-Session-4-GA-4 [top](#)

<http://gateoverflow.in/110830>



Selected Answer

Ans. (C)

$$324 = (18)^2$$

$$441 = (21)^2$$

$$64 = (8)^2$$

whereas 97 is not perfect square of any number.

Therefore, ans is (c)

4 votes

-- targate2018 (1k points)

### 8.32.3 Odd One: GATE2016-Session-8-GA-3 [top](#)

<http://gateoverflow.in/111280>



Selected Answer

33 is odd one among others because it is only composite number while others are prime numbers.

So, answer is B.

4 votes

-- Arnabi (6.4k points)

8.33

Percentage(8) [top](#)

### 8.33.1 Percentage: GATE-2012-AE-7 [top](#)

<http://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](#) [numerical-ability](#) [percentage](#)

Answer

### 8.33.2 Percentage: GATE2012-CY-GA-8 [top](#)

<http://gateoverflow.in/40239>

The data given in the following table summarizes the monthly budget of an average household.

Category	Amount (Rs)
Food	4000
Clothing	1200
Rent	2000
Savings	1500
Other expenses	1800

The approximate percentage of the monthly budget **NOT** spent on savings is

- A. 10%
- B. 14%
- C. 81%
- D. 86%

[gate2012-cy](#) [numerical-ability](#) [percentage](#)

Answer

### 8.33.3 Percentage: GATE2013-ee-2 [top](#)

<http://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](#) [numerical-ability](#) [percentage](#)[Answer](#)

### 8.33.4 Percentage: GATE2014-1-GA-8 [top](#)

<http://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 \_\_\_\_\_

[gate2014-1](#) [numerical-ability](#) [easy](#) [numerical-answers](#) [percentage](#)[Answer](#)

### 8.33.5 Percentage: GATE2014-3-GA-8 [top](#)

<http://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%

[gate2014-3](#) [numerical-ability](#) [normal](#) [percentage](#)[Answer](#)

### 8.33.6 Percentage: GATE2014-EC04-GA8 [top](#)

<http://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-ec04](#) [percentage](#) [normal](#) [numerical-ability](#)[Answer](#)

### 8.33.7 Percentage: GATE2014-ae-9 [top](#)

<http://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

[gate-2014-ae](#) [percentage](#) [numerical-ability](#)[Answer](#)

### 8.33.8 Percentage: GATE2016-Session-1-GA-4 [top](#)

<http://gateoverflow.in/100074>

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

[gate2016session1aptitude](#) [percentage](#) [numerical-ability](#)

[Answer](#)

## Answers: Percentage

### 8.33.1 Percentage: GATE-2012-AE-7 [top](#)

<http://gateoverflow.in/40218>



Selected Answer

//total number of runs ->

p->1810

q->1677

r->1048

s->1202//

now % increase is defined as..> ((final value-intial value)/initial value)\*100

p->(206/802)\*100=25.68%

q->(147/765)\*100=19.21

r->(190/429)\*100=44.28

s->(200/501)\*100=39.42

so the lowest increase is => Q so B is the answer

3 votes

-- Joker (1.5k points)

### 8.33.2 Percentage: GATE2012-CY-GA-8 [top](#)

<http://gateoverflow.in/40239>

$$9000 / 10500 * 100 = 85.7\%$$

3 votes

-- srestha (58.3k points)

### 8.33.3 Percentage: GATE2013-ee-2 [top](#)

<http://gateoverflow.in/40289>



Selected Answer

Let the temperatures on Monday, Tuesday, Wednesday and Thursday are  $x^\circ$ ,  $y^\circ$ ,  $z^\circ$  and  $w^\circ$  C respectively.

Given that,

$$x+y+z = 3 * 41$$

$$y+z+w = 3 * 43$$

Thursday temperature is 15% higher than Monday temperature.

$$w = 1.15x$$

After solving above equations, we'll get  $w=46$

Therefore, correct answer is (c).

2 votes

-- suraj (5.1k points)

#### 8.33.4 Percentage: GATE2014-1-GA-8 [top](#)

<http://gateoverflow.in/776>



Selected Answer

For individual , Round-trip discount 10% on TOTAL fare . So for each person  $(200 \times 10\%) = 20$  .

So for 5 member 100 rupees .

For 5 member group they will get 5% discount on TOTAL fare i.e.  $(5 \times 200 \times 5\%) = 50$  rupess.

Total discount is  $(100+50) = 150$  . They have to pay 850 rupees

8 votes

-- Palash Nandi (1.5k points)

#### 8.33.5 Percentage: GATE2014-3-GA-8 [top](#)

<http://gateoverflow.in/2032>



Selected Answer

let India's GDP = Rs  $x$

$$\text{Rs } 50 = 1 \text{ USD}$$

$$\text{Rs } x = \frac{1}{50} \times x \text{ USD}$$

$$\begin{aligned} \text{New GDP} &= \text{GDP} + 0.07 \times \text{GDP} \\ &= \text{Rs } 1.07x \end{aligned}$$

$$\text{Rs } 60 = 1 \text{ USD}$$

$$\text{Rs } 1.07x = \frac{1}{60} \times 1.07x$$

$$\begin{aligned} \text{Change in GDP} &= \frac{\text{new} - \text{old}}{\text{old}} \times 100 \\ &= \frac{(1.07x/60) - (x/50)}{x/50} \times 100 \\ &= \frac{-13x/6000}{x/50} \times 100 \\ &= \frac{-13}{120} \times 100 \\ &= -0.10833 \times 100 \\ &= -10.833 \\ &\approx -11 \end{aligned}$$

so there is an 11% decrease

answer = **option D**

9 votes

-- Amar Vashishth (28.7k points)

D)

In such questions take "What we have to find" as 100 (easy way). i.e Let India's GDP be Rs 100.

When GDP was Rs 100 exchange rate was Rs 50/USD

1 USD = Rs 50

? = Rs 100  
 Rs 100 = 100/50 Dollars  
 GDP grew by 7% =  $100 + 7\%(100) = 100 + 7 = \text{Rs } 107$   
 When GDP is Rs 107 exchange rate is Rs 60/USD  
 1 USD = Rs 60  
? = Rs 107  
Rs 107 =  $107/60$  Dollars

$((107/60)/(100/50)) * 100 = 89\%$  increase of USD. which means Indian GDP has decreased , and it has decreased to  $(100 - 89) = 11\%$

12 votes

-- Srinath Jayachandran (3.7k points)

### 8.33.6 Percentage: GATE2014-EC04-GA8 [top](#)

<http://gateoverflow.in/41470>



Selected Answer

Here we need to consider compound interest  
consumption is doubled in 10 years

$$2P = P \left[1 + \frac{R}{100}\right]^{10} 2 = \left[1 + \frac{R}{100}\right]^{10} \sqrt{2} \times 100 = 100 + R1.07177 \times 100 = 100 + RR = 7.177 = 7.2$$

**So, ans is option B**

Official ans key is also B

5 votes

-- Lokesh . (9.8k points)

### 8.33.7 Percentage: GATE2014-ae-9 [top](#)

<http://gateoverflow.in/40309>



Selected Answer

people in Y=a      total people in Y >6 ft= $2a/100$

people in X=3a      total people in X >6 ft= $3a/100$

total people >6 ft= $2a/100 + 3a/100 = 5a/100$

total=a+3a=4a

total people in (X+Y)>6 ft= $(5a/100) * (100/4a) = 1.25\%$

3 votes

-- Sandip Shaw (1.1k points)

### 8.33.8 Percentage: GATE2016-Session-1-GA-4 [top](#)

<http://gateoverflow.in/108074>



Selected Answer

$$\text{Total fruits} = 5692000 = \left\{ \begin{array}{l} \text{Unripe}(15\%) \rightarrow 853800 \\ \text{Ripe}(85\%) \rightarrow 4838200 \end{array} \right\} = \left\{ \begin{array}{l} \text{Unripe}(15\%) \left\{ \begin{array}{l} \text{Apples}(45\%) \rightarrow 384210 \\ \text{Orange} \rightarrow \text{Don't care} \end{array} \right\} \\ \text{Ripe}(85\%) \left\{ \begin{array}{l} \text{Apples}(34\%) \rightarrow 1644988 \\ \text{Orange} \rightarrow \text{Don't care} \end{array} \right\} \end{array} \right\}$$

**So, Total Apples = 384210 + 1644988 = 2029198**

2 votes

-- Lokesh . (9.8k points)

## 8.34

### Permutations And Combinations(9) [top](#)

### 8.34.1 Permutations And Combinations: GATE 2016-2-GA-09 [top](#)

<http://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

[gate2016-2](#) [numerical-ability](#) [normal](#) [permutations-and-combinations](#)

[Answer](#)

### 8.34.2 Permutations And Combinations: GATE2010-65 [top](#)

<http://gateoverflow.in/2373>

Given digits 2, 2, 3, 3, 3, 4, 4, 4 how many distinct 4 digit numbers greater than 3000 can be formed?

- A. 50
- B. 51
- C. 52
- D. 54

[gate2010](#) [numerical-ability](#) [permutations-and-combinations](#) [normal](#)

[Answer](#)

### 8.34.3 Permutations And Combinations: GATE2012-AR-5 [top](#)

<http://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](#) [numerical-ability](#) [permutations-and-combinations](#)

[Answer](#)

### 8.34.4 Permutations And Combinations: GATE2014-EC04-GA10 [top](#)

<http://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-ec04](#) [numerical-ability](#) [normal](#) [permutations-and-combinations](#)

[Answer](#)

### 8.34.5 Permutations And Combinations: GATE2017-1-GA-9 [top](#)

<http://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

[gate2017-1](#) | [permutations-and-combinations](#) | [numerical-ability](#)

[Answer](#)

### 8.34.6 Permutations And Combinations: GATE\_MN\_2011\_59 [top](#)

<http://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

[numerical-ability](#) | [gate2011-mn](#) | [permutations-and-combinations](#)

[Answer](#)

### 8.34.7 Permutations And Combinations: ISI Sample Paper Question [top](#)

<http://gateoverflow.in/125949>

A club with  $n$  members is organized into four committees so that each member belongs to exactly two committees and each pair of committees has exactly one member in common. Then

- A.  $n = 4$
- B.  $n = 6$
- C.  $n = 8$
- D.  $n$  cannot be determined from the given information

[isisamplepapers](#) | [numerical-ability](#) | [permutations-and-combinations](#)

[Answer](#)

### 8.34.8 Permutations And Combinations: TIFR2011-A-20 [top](#)

<http://gateoverflow.in/20260>

Let  $n > 1$  be an odd integer. The number of zeros at the end of the number  $99^n + 1$  is.

- a. 1
- b. 2
- c. 3
- d. 4
- e. None of the above.

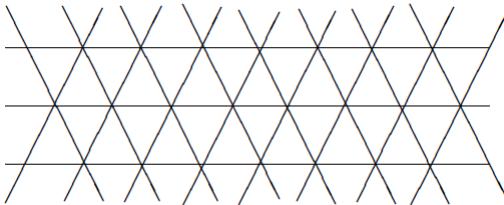
[tifr2011](#) | [numerical-ability](#) | [permutations-and-combinations](#)

[Answer](#)

### 8.34.9 Permutations And Combinations: TIFR2013-A-1 [top](#)

<http://gateoverflow.in/25382>

An infinite two-dimensional pattern is indicated below.



The smallest closed figure made by the lines is called a unit triangle. Within every unit triangle, there is a mouse. At every vertex there is a laddoo. What is the average number of laddoos per mouse?

- a. 3
- b. 2
- c. 1
- d.  $\frac{1}{2}$
- e.  $\frac{1}{3}$

tifr2013 numerical-ability permutations-and-combinations

Answer

## Answers: Permutations And Combinations

### 8.34.1 Permutations And Combinations: GATE 2016-2-GA-09 [top](#)

<http://gateoverflow.in/39537>



Selected Answer

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  $3C2$  ways. Similarly to choose 2 vertical lines out of 5 vertical lines is  $5C2$  so answer is

$$\binom{5}{2} \times \binom{3}{2}$$

32 votes

-- rajan (4k points)

Here answer is (C) 30.

Rectangle of Size 1 => 8

Size 2 => 10

Size 3 => 4

Size 4 => 5

Size 5 => 0

Size 6 => 2

Size 7 => 0

Size 8 => 1

12 votes

-- Akash (43.8k points)

### 8.34.2 Permutations And Combinations: GATE2010-65 [top](#)

<http://gateoverflow.in/2373>



Selected Answer

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  $= 26 + 25 = 51$

answer = **option B**

22 votes

-- Amar Vashishth (28.7k points)

### 8.34.3 Permutations And Combinations: GATE2012-AR-5 [top](#)

<http://gateoverflow.in/40228>

90...

let 1.2.3.4.5.6.7.8.9.10 be teams now

first team can play with any=9

similarly second can play with any =8 ...similarly 3rd team will play 7 games ...so

$9+8+7\dots+1=n(n-1)/2 == 10(9)/2=45$  ..we are said ..to have 2 matches= $45*2=90$

4 votes

-- Deepesh Kataria (1.8k points)

### 8.34.4 Permutations And Combinations: GATE2014-EC04-GA10 [top](#)

<http://gateoverflow.in/41472>



Selected Answer

(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.

7 votes

-- Pragy Agarwal (19.5k points)

### 8.34.5 Permutations And Combinations: GATE2017-1-GA-9 [top](#)

<http://gateoverflow.in/118412>



Selected Answer

Total possibilities =  $4! = 24$ .

no.of ways 'arun chooses red' or 'shwetha chooses white'= no.of ways 'arun chooses red'+no.of ways 'shwetha chooses white'-no.of ways 'arun chooses red' and 'shwetha chooses white'=6+6-2 = 10

required=24-10=14.

10 votes

-- Vinay Rachapalli (1.1k points)

### 8.34.6 Permutations And Combinations: GATE\_MN\_2011\_59 [top](#)

<http://gateoverflow.in/31531>

One scholarship can be awarded to 4 applicant 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 scholarship between 0 to 3 )

2 votes

-- Akash (43.8k points)

### 8.34.7 Permutations And Combinations: ISI Sample Paper Question [top](#)

<http://gateoverflow.in/125949>



Selected Answer

let first committee = {1,2,3}

second = {3,4,5}

third = {5,6,1}

four={2,4,6}

n=6

now you take intersection of any two committees you will get only one member common, and also each member is part of exactly two groups

You can also imagine it as an graph theory problem 4 committees = 4 nodes and solution is to draw edges such that each edges is part of exactly two nodes and answer you will get is 4 nodes complete graph having total six edges.

Hence **answer B**

2 votes

-- Keval Malde (7.8k points)

### 8.34.8 Permutations And Combinations: TIFR2011-A-20 [top](#)

<http://gateoverflow.in/20260>



Selected Answer

**For odd**  
 $n_r$

$$99^n = (100 - 1)^n$$

$$= 100^n - \binom{n}{1} 100^{n-1} + \dots - \binom{n}{n-2} 100^2 + \binom{n}{n-1} 100^1 - 1$$

$$99^n + 1 = 100^n - \binom{n}{1} 100^{n-1} + \dots - \binom{n}{n-2} 100^2 + \binom{n}{n-1} 100^1 - 1 + 1$$

$$= 100 \left( 100^{n-1} - \binom{n}{1} 100^{n-2} + \dots - \binom{n}{n-1} \right)$$

Since  $n$  is odd, it cannot end in a 0

Thus,  $99^n + 1 = 100 \left( \dots \text{ doesn't end with } 0 \right)$

Which means that  $99^n + 1$  ends with exactly 2 zeros

**Hence, option b) is correct.**

**Alternative way:**

$$\begin{array}{rcl}
 99 & \times & 01 = 99 \\
 99 & \times & 099 = 9801 \\
 99 & \times & (\dots)801 = (\dots)299 \\
 99 & \times & (\dots)299 = (\dots)601 \\
 99 & \times & (\dots)601 = (\dots)499 \\
 99 & \times & (\dots)499 = (\dots)401 \\
 99 & \times & (\dots)401 = (\dots)699 \\
 99 & \times & (\dots)699 = (\dots)201 \\
 99 & \times & (\dots)201 = (\dots)899 \\
 99 & \times & (\dots)899 = (\dots)001
 \end{array}$$

Thus,  $99^n$  always ends in a 99 when  $n$  is odd, but never in a 999.

Hence,  $99^n + 1$  will always end with exactly 2 zeros.

**Note:** We couldn't just say that  $99^3 + 1$  ends with exactly 2 zeros, so **b** must be correct. This is because we also have an option **e** which says **None of the above**. Had it not been there, we could have marked b without having to prove that the pattern will continue.

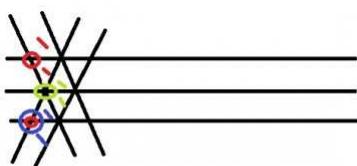
5 votes

-- Pragy Agarwal (19.5k points)

### 8.34.9 Permutations And Combinations: TIFR2013-A-1 [top](#)

<http://gateoverflow.in/25382>

Ans will be 1/2. Every Laddoo shared by 2 mouse



4 votes

-- srestha (58.3k points)

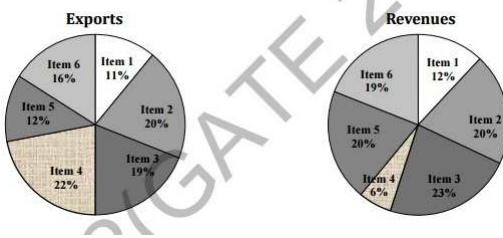
### 8.35

### Pie Chart(4) [top](#)

#### 8.35.1 Pie Chart: GATE2014-AG-GA8 [top](#)

<http://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 numerical-ability data-interpretation pie-chart ratios normal

Answer

### 8.35.2 Pie Chart: GATE2014-EC03-GA7 [top](#)

<http://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

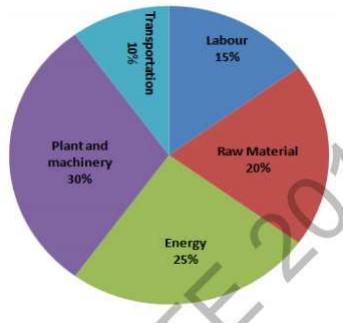
gate2014-ec03 numerical-ability data-interpretation pie-chart ratios normal

Answer

### 8.35.3 Pie Chart: GATE2014-EC03-GA9 [top](#)

<http://gateoverflow.in/41461>

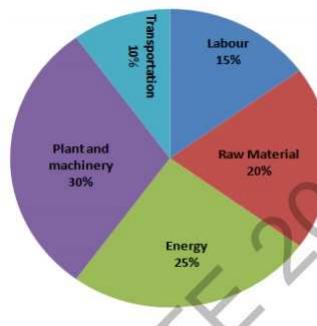
A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs.4,50,000. In 2013, the raw material 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-ec03](#) [numerical-ability](#) [data-interpretation](#) [pie-chart](#) [numerical-answers](#)
[Answer](#)

### 8.35.4 Pie Chart: GATE2014-EC04-GA9 [top](#)

<http://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-ec04](#) [numerical-ability](#) [data-interpretation](#) [pie-chart](#) [numerical-answers](#)
[Answer](#)

## Answers: Pie Chart

### 8.35.1 Pie Chart: GATE2014-AG-GA8 [top](#)

<http://gateoverflow.in/41672>

Item 1:  $11x \rightarrow 12$

Item 4:  $22y \rightarrow 6$

$$x/y = 12*22/(11*6) = 4:1$$

2 votes

-- Arjun Suresh (294k points)

### 8.35.2 Pie Chart: GATE2014-EC03-GA7 [top](#)

<http://gateoverflow.in/41459>


Ans will be (D)

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.

3 votes

-- srestha (58.3k points)

### 8.35.3 Pie Chart: GATE2014-EC03-GA9 [top](#)

<http://gateoverflow.in/41461>



Selected Answer

expenditure of labour Rs.4,50,000

15% expenditure is Rs.4,50,000

then,  $100\% \text{ " } \text{Rs. } 4,50,000 \times 100\% / 15\% = \text{Rs. } 30,00,000$

Now, Profit Rs.10,00,000

Total selling cost  $\text{Rs. } 30,00,000 + 10,00,000 = \text{Rs. } 40,00,000$

200 air purifier selling cost Rs.40,00,000

1 " " " " Rs.20,000

2 votes

-- srestha (58.3k points)

### 8.35.4 Pie Chart: GATE2014-EC04-GA9 [top](#)

<http://gateoverflow.in/41471>



Selected Answer

2012:

Given Expenditure on Labour is 450000, which is 15% of total cost(From Pie Chart). then

Total Cost (X)  $\Rightarrow 15\% \text{ of } X = 450000 \Rightarrow X = 3000000$

So, Expenditure on Transportation will be 10 % of X = 300000

Expenditure on plan and Machinery will be 30% of X = 900000

Expenditure on Energy will be 25% of X = 750000

Expenditure on raw material will be 20% of X = 600000

2013:

New Expense in Raw Material will be 30% more than last year expense :  $600000 + (30\% \text{ of } 600000) = 780000$

New Expense in Labour will be 20% more than last year expense :  $450000 + (20\% \text{ of } 450000) = 540000$

New Expense in Transportation will be 20% more than last year expense :  $300000 + (20\% \text{ of } 300000) = 360000$

New Expense in Plant and Machinery will be 20% more than last year expense :  $900000 + (20\% \text{ of } 900000) = 1080000$

New Expense in Energy will be 20% more than last year expense :  $750000 + (20\% \text{ of } 750000) = 900000$

Total Cost in 2013 =  $(7.8 \text{ L} + 5.4 \text{ L} + 3.6 \text{ L} + 10.8 \text{ L} + 9 \text{ L}) = 3660000$

Total Increase in cost =  $(3660000 - 3000000) = 660000$

Total % increase in cost =  $((660000)/3000000)*100 = 22\%$ .

**Answer will be 22%.**

6 votes

-- Muktinath Vishwakarma (34.1k points)

## 8.36

### Pigeonhole(1) [top](#)

#### 8.36.1 Pigeonhole: CMI2012-A-06 [top](#)

<http://gateoverflow.in/46535>

A basket of fruit is being arranged out of apples, bananas, and oranges. What is the smallest number of pieces of fruit that should be put in the basket in order to guarantee that either there are at least 8 apples or at least 6 bananas or at least 9

oranges?

- A. 9
- B. 10
- C. 20
- D. 21

[cmi2012](#) | [numerical-ability](#) | [pigeonhole](#)

[Answer](#)

## Answers: Pigeonhole

### 8.36.1 Pigeonhole: CMI2012-A-06 [top](#)

<http://gateoverflow.in/46535>



Selected Answer

D) 21

In order to "guarantee" , we have to consider the worst case scenario which we obtain like this :

O A B  
O A B  
O A B  
O A B  
O A B  
O A A  
O O B

thus giving a total of 21 possibilities

2 votes

-- Prasita Mukherjee (447 points)

## 8.37

## Polynomials(1) [top](#)

### 8.37.1 Polynomials: GATE2016-1-GA09 [top](#)

<http://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.  $(x + 1)$

[gate2016-1](#) | [numerical-ability](#) | [polynomials](#) | [normal](#)

[Answer](#)

## Answers: Polynomials

### 8.37.1 Polynomials: GATE2016-1-GA09 [top](#)

<http://gateoverflow.in/39611>



Selected Answer

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

23 votes

-- Pooja Palod (32.4k points)

## 8.38

## Probability(11) top

### 8.38.1 Probability: GATE-2012-AE-6 top

<http://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](#) [numerical-ability](#) [probability](#)

Answer

### 8.38.2 Probability: GATE2012-AR-9 top

<http://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](#) [numerical-ability](#) [probability](#)

Answer

### 8.38.3 Probability: GATE2012-CY-GA-7 top

<http://gateoverflow.in/41173>

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](#) [numerical-ability](#) [probability](#)

Answer

### 8.38.4 Probability: GATE2013-ee-6 top

<http://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](#) [numerical-ability](#) [probability](#)[Answer](#)

### 8.38.5 Probability: GATE2014-AG-GA4 [top](#)

<http://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](#) [numerical-ability](#) [probability](#) [numerical-answers](#) [normal](#)[Answer](#)

### 8.38.6 Probability: GATE2014-EC02-GA4 [top](#)

<http://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-ec02](#) [numerical-ability](#) [probability](#) [normal](#)[Answer](#)

### 8.38.7 Probability: GATE2014-EC03-GA10 [top](#)

<http://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-ec03](#) [numerical-ability](#) [probability](#) [numerical-answers](#) [normal](#)[Answer](#)

### 8.38.8 Probability: GATE2015-1\_GA\_10 [top](#)

<http://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.

[gate2015-1](#) [numerical-ability](#) [probability](#)[Answer](#)

### 8.38.9 Probability: GATE2015-1\_GA\_3 [top](#)

<http://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

[gate2015-1](#) [numerical-ability](#) [probability](#) [normal](#)

**Answer****8.38.10 Probability: GATE2017-1-GA-5** [top](#)<http://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)  $0.9^k$

[gate2017-1](#) | [numerical-ability](#) | [probability](#) | [easy](#)

**Answer****8.38.11 Probability: GATE2017-2-GA-5** [top](#)<http://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.  $1/5$
- B.  $7/30$
- C.  $1/4$
- D.  $4/15$

[gate2017-2](#) | [numerical-ability](#) | [probability](#)

**Answer****Answers: Probability****8.38.1 Probability: GATE-2012-AE-6** [top](#)<http://gateoverflow.in/40217>

Selected Answer

X - A hits the convict  
Y - B hits the convict  
Given,  $P(X) = 3 * P(Y)$

Z - Convict is injured  
Z' - Convict is not injured  
Given,  $P(Z') = 0.5$   
 $P(Z) = 1 - P(Z')$   
 $P(Z) = 1 - 0.5 = 0.5$

Now,  
 $P(Z) = P(X) * P(Y') + P(X') * P(Y) + P(X) * P(Y)$   
Let  
 $P(Y) = t$   
 $P(X) = 3t$   
 $P(Y') = 1-t$   
 $P(X') = 1-3t$

Substituting in above equation,  
 $0.5 = (3t * (1-t)) + ((1-3t) * t) + (t * 3t)$   
 $\Rightarrow 3t - 3t^2 + t - 3t^2 + 3t^2 = 0.5$   
 $\Rightarrow 3t^2 - 4t + 0.5 = 0$   
 $\Rightarrow 6t^2 - 8t + 1 = 0$   
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**

$$P(Z')=0.5$$

Now,

$$P(Z') = (P(X') * P(Y'))$$

$$\Rightarrow 0.5 = (1-t) * (1-3t)$$

Solving this gives the same equation as above.

$$6t^2 - 8t + 1 = 0$$

and the same answer

4 votes

-- Abhilash Panicker (8.8k points)

### 8.38.2 Probability: GATE2012-AR-9 [top](#)

<http://gateoverflow.in/40230>



The smuggler would be caught if any one or both the randomly picked capsules 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

$$P(A) = P(B) + P(C) + P(D)$$

$$P(A) = (5/10)*(5/9) + (5/10)*(5/9) + (5/10)*(4/9)$$

$$P(A) = 0.278 + 0.278 + 0.222$$

$$P(A) = 0.778 = 0.78$$

Hence, Answer Option C) 0.78

4 votes

-- Abhilash Panicker (8.8k points)

### 8.38.3 Probability: GATE2012-CY-GA-7 [top](#)

<http://gateoverflow.in/4173>



For such questions which are also known as probability based on areas , u can find easily using grid of 2 dimension as shown below

		1/2*F	F
	1/2 * F		1/2 * F
1/2*F		1/2 *	
F	1/2 *		

The favorable area for the given problem is shown above...

$$\text{So no of favourable cells} = 4 + 6 * 1/2 = 7$$

$$\begin{aligned} \text{Therefore probability that they meet} &= \frac{\text{No of favourable cells}}{\text{No of total cells}} \\ &= 7 / 16 \end{aligned}$$

**Hence C) should be the correct option.**

2 votes

-- HABIB MOHAMMAD KHAN (76.5k points)

### 8.38.4 Probability: GATE2013-ee-6 [top](#)

<http://gateoverflow.in/40293>



Selected Answer

sample space is  $S : \{\text{Monday-Tuesday, Tuesday-Wednesday, Wednesday-Thursday, ..., Sunday-Monday}\}$

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-Saturday

Number of elements in set  $A = n(A) = 2$

By definition, probability of occurrence of  $A = n(A)/n(S) = 2/7$

Therefore, probability that a leap year has 53 Saturdays is  $2/7$ .

4 votes

-- Pooja Palod (32.4k points)

### 8.38.5 Probability: GATE2014-AG-GA4 [top](#)

<http://gateoverflow.in/41668>



Selected Answer

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

4 votes

-- Aditya Sharma (825 points)

### 8.38.6 Probability: GATE2014-EC02-GA4 [top](#)

<http://gateoverflow.in/41511>



Selected Answer

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.

3 votes

-- Ashish Gupta (921 points)

### 8.38.7 Probability: GATE2014-EC03-GA10 [top](#)

<http://gateoverflow.in/41462>



Selected Answer

In a batch there are total 100 bulbs of which

95 are working

5 are defective.

$$P(\text{Selecting 4 working bulbs}) = \frac{95}{100} * \frac{94}{99} * \frac{93}{98} * \frac{92}{97} = 0.81$$

3 votes

-- Abhilash Panicker (8.8k points)

### 8.38.8 Probability: GATE2015-1\_GA\_10 [top](#)

<http://gateoverflow.in/8014>



Selected Answer

Probability of non pass = 1 - Probability of at least one pass = 1 - 0.75 = 0.25

$$(1-m)(1-p)(1-c) = 0.25$$

$$(1 + mp - m - p)(1-c) = 0.25$$

$$1 + mp - m - p - c - mpc + mc + pc = 0.25$$

$$\mathbf{m + p + c - mp - pc - mc + mpc = 0.75 \text{ -- (1)}}$$

Probability of exactly 2 pass = 0.4

$$mp(1-c) + pc(1-m) + mc(1-p) = 0.4$$

$$mp + pc + mc - 3mpc = 0.4$$

**mp + pc + mc - 2mpc = 0.5 -- (2)** (Adding the probability of all pass to probability of exactly 2 pass gives probability of at least 2 pass)

So, **mpc = 0.1**, -- (3)

From (2) and (3),

$$\mathbf{mp + pc + mc - mpc = 0.6 \text{ -- (4)}}$$

From (1) and (4)

$$m + p + c = 0.75 + 0.6$$

$$m + p + c = 1.35 = 135/100 = 27/20$$

So, D option

12 votes

-- Arjun Suresh (294k points)

### 8.38.9 Probability: GATE2015-1\_GA\_3 top

<http://gateoverflow.in/8004>



Selected Answer

option A because total combination is  $5*4=20$  and out 20 we have only 4 combination of which have sum 16

2,14

3,13

4,12

5,11

4 votes

-- Anoop Sonkar (4.8k points)

### 8.38.10 Probability: GATE2017-1-GA-5 top

<http://gateoverflow.in/118408>



Selected Answer

Total possibilities = **(10)<sup>k</sup>**, because every digit has 10 options from 0 to 9.

Possibility of not containing any digit 0, 5, 9 = **(7)<sup>k</sup>**, now every digit has 7 options.

$$\text{Asked probability} = (7)^k / (10)^k = (0.7)^k$$

So C is the answer.

5 votes

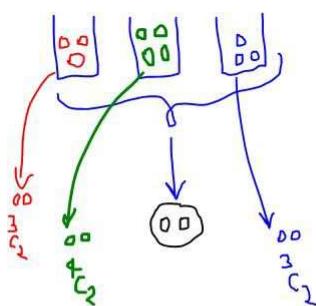
-- KAUSHAL DUBEY (325 points)

### 8.38.11 Probability: GATE2017-2-GA-5 top

<http://gateoverflow.in/118419>



Selected Answer



$$\frac{3}{C_1} + \frac{4}{C_2} + \frac{3}{C_3} = \frac{4}{15}$$

assuming ball are not identical

11 votes

-- 2018 (5.2k points)

8.39

## Proportions(1) top

### 8.39.1 Proportions: GATE2016-1-GA10 top

<http://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 \_\_\_\_\_.

- A. 40.00
- B. 46.02
- C. 60.01
- D. 92.02

[gate2016-1](#) [numerical-ability](#) [proportions](#) [normal](#)

[Answer](#)

## Answers: Proportions

### 8.39.1 Proportions: GATE2016-1-GA10 top

<http://gateoverflow.in/39612>



Selected Answer

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.

$$100 = ae^{-80b} \quad \text{-----(1)}$$

when load is halved it takes  
10000 cycles for failure.

$$10000 = ae^{-40b} \quad \dots(2)$$

Divide (2) by (1)

$$e^{40b} = 100$$

$$b = \frac{\log_e 100}{40} \quad \dots(3)$$

At  
5000 cycles to failure

$$5000 = ae^{-xb} \quad \dots(4)$$

divide (2) by (4)

$$e^{b(x-40)} = 2$$

$$b(x - 40) = \log_e 2$$

$$\frac{\log_e 100}{40} \times (x - 40) = \log_e 2 \quad \dots\text{(using (3))}$$

$$x = 40 \times \frac{(\log_e 2 + \log_e 100)}{\log_e 100}$$

$$x = 40 \times \frac{\log_e 200}{\log_e 100}$$

$$x = 46.02$$

30 votes

-- Praveen Saini (53.5k points)

## 8.40

## Quadratic Equations(4) top

### 8.40.1 Quadratic Equations: GATE 2016-2-GA-05 top

<http://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.  $4^{n-1}$

[gate2016-2](#) [numerical-ability](#) [quadratic-equations](#) [normal](#)

Answer

### 8.40.2 Quadratic Equations: GATE2013-ee-8 top

<http://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](#) [numerical-ability](#) [quadratic-equations](#)

Answer

### 8.40.3 Quadratic Equations: GATE2014-1-GA-5 [top](#)

<http://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

- A. no roots
- B. 2 real roots
- C. 3 real roots
- D. 4 real roots

[gate2014-1](#) | [numerical-ability](#) | [quadratic-equations](#) | [normal](#)

[Answer](#)

### 8.40.4 Quadratic Equations: GATE\_2011\_MN\_62 [top](#)

<http://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)

[numerical-ability](#) | [gate2011-mn](#) | [quadratic-equations](#)

[Answer](#)

## Answers: Quadratic Equations

### 8.40.1 Quadratic Equations: GATE 2016-2-GA-05 [top](#)

<http://gateoverflow.in/39532>



Selected Answer

$$\begin{aligned} & \frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}} \\ &= \frac{\alpha^n + \beta^n}{\left(\frac{1}{\alpha^n} + \frac{1}{\beta^n}\right)} \\ &= \frac{\alpha^n + \beta^n}{\left(\frac{1 + \alpha^n \beta^n}{\alpha^n \beta^n}\right)} \\ &= (\alpha \beta)^n \\ &= 4^n \end{aligned}$$

as product of roots,  
 $\alpha \beta = 4$

17 votes

-- Praveen Saini (53.5k points)

### 8.40.2 Quadratic Equations: GATE2013-ee-8 [top](#)

<http://gateoverflow.in/40295>



Selected Answer

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

1 6 votes

-- Praveen Saini (53.5k points)

### 8.40.3 Quadratic Equations: GATE2014-1-GA-5 [top](#)

<http://gateoverflow.in/770>



Selected Answer

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 roots.

1 15 votes

-- Arjun Suresh (294k points)

### 8.40.4 Quadratic Equations: GATE\_2011\_MN\_62 [top](#)

<http://gateoverflow.in/31540>



Selected Answer

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  $x_1 + x_2 = 4+3=7$ .....(i) [as here  $-b/a$  is correct]

in 2nd attempt b is incorrect . So, we can say  $x_1 \cdot x_2 = 3.2=6$ .....(ii) [as here  $c/a$  is correct]

Now solving (ii) we get

$x_2 = 6 / x_1$ .....(iii)

putting it in eqn. (i)

$x_1 + 6 / x_1 = 7$

or,  $x_1^2 - 7x_1 + 6 = 0$

or,  $x_1 = 1, 6$

Answer is (c)

1 3 votes

-- srestha (58.3k points)

## 8.41

### Ratios(5) [top](#)

#### 8.41.1 Ratios: GATE2011-GG-GA-4 [top](#)

<http://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 numerical-ability ratios

**Answer****8.41.2 Ratios: GATE2013-AE-GA-1** [top](#)<http://gateoverflow.in/40242>

If  $3 \leq X \leq 5$  and  $8 \leq Y \leq 11$  then which of the following options is TRUE?

- A.  $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{5}$
- B.  $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{5}{8}$
- C.  $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{8}{5}$
- D.  $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{11}$

[gate2013-ae](#) [numerical-ability](#) [ratios](#) [normal](#)
**Answer****8.41.3 Ratios: GATE2014-ae-8** [top](#)<http://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?

[gate-2014-ae](#) [numerical-ability](#) [ratios](#)
**Answer****8.41.4 Ratios: TIFR2012-A-18** [top](#)<http://gateoverflow.in/25043>

A large community practices birth control in the following peculiar fashion. Each set of parents continues having children until a son is born; then they stop. What is the ratio of boys to girls in the community if, in the absence of birth control, 51% of the babies are born male?

- a. 51 : 49
- b. 1 : 1
- c. 49 : 51
- d. 51 : 98
- e. 98 : 51

[tifr2012](#) [numerical-ability](#) [ratios](#)
**Answer****8.41.5 Ratios: TIFR2014-A-2** [top](#)<http://gateoverflow.in/25987>

A body at a temperature of 30 Celsius is immersed into a heat bath at 0 Celsius at time  $t = 0$ . The body starts cooling at a rate proportional to the temperature difference. Assuming that the heat bath does not change in temperature throughout the process, calculate the ratio of the time taken for the body to reach 1 Celsius divided by the time taken for the body to reach 5 Celsius.

- a.  $\log 5$ .
- b.  $\frac{\log 29}{\log 25}$ .
- c.  $e^5$ .
- d.  $1 + \log_6 5$ .
- e. None of the above.

[tifr2014](#) [numerical-ability](#) [ratios](#)
**Answer****Answers: Ratios****8.41.1 Ratios: GATE2011-GG-GA-4** [top](#)<http://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  $M_1 D_1 / W_1 = M_2 D_2 / W_2$

According to given data in question

$$m^*m/m = 100*D_2/100$$

$D_2 = m$  days

3 votes

-- sonam vyas (13.2k points)

## 8.41.2 Ratios: GATE2013-AE-GA-1 [top](#)

<http://gateoverflow.in/40242>



Selected Answer

$x/y = \text{minimum for the given range if } x \text{ is minimum possible \& } y \text{ is maximum possible i.e. } 3/11$

$x/y = \text{maximum for the given range if } x \text{ is maximum possible \& } y \text{ is minimum possible i.e. } 5/8$

So, answer is (B)

6 votes

-- Vivek Srivastava (667 points)

## 8.41.3 Ratios: GATE2014-ae-8 [top](#)

<http://gateoverflow.in/40308>

Clearly, the angles of quadrilateral are 60, 80, 100, 120.

That makes smallest angle of triangle  $60*(2/3) = 40$ .

That makes largest angle of triangle  $40*(2) = 80$ .

so third angle of triangle = 60.

The required value is  $= 120 + 60 = 180$

2 votes

-- Akshay Patil (31 points)

## 8.41.4 Ratios: TIFR2012-A-18 [top](#)

<http://gateoverflow.in/25043>

Let,  $X$  is the expected no of child a parent has.

So, No of boys = 1.

No of girls =  $X - 1$ .

The probability of having a baby boy = 0.51.

And the probability of having a baby girl = 0.49.

So,

$$X = 1 * (0.51) + 2 * (0.49) * (0.51) + 3 * (0.49)^2 * (0.51) + 4 * (0.49)^3 * (0.51)$$

$$0.49X = 1 * (0.49) * (0.51) + 2 * (0.49)^2 * (0.51) + 3 * (0.49)^3 * (0.51)$$

$$X - 0.49X = (0.51)[1 + (0.49) * (0.51) + (0.49)^2 * (0.51) + (0.49)^3 * (0.51) + \dots]$$

$$0.51X = (0.51)[1 / 0.51]$$

$$X = 100 / 51.$$

So, No of girl child =  $X - 1$ .

$$= [100 / 51] - 1 = 49 / 51.$$

No of boy child = 1.

Hence, Ratio = Boys : Girls = 51 : 49 . [ Ans - A ]

3 votes

-- Dhananjay Kumar Sharma (25.2k points)

### 8.41.5 Ratios: TIFR2014-A-2 [top](#)

<http://gateoverflow.in/25987>



Selected Answer

Let's say the Temperature of body at time  $t$  be  $T_t$ , which means  $T_0 = 30$ .

Now let the time at which temperature is 5 be  $t_1$ , which means  $T_{t_1} = 5$

and the time at which temperature is 1 be  $t_2$ , which means  $T_{t_2} = 1$ .

Question Asks us to find  $t_2/t_1$ ..

Now, Temperature decrease( $D$ ) at time  $t \propto$  Body Temperature - Bath Temperature

$$D \propto T_t \{ \text{As Bath Temp. is 0 \& Body Temp. is } T_b \}$$

$$D = k * T_t \{ \text{where } k \text{ is proportionality constant} \}$$

$$\text{now, it gives } T_{t+1} = T_t - D = T_t - k * T_t = (1-k) T_t$$

$$\text{Now, } T_0 = 30$$

$$T_1 = 30(1-k)$$

$$T_2 = 30(1-k)^2$$

$$T_{t_1} = 30(1-k)^{t_1} \quad \& \quad T_{t_2} = 30(1-k)^{t_2}$$

$$\Rightarrow 30(1-k)^{t_1} = 5 \Rightarrow t_1 * \log(1-k) = \log(5/30) = \log(1/6)$$

$$\text{Similarly } \Rightarrow t_2 * \log(1-k) = \log(1/30)$$

$$\Rightarrow t_2 / t_1 = \log(1/30) / \log(1/6) = \log(30^{-1}) / \log(6^{-1}) = \log(30) / \log(6) = \log_6 30$$

$$= \log_6 (6^5) = \log_6 6 + \log_6 5 = 1 + \log_6 5 \text{ which is } \text{OPTION (D)} ..$$

2 votes

-- Himanshu Agarwal (16.2k points)

### 8.42

### Sequence(4) [top](#)

<http://gateoverflow.in/2213>

#### 8.42.1 Sequence: GATE2012\_65 [top](#)

Given the sequence of terms, AD CG FK JP, the next term is

- (A) OV
- (B) OW
- (C) PV
- (D) PW

[gate2012](#) [numerical-ability](#) [sequence](#) [easy](#)

**Answer**

#### 8.42.2 Sequence: GATE2014-EC04-GA5 [top](#)

<http://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-ec04](#) [numerical-ability](#) [sequence](#) [normal](#) [numerical-answers](#)

**Answer**

### 8.42.3 Sequence: GATE2014-EC04-GA6 [top](#)

<http://gateoverflow.in/41468>

Find the next term in the sequence: 13M, 17Q, 19S, \_\_\_\_\_.

- A. 21W
- B. 21V
- C. 23W
- D. 23V

[gate2014-ec04](#) [numerical-ability](#) [sequence](#) [normal](#)

[Answer](#)

### 8.42.4 Sequence: TIFR2013-A-19 [top](#)

<http://gateoverflow.in/2550>

Consider a sequence of numbers  $(\epsilon_n : n = 1, 2, \dots)$ , such that  $\epsilon_1 = 10$  and

$$\epsilon_{n+1} = \frac{20\epsilon_n}{20 + \epsilon_n}$$

for  $n \geq 1$ . Which of the following statements is true?

Hint: Consider the sequence of reciprocals.

- a. The sequence  $(\epsilon_n : n = 1, 2, \dots)$  converges to zero.
- b.  $\epsilon_n \geq 1$  for all  $n$
- c. The sequence  $(\epsilon_n : n = 1, 2, \dots)$  is decreasing and converges to 1.
- d. The sequence  $(\epsilon_n : n = 1, 2, \dots)$  is decreasing and then increasing. Finally it converges to 1.
- e. None of the above.

[tifr2013](#) [numerical-ability](#) [sequence](#)

[Answer](#)

## Answers: Sequence

### 8.42.1 Sequence: GATE2012\_65 [top](#)

<http://gateoverflow.in/2213>



Selected Answer

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 2nd last letter

so JKLMNOP , next term will start with O and having 6 difference it will be OV

8 votes

-- shreya ghosh (3.4k points)

### 8.42.2 Sequence: GATE2014-EC04-GA5 [top](#)

<http://gateoverflow.in/41467>



Selected Answer

Let a be the first odd number..  
So the terms of sequence would 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,  $5a = 405$   
 $a = 81$

Sum of last 5 terms is =  $a+22 + a+20 + a+18 + a+16 + a+14 = 5a + 90$

now we have  $a = 81$ . Substituting it we get.

Answer as  $5*81 + 90 = 405 + 90 = 495$

Answer) 495

1 upvote

-- Abhilash Panicker (8.8k points)

### 8.42.3 Sequence: GATE2014-EC04-GA6 [top](#)

<http://gateoverflow.in/41468>



Selected Answer

13,17,19, 23 All are prime numbers  
 13th alphabet M  
 17th alphabet Q  
 19th alphabet S  
 23th alphabet W

Answer C) 23W

1 upvote

-- Abhilash Panicker (8.8k points)

### 8.42.4 Sequence: TIFR2013-A-19 [top](#)

<http://gateoverflow.in/25500>



Selected Answer

$\varepsilon_1$  is positive.

In the formula for  $\varepsilon_{n+1}$ , we only add, multiply and divide positive numbers. Thus, all  $\varepsilon_n$  are positive.

Also,  $\varepsilon_{n+1} < \varepsilon_n$

Proof:

$$\begin{aligned}\varepsilon_{n+1} - \varepsilon_n &= \frac{20 \cdot \varepsilon_n}{20 + \varepsilon_n} - \varepsilon_n \\ &= \frac{20 \cdot \varepsilon_n - 20 \cdot \varepsilon_n - (\varepsilon_n)^2}{20 + \varepsilon_n} \\ &= \frac{-(\varepsilon_n)^2}{20 + \varepsilon_n} \\ &< 0\end{aligned}$$


---


$$\begin{aligned}\varepsilon_{n+1} - \varepsilon_n &< 0 \\ \varepsilon_{n+1} &< \varepsilon_n\end{aligned}$$

Thus, the sequence is decreasing.

Since the sequence is decreasing and is bounded below by 0, we know that the sequence converges (Monotone Convergence Theorem).

The only fixed point of the sequence can be found as follows:

$$\varepsilon_f = \frac{20 \cdot \varepsilon_f}{20 + \varepsilon_f}$$

$$20 \cdot \varepsilon_f + (\varepsilon_f)^2 = 20 \cdot \varepsilon_f$$

$$(\varepsilon_f)^2 = 0$$

$$\varepsilon_f = 0$$

Hence, the sequence converges to 0.

**Option a is correct.**

1 votes

-- Pragy Agarwal (19.5k points)

8.43

## Sequence Series(1) top

### 8.43.1 Sequence Series: GATE2016-Session-2-GA-8 top

<http://gateoverflow.in/108300>

Find the missing sequence in the letter series. B, FH, LNP, \_\_\_\_\_.

- A. SUWY
- B. TUVW
- C. TVXZ
- D. TWXZ

[gate2016session2aptitude](#) [sequence-series](#) [numerical-ability](#)

Answer

## Answers: Sequence Series

### 8.43.1 Sequence Series: GATE2016-Session-2-GA-8 top

<http://gateoverflow.in/108300>



Selected Answer

Answer is C

1 votes

-- Pavan Kumar Munnam (10k points)

8.44

## Sets(1) top

### 8.44.1 Sets: GATE 2016-2-GA-06 top

<http://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

[gate2016-2](#) [numerical-ability](#) [sets](#) [easy](#)

Answer

## Answers: Sets

### 8.44.1 Sets: GATE 2016-2-GA-06 [top](#)

<http://gateoverflow.in/39536>



Selected Answer

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

$$n(F \cap W') = n(F) - n(F \cap W) = 55 - 20 = 35$$

16 votes

-- Praveen Saini (53.5k points)

### 8.45

## Speed Time Distance(9) [top](#)

### 8.45.1 Speed Time Distance: GATE-2013-AE-GA-6 [top](#)

<http://gateoverflow.in/40247>

Q.61 Velocity of an object fired directly in upward direction is given by

$$V=80$$

$$-32$$

$t$ , where

$t$  (time) is in seconds. When will the velocity be between 32 m/sec and 64 m/sec?

- (A) (1, 3/2) (B) (1/2, 1)
- (C) (1/2, 3/2) (D) (1, 3)

[gate2013-ae](#) [numerical-ability](#) [speed-time-distance](#)

Answer

### 8.45.2 Speed Time Distance: GATE2013-64 [top](#)

<http://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](#) [numerical-ability](#) [easy](#) [speed-time-distance](#)
**Answer**

### 8.45.3 Speed Time Distance: GATE2013-ee-9 [top](#)

<http://gateoverflow.in/40296>

A car travels 8 km in the first quarter of an hour, 6 km in the second quarter and 16 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](#) [numerical-ability](#)
**Answer**

### 8.45.4 Speed Time Distance: GATE2014-EC01-GA8 [top](#)

<http://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-ec01](#) [numerical-ability](#) [speed-time-distance](#) [normal](#) [numerical-answers](#)
**Answer**

### 8.45.5 Speed Time Distance: GATE2014-EC02-GA10 [top](#)

<http://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-ec02](#) [numerical-ability](#) [speed-time-distance](#) [normal](#)
**Answer**

### 8.45.6 Speed Time Distance: GATE2014-EC03-GA8 [top](#)

<http://gateoverflow.in/41460>

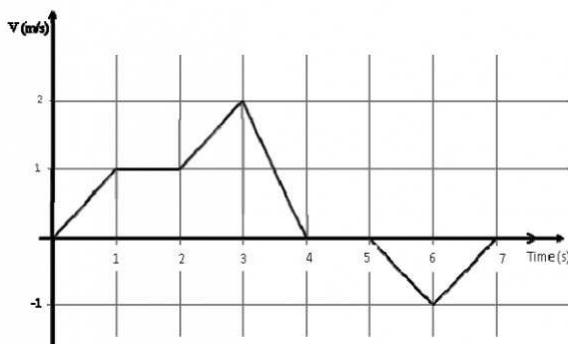
A man can row at 8 km per hour in still water. If it takes him thrice as long to row upstream, as to row downstream, then find the stream velocity in km per hour.

[gate2014-ec03](#) [numerical-ability](#) [speed-time-distance](#) [normal](#) [numerical-answers](#)
**Answer**

### 8.45.7 Speed Time Distance: GATE2016-Session-4-GA-6 [top](#)

<http://gateoverflow.in/110824>

The velocity  $V$  of a vehicle along a straight line is measured in  $m/s$  and plotted 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

[gate2016session4aptitude](#) [numerical-ability](#) [speed-time-distance](#) [data-interpretation](#)

[Answer](#)

### 8.45.8 Speed Time Distance: TIFR2012-A-16 [top](#)

<http://gateoverflow.in/25041>

Walking at  $\frac{4}{5}$  is normal speed a man is 10 minute too late. Find his usual time in minutes.

- a. 81  
b. 64  
c. 52  
d. 40  
e. It is not possible to determine the usual time from given data.

[tifr2012](#) [numerical-ability](#) [speed-time-distance](#)

[Answer](#)

### 8.45.9 Speed Time Distance: TIFR2017-A-3 [top](#)

<http://gateoverflow.in/94941>

On planet TIFR, the acceleration of an object due to gravity is half that on planet earth. An object on planet earth dropped from a height  $h$  takes time  $t$  to reach the ground. On planet TIFR, how much time would an object dropped from height  $h$  take to reach the ground?

- A.  $t/\sqrt{2}$   
B.  $\sqrt{2}t$   
C.  $2t$   
D.  $h/t$   
E.  $h/2t$

[tifr2017](#) [numerical-ability](#) [speed-time-distance](#)

[Answer](#)

## Answers: Speed Time Distance

### 8.45.1 Speed Time Distance: GATE-2013-AE-GA-6 [top](#)

<http://gateoverflow.in/40247>



Selected Answer

Given  $32 < 80 - 32t < 64$

$$-48 < -32t < -16$$

$$48 > 32t > 16$$

$$\frac{3}{2} > t > \frac{1}{2}$$

so ans ( 1

/ 2 , 3

/ 2 ) option c )

2 votes

-- sonam vyas (13.2k points)

### 8.45.2 Speed Time Distance: GATE2013-64 [top](#)

<http://gateoverflow.in/1568>



Selected Answer

let the total distance be D then

avg speed=D/total time taken  
 Total time taken=D/2\*60+D/4\*30+D/4\*10  
 avg speed- $120/5=24$

10 votes

-- Bhagirathi Nayak (13.3k points)

### 8.45.3 Speed Time Distance: GATE2013-ee-9 [top](#)

<http://gateoverflow.in/40296>



Selected Answer

40km/hr

2 votes

-- khamer (525 points)

### 8.45.4 Speed Time Distance: GATE2014-EC01-GA8 [top](#)

<http://gateoverflow.in/41497>



Selected Answer

Speed of train= $280/20=14\text{m/s}$

let L be length of platform

$280+L$  covered in 60s

$280+L/14=60$

$280+L=840$

$L=840-280$

$L=560\text{m}$

4 votes

-- Pooja Palod (32.4k points)

### 8.45.5 Speed Time Distance: GATE2014-EC02-GA10 [top](#)

<http://gateoverflow.in/41518>

lets say capacity of tank is 1 litre  
 draining rate=  $0.5\text{litre}/30\text{minutes}= 1/60 \text{ litre/min}$   
 let filling rate =  $x \text{ litre/min}$   
 in 1 min tank gets  $x-(1/60)$  litre filled.  
 to fill the remaining half part we need 10mins  
 $x-1/60 \text{ litre} \rightarrow 1\text{min}$   
 $0.5 \text{ litre} \rightarrow 10 \text{ mins}$   
 $0.5/(x-1/60) = 10$   
 solving, we get  $x= 4/60$   
 which is 4 times more than draining rate.  
 so option A

4 votes

-- Motamarri Anusha (11.6k points)

### 8.45.6 Speed Time Distance: GATE2014-EC03-GA8 [top](#)

<http://gateoverflow.in/41460>



Selected Answer

Speed of man (m) =  $8\text{km/h}$

Speed of stream (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 are same.

$$D = S_1 * T_1$$

$$D = S_2 * T_2$$

$$S_1 * T_1 = S_2 * T_2$$

$$\frac{S_1}{S_2} = \frac{T_2}{T_1} = 3$$

$$m+s = 3(m-s)$$

$$\text{or, } 8+s=3(8-s)$$

$$\text{or, } s=4\text{ km/h}$$

1 votes

-- srestha (58.3k points)

### 8.45.7 Speed Time Distance: GATE2016-Session-4-GA-6 [top](#)

<http://gateoverflow.in/110834>



Selected Answer

Odometer is a device used to measure distance travelled by an object.

Area under Velocity-Time graph represents the distance travelled.

So answer is =>  $0.5+1+1.5+1+0.5+0.5 = 5 \text{ m}$

1 votes

-- Akash Sheoran (1.7k points)

### 8.45.8 Speed Time Distance: TIFR2012-A-16 [top](#)

<http://gateoverflow.in/25041>



Selected Answer

Let man travel distance d with speed s in time t

$$d=st \quad \text{----- eqn 1}$$

Acc to que we get second equation

$$d=4/5s(t+10) \quad \text{----- eqn 2}$$

$$5/4t - t = 10$$

$$\text{So } t=40$$

$$\text{So ans is } d$$

3 votes

-- Pooja Palod (32.4k points)

### 8.45.9 Speed Time Distance: TIFR2017-A-3 [top](#)

<http://gateoverflow.in/94941>



Selected Answer

Let, The acceleration due to gravity on earth = g.

and the acceleration due to gravity on TIFR = G. = g/2.

$$\text{Time taken to reach the ground on earth} = t = \sqrt{2h/g}.$$

$$\text{Similarly, on TIFR planet, time taken} = T = \sqrt{2h/G} = \sqrt{4h/g}. // G = g/2.$$

$$==> T = \sqrt{2}t.$$

Ans - Option (b)

4 votes

-- Dhananjay Kumar Sharma (25.2k points)

**8.46****Statement Argument(1)** top**8.46.1 Statement Argument: GATE2015-2\_GA\_5** top<http://gateoverflow.in/8033>

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.

[gate2015-2](#) [numerical-ability](#) [normal](#) [logical-reasoning](#) [statement-argument](#)

[Answer](#)

**Answers: Statement Argument****8.46.1 Statement Argument: GATE2015-2\_GA\_5** top<http://gateoverflow.in/8033>

Selected Answer

Ans C

4 votes

-- Vikrant Singh (13.4k points)

**8.47****Statement Sufficiency(1)** top**8.47.1 Statement Sufficiency: GATE2015-1\_GA\_4** top<http://gateoverflow.in/8006>

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 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.

[gate2015-1](#) [numerical-ability](#) [easy](#) [statement-sufficiency](#)

[Answer](#)

**Answers: Statement Sufficiency****8.47.1 Statement Sufficiency: GATE2015-1\_GA\_4** top<http://gateoverflow.in/8006>



Selected Answer

- A. Statements I alone is sufficient, but statement II alone is not sufficient.

9 votes

-- Anoop Sonkar (4.8k points)

8.48

## Statistics(1) top

### 8.48.1 Statistics: GATE2012\_64 top

<http://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](#) [numerical-ability](#) [statistics](#) [normal](#)

[Answer](#)

## Answers: Statistics

### 8.48.1 Statistics: GATE2012\_64 top

<http://gateoverflow.in/2212>



Selected Answer

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.

$$\text{Standard Deviation } \sigma_I = \sqrt{\sum_{i=1}^n (M_I - x_i)^2}$$

$$\text{New Standard Deviation } \sigma_N = \sqrt{\sum_{i=1}^n (M_N - 2 \times x_i)^2}$$

$$= \sqrt{\sum_{i=1}^n (2 \times (M_I - x_i))^2}$$

$$= 2\sigma_I$$

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.

14 votes

-- Arjun Suresh (294k points)

8.49

**Summation(1)** top

### 8.49.1 Summation: ISI2013-A-2 top

<http://gateoverflow.in/47496>

Find the value of  $\sum ij$ , where the summation is over all integers  $i$  and  $j$  such that  $1 \leq i < j \leq 10$ .

isi2013 numerical-ability summation numerical-answers

Answer

### Answers: Summation

### 8.49.1 Summation: ISI2013-A-2 top

<http://gateoverflow.in/47496>



Selected Answer

**Given:  $1 \leq i < j \leq 10$**

$$\sum ij = (1.2 + 1.3 + \dots + 1.10) + (2.3 + 2.4 + \dots + 2.10) + (3.4 + 3.5 + \dots + 3.10) \dots (8.9 + 8.10) + 9.10$$

$$= 1.(2+3+4+\dots+10) + 2.(3+4+\dots+10) + 3.(4+5+\dots+10) + 4.(5+6+\dots+10) + 5.(6+7+\dots+10) + 6.(7+8+\dots+10) + 7.(8+9+10)$$

We know Sum of first Natural Numbers=

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

now,

$$\begin{aligned} &= 1.[\frac{n(n+1)}{2} - 1] + 2.[\frac{n(n+1)}{2} - 3] + 3.[\frac{n(n+1)}{2} - 6] + 4.[\frac{n(n+1)}{2} - 10] + 5.[\frac{n(n+1)}{2} - 15] + 6.[\frac{n(n+1)}{2} - 21] + 7.[\frac{n(n+1)}{2} - 28] + 8.[\frac{n(n+1)}{2} - 36] + 9.[\frac{n(n+1)}{2} - 45] \\ &= 55.[1+2+\dots+9] - \sum_{i=1}^9 i.(i+1)/2 \\ &= 55.45 - 1/2 \sum_{i=1}^{10} i^3 + i^2 \\ &= 2475 - 1/2(45^2 + 9.10.19/6) \\ &= 1320. \end{aligned}$$

1 votes

-- Leen Sharma (32.2k points)

8.50

**System Of Equations(1)** top

### 8.50.1 System Of Equations: GATE2011-GG-GA-6 top

<http://gateoverflow.in/40207>

Q.61 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](#) [numerical-ability](#) [system-of-equations](#)

[Answer](#)

## Answers: System Of Equations

### 8.50.1 System Of Equations: GATE2011-GG-GA-6 [top](#)

<http://gateoverflow.in/40207>

$$\begin{aligned} X_1 &\geq 0 & \dots[1] \\ X_2 &\geq 0 & \dots[2] \\ X_1 + X_2 &\leq 10 & \dots[3] \\ 2X_1 + 2X_2 &\geq 22 & \dots[4] \end{aligned}$$

Now the equation [4] can be written as

$$X_1 + X_2 \geq 11 \quad \dots[5]$$

Now equation [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.

Hence **Answer A)0**

2 votes

-- Abhilash Panicker (8.8k points)

### 8.51

## Variance(1) [top](#)

### 8.51.1 Variance: GATE2014-EC01-GA4 [top](#)

<http://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-ec01](#) [statistics](#) [variance](#) [numerical-ability](#)

[Answer](#)

## Answers: Variance

### 8.51.1 Variance: GATE2014-EC01-GA4 [top](#)

<http://gateoverflow.in/41493>



Selected Answer

I think the 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)

3 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

## 8.52

## Venn Diagrams(2) top

### 8.52.1 Venn Diagrams: GATE2010-59 top

<http://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](#) [numerical-ability](#) [easy](#) [set-theory&algebra](#) [venn-diagrams](#)

[Answer](#)

### 8.52.2 Venn Diagrams: GATE2011-GG-GA-7 top

<http://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](#) [numerical-ability](#) [set-theory&algebra](#) [venn-diagrams](#)

[Answer](#)

## Answers: Venn Diagrams

### 8.52.1 Venn Diagrams: GATE2010-59 top

<http://gateoverflow.in/2367>



Selected Answer

D. 3

No. of persons who play either football or hockey =  $15 + 17 - 10 = 22$

No. of persons playing neither hockey nor football =  $25 - 22 = 3$

7 votes

-- shreya ghosh (3.4k points)

### 8.52.2 Venn Diagrams: GATE2011-GG-GA-7 top

<http://gateoverflow.in/40208>



Selected Answer

Let the no. of students who took all courses be  $x$ .

Since every one must take at least 1 course, we have

$$200 - x + 100 - x + 60 - x \geq 300 - x \implies 360 - 2x \geq 300 \implies x \leq 30.$$

4 votes

-- Arjun Suresh (294k points)

8.53

## Work Time(3) top

### 8.53.1 Work Time: GATE2010-64 top

<http://gateoverflow.in/2372>

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 will it take to build the wall?

- A. 20 days
- B. 18 days
- C. 16 days
- D. 15 days

[gate2010](#) [numerical-ability](#) [normal](#) [work-time](#)

[Answer](#)

### 8.53.2 Work Time: GATE2011\_64 top

<http://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](#) [numerical-ability](#) [normal](#) [work-time](#)

[Answer](#)

### 8.53.3 Work Time: GATE2013-65 top

<http://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](#) [numerical-ability](#) [normal](#) [work-time](#)

[Answer](#)

## Answers: Work Time

### 8.53.1 Work Time: GATE2010-64 top

<http://gateoverflow.in/2372>



Selected Answer

- D. 15 days

1 skilled person can do 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 respectively in 1 day.

so they do 1/15 of work together in 1 day, which gives required number of day to complete the work = 15 .

10 votes

-- shreya ghosh (3.4k points)

### 8.53.2 Work Time: GATE2011\_64 [top](#)



Selected Answer

Let the amount of orders received per day be  $x$  and let the amount of pending orders be  $y$  and let the amount of orders carried by a truck each day be  $z$ .

$$7z * 4 = 4x + y \rightarrow (1)$$

$$3z * 10 = 10x + y \quad (2)$$

$$(2) - (1) \Rightarrow 2z = 6x, z = 3x, y = 80x$$

We want to find the number of trucks to finish the orders in 5 days. Let it be  $A$ .

$$Az * 5 = 5x + y$$

$$15Ax = 5x + 80x$$

$$A = 85/15 = 17/3 = 5.67$$

So, minimum 6 trucks must be used.

18 votes

-- Arjun Suresh (294k points)

### 8.53.3 Work Time: GATE2013-65 [top](#)



Selected Answer

Since wages per day increase by 1/5 of current wages, new wages per day becomes  $6/5$  of current wages.

Similarly new working hours are  $23/24$  of current working hours.

So new erection cost becomes  $13200 * 6/5 * 23/24 = 15180$ .

So option (B) is correct.

4 votes

-- Happy Mittal (10.9k points)

## 9 General Aptitude: Verbal Ability (155) [top](#)

9.1

Closest Word(3) [top](#)

### 9.1.1 Closest Word: GATE 2013-ee-1 [top](#)

<http://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-ability](#) [closest-word](#)

[Answer](#)

### 9.1.2 Closest Word: GATE2013-CE-3 [top](#)

<http://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](#)

### 9.1.3 Closest Word: gate-2014-ae-1 [top](#)

<http://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

[gate-2014-ae](#) [closest-word](#)

[Answer](#)

## Answers: Closest Word

### 9.1.1 Closest Word: GATE 2013-ee-1 [top](#)

<http://gateoverflow.in/40288>

Selected Answer

**quarrel** means having an argument.  
option D) **fall out** means the same.

4 votes

-- Monanshi Jain (8.4k points)

### 9.1.2 Closest Word: GATE2013-CE-3 [top](#)

<http://gateoverflow.in/40270>

Selected Answer

Ans C--> Primitive, its synonym for Primeval

1 votes

-- UK (2k points)

### 9.1.3 Closest Word: gate-2014-ae-1 [top](#)

<http://gateoverflow.in/40300>



Selected Answer

comprehension means understanding.  
option A.

3 votes

-- Monanshi Jain (8.4k points)

## 9.2

### English Grammar(21) [top](#)

#### 9.2.1 English Grammar: GATE 2016-2-GA-01 [top](#)

<http://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

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

[gate2016-2](#) [verbal-ability](#) [english-grammar](#) [normal](#)

[Answer](#)

#### 9.2.2 English Grammar: GATE-2013-AE-GA-2 [top](#)

<http://gateoverflow.in/40243>

Q.57 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-ability](#) [english-grammar](#)

[Answer](#)

#### 9.2.3 English Grammar: GATE-2013-AE-GA-4 [top](#)

<http://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-ability](#)

[Answer](#)

## 9.2.4 English Grammar: GATE2012-AR-3 [top](#)

<http://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-ability](#) [english-grammar](#) [easy](#)

[Answer](#)

## 9.2.5 English Grammar: GATE2012-AR-4 [top](#)

<http://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-ability](#) [english-grammar](#)

[Answer](#)

## 9.2.6 English Grammar: GATE2013-CE-2 [top](#)

<http://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-ability](#)

[Answer](#)

## 9.2.7 English Grammar: GATE2013-ee-4 [top](#)

<http://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-ability](#)

[Answer](#)

## 9.2.8 English Grammar: GATE2014-3-GA-1 [top](#)

<http://gateoverflow.in/2024>

While trying to collect an envelope from under the table, Mr. X fell down and

I

II

III

was losing consciousness.

IV

Which one of the above underlined parts of the sentence is NOT appropriate?

- A. I
- B. II
- C. III
- D. IV

[gate2014-3](#) [verbal-ability](#) [easy](#) [english-grammar](#)

[Answer](#)

## 9.2.9 English Grammar: GATE2014-3-GA-2 [top](#)

<http://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

[gate2014-3](#) [verbal-ability](#) [easy](#) [english-grammar](#)

[Answer](#)

## 9.2.10 English Grammar: GATE2014-EC02-GA2 [top](#)

<http://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-ec02](#) [verbal-ability](#) [english-grammar](#) [normal](#)

[Answer](#)

## 9.2.11 English Grammar: GATE2015-1\_GA\_1 [top](#)

<http://gateoverflow.in/7995>

Didn't you buy \_\_\_\_\_ when you went shopping?

- A. any paper
- B. much paper
- C. no paper
- D. a few paper

[gate2015-1](#) [verbal-ability](#) [easy](#) [english-grammar](#)

[Answer](#)

## 9.2.12 English Grammar: GATE2015-2\_GA\_1 [top](#)

<http://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

[gate2015-2](#) | [verbal-ability](#) | [easy](#) | [english-grammar](#)

[Answer](#)

### 9.2.13 English Grammar: GATE2015-2\_GA\_10 [top](#)

<http://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.

[gate2015-2](#) | [verbal-ability](#) | [normal](#) | [english-grammar](#)

[Answer](#)

### 9.2.14 English Grammar: GATE2015-3\_GA\_2 [top](#)

<http://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

[gate2015-3](#) | [verbal-ability](#) | [normal](#) | [english-grammar](#)

[Answer](#)

### 9.2.15 English Grammar: GATE2016-1-GA01 [top](#)

<http://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.

[gate2016-1](#) | [verbal-ability](#) | [english-grammar](#) | [easy](#)

[Answer](#)

### 9.2.16 English Grammar: GATE2016-1-GA03 [top](#)

<http://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

[gate2016-1](#) | [verbal-ability](#) | [normal](#) | [english-grammar](#)

[Answer](#)

## 9.2.17 English Grammar: GATE2016-Session-1-GA-1 [top](#)

<http://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

[gate2016session1aptitude](#) [verbal-ability](#) [english-grammar](#)

[Answer](#)

## 9.2.18 English Grammar: GATE2016-Session-3-GA-1 [top](#)

<http://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.

[gate2016session3aptitude](#) [verbal-ability](#) [english-grammar](#)

[Answer](#)

## 9.2.19 English Grammar: GATE2016-Session-7-GA-1 [top](#)

<http://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

[gate2016session7aptitude](#) [verbal-ability](#) [english-grammar](#)

[Answer](#)

## 9.2.20 English Grammar: GATE2017-1-GA-2 [top](#)

<http://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

[gate2017-1](#) [verbal-ability](#) [english-grammar](#)

[Answer](#)

## 9.2.21 English Grammar: GATE2017-2-GA-2 [top](#)

<http://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

gate2017-2 | verbal-ability | english-grammar

Answer

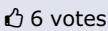
## Answers: English Grammar

### 9.2.1 English Grammar: GATE 2016-2-GA-01 [top](#)



Selected Answer

option b



6 votes

-- Mohit Kumar Gupta (245 points)

<http://gateoverflow.in/39529>

### 9.2.2 English Grammar: GATE-2013-AE-GA-2 [top](#)

<http://gateoverflow.in/40243>

#### Answer is C

"want" is a plural verb. So it cannot follow a singular noun "Headmaster".



3 votes

-- Anand Vijayan (883 points)

### 9.2.3 English Grammar: GATE-2013-AE-GA-4 [top](#)

<http://gateoverflow.in/40245>

I will have to go with D on this one.

All engineering students should learn mechanics, mathematics and computation.

or possibly

All engineering students should learn how to do mechanics, mathematics and computation.



5 votes

-- Kathleen Bankson (64.5k points)

### 9.2.4 English Grammar: GATE2012-AR-3 [top](#)

<http://gateoverflow.in/40224>

Selected Answer

Answer should be "D"

#### Lay vs. Lie Chart

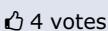
Infinitive   Definition   Present   Past   Past Participle   Present Participle

to lay   to put or place   lay(s)   laid   laid   laying  
something down

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**



4 votes

-- Prateek Kumar (6k points)

### 9.2.5 English Grammar: GATE2012-AR-4 [top](#)

<http://gateoverflow.in/40225>

"to 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/>

1 3 votes

-- Arjun Suresh (294k points)

## 9.2.6 English Grammar: GATE2013-CE-2 [top](#)

<http://gateoverflow.in/40269>

B) II

The correct phrase is **ordered**.

This [link](#) explains the correct use of the verb *order*.

1 2 votes

-- Gaurav Sharma (2.6k points)

## 9.2.7 English Grammar: GATE2013-ee-4 [top](#)

<http://gateoverflow.in/40291>



D) seems to be correct ans.

1 5 votes

-- Manashi Sarkar (351 points)

## 9.2.8 English Grammar: GATE2014-3-GA-1 [top](#)

<http://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>

1 7 votes

-- Srinath Jayachandran (3.7k points)

## 9.2.9 English Grammar: GATE2014-3-GA-2 [top](#)

<http://gateoverflow.in/2025>



Selected Answer

To answer these I normally use the language (even English itself) I am fluent in.  
Option C makes perfect sense, rest do not relate to each other.

8 votes

-- Srinath Jayachandran (3.7k points)

## 9.2.10 English Grammar: GATE2014-EC02-GA2 [top](#)

<http://gateoverflow.in/41509>

Answer will be (B)

5 votes

-- srestha (58.3k points)

## 9.2.11 English Grammar: GATE2015-1\_GA\_1 [top](#)

<http://gateoverflow.in/7995>

Selected Answer

A] Any paper

7 votes

-- Kathleen Bankson (64.5k points)

## 9.2.12 English Grammar: GATE2015-2\_GA\_1 [top](#)

<http://gateoverflow.in/8028>

Selected Answer

answer is option c

7 votes

-- naresh1845 (1.4k points)

## 9.2.13 English Grammar: GATE2015-2\_GA\_10 [top](#)

<http://gateoverflow.in/8041>

Selected Answer

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.

Another copied question.

<https://books.google.co.in/books?id=pEs8BAAQBAJ&pg=PA456&lpg=PA456&dq=The+report+was+useless+to+them+because+there+was+no+needed+information+in+it&hl=en&sa=X&ei=ODbmVJniN4zjaLzkgNgC&ved=0CB8Q6AEwAA#v=onepage&q=The%20report%20was%20useless%20to%20them>

6 votes

-- Arjun Suresh (294k points)

## 9.2.14 English Grammar: GATE2015-3\_GA\_2 [top](#)

<http://gateoverflow.in/8300>

Selected Answer

answer is c

13 votes

-- naresh1845 (1.4k points)

## 9.2.15 English Grammar: GATE2016-1-GA01 [top](#)

<http://gateoverflow.in/39608>



Selected Answer

ans will be d

17 votes

-- Pooja Palod (32.4k points)

## 9.2.16 English Grammar: GATE2016-1-GA03 [top](#)

<http://gateoverflow.in/39606>

A) Figurative

9 votes

-- Abhilash Panicker (8.8k points)

## 9.2.17 English Grammar: GATE2016-Session-1-GA-1 [top](#)

<http://gateoverflow.in/108061>

Selected Answer

Mount Everest is **the highest peak in the world.**  
option A

3 votes

-- Shobhit (17.8k points)

## 9.2.18 English Grammar: GATE2016-Session-3-GA-1 [top](#)

<http://gateoverflow.in/108474>

Selected Answer

Option C. That is too obvious and we use it sometime in our vocab too, right ? -\_-

1 votes

-- robin sharma (283 points)

## 9.2.19 English Grammar: GATE2016-Session-7-GA-1 [top](#)

<http://gateoverflow.in/110868>

If I were you, I **wouldn't buy** that laptop. It's much too expensive  
**option C.**

2 votes

-- Shobhit (17.8k points)

## 9.2.20 English Grammar: GATE2017-1-GA-2 [top](#)

<http://gateoverflow.in/116405>

Selected Answer

okay in this kind of cases it is **BESIDES**

so D is the answer i think

3 votes

-- Aboveallplayer (18.5k points)

## 9.2.21 English Grammar: GATE2017-2-GA-2 [top](#)

<http://gateoverflow.in/118416>

Selected Answer

Option B-bright enough

3 votes

-- Swapnil (2k points)

## 9.3

## Geometry(1) [top](#)

### 9.3.1 Geometry: GATE2016-Session-7-GA-9 [top](#)

<http://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.  $0.25x^2$

[gate2016session7aptitude](#) [geometry](#) [numerical-ability](#)

[Answer](#)

### Answers: Geometry

### 9.3.1 Geometry: GATE2016-Session-7-GA-9 [top](#)

<http://gateoverflow.in/110921>



Selected Answer

Given, perimeter of a pyramid is  $x$ , so slant height is  $x/2$ .

Lateral Surface Area of a pyramid

$$\begin{aligned} &= 1/2 * \text{perimeter} * \text{slant height} \\ &= 1/2 * x * x/2 \\ &= 0.25 x^2 \end{aligned}$$

so option D is correct.

0 votes

-- Bikram (44.7k points)

## 9.4

### Grammatically Incorrect Sentence(2) [top](#)

### 9.4.1 Grammatically Incorrect Sentence: GATE2012\_59 [top](#)

<http://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](#) [verbal-ability](#) [grammatically-incorrect-sentence](#) [normal](#)

[Answer](#)

### 9.4.2 Grammatically Incorrect Sentence: GATE2013\_60 [top](#)

<http://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](#) [verbal-ability](#) [grammatically-incorrect-sentence](#) [normal](#)

[Answer](#)

### Answers: Grammatically Incorrect Sentence

### 9.4.1 Grammatically Incorrect Sentence: GATE2012\_59 [top](#)

<http://gateoverflow.in/2198>



Selected Answer

D.... "is very less" should be "is much less".

4 votes

-- Kathleen Bankson (64.5k points)

### 9.4.2 Grammatically Incorrect Sentence: GATE2013\_60 [top](#)

<http://gateoverflow.in/1564>



Selected Answer

C. Should be... 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".

10 votes

-- Kathleen Bankson (64.5k points)

## 9.5

### Inference(2) [top](#)

#### 9.5.1 Inference: GATE2012\_61 [top](#)

<http://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?

- (A) Gender-discriminatory
- (B) Xenophobic
- (C) Not designed to make the post attractive
- (D) Not gender-discriminatory

[gate2012](#) [verbal-ability](#) [inference](#) [normal](#)

[Answer](#)

#### 9.5.2 Inference: GATE2014-1-GA-7 [top](#)

<http://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:

- A. Strategies are now available for eliminating psychiatric illnesses
- B. Certain psychiatric illnesses have a genetic basis
- C. All human diseases can be traced back to genes and how they are expressed
- D. In the future, genetics will become the only relevant field for identifying psychiatric illnesses

[gate2014-1](#) [verbal-ability](#) [inference](#) [normal](#)

[Answer](#)

### Answers: Inference

#### 9.5.1 Inference: GATE2012\_61 [top](#)

<http://gateoverflow.in/2209>



Selected Answer

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.

9 votes

-- Kathleen Bankson (64.5k points)

## 9.5.2 Inference: GATE2014-1-GA-7 [top](#)

<http://gateoverflow.in/775>



Selected Answer

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.

12 votes

-- Kathleen Bankson (64.5k points)

## 9.6

## Logical Reasoning(15) [top](#)

### 9.6.1 Logical Reasoning: GATE 2013-ee-5 [top](#)

<http://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](#) [logical-reasoning](#) [verbal-ability](#)

Answer

### 9.6.2 Logical Reasoning: GATE 2016-2-GA-08 [top](#)

<http://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)

[gate2016-2](#) | [verbal-ability](#) | [logical-reasoning](#) | [easy](#)**Answer**

### 9.6.3 Logical Reasoning: GATE-2013-AE-GA-3 [top](#)

<http://gateoverflow.in/40244>

- Q.58 Mahatama 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-ability](#) | [logical-reasoning](#)**Answer**

### 9.6.4 Logical Reasoning: GATE-2013-AE-GA-9 [top](#)

<http://gateoverflow.in/40250>

- Q.65 All professors are researchers Some scientists are professors Which of the given conclusions is logically valid and is inferred from the above arguments:  
(A) All scientists are researchers  
(B) All professors are scientists  
(C) Some researchers are scientists  
(D) No conclusion follows

[gate2013-ae](#) | [verbal-ability](#) | [logical-reasoning](#)**Answer**

### 9.6.5 Logical Reasoning: GATE2012-AR-8 [top](#)

<http://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](#) | [verbal-ability](#)**Answer**

### 9.6.6 Logical Reasoning: GATE2016-1-GA04 [top](#)

<http://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. tagazen.
- D. refffer.

[gate2016-1](#) | [verbal-ability](#) | [logical-reasoning](#) | [normal](#)**Answer**

### 9.6.7 Logical Reasoning: GATE2016-1-GA08 [top](#)

<http://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)

[gate2016-1](#) [numerical-ability](#) [logical-reasoning](#) [normal](#)

[Answer](#)

### 9.6.8 Logical Reasoning: GATE2016-Session-1-GA-5 [top](#)

<http://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

[gate2016session1aptitude](#) [logical-reasoning](#) [numerical-ability](#)

[Answer](#)

### 9.6.9 Logical Reasoning: GATE2016-Session-2-GA-1 [top](#)

<http://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

[gate2016session2aptitude](#) [logical-reasoning](#)

[Answer](#)

### 9.6.10 Logical Reasoning: GATE2016-Session-2-GA-2 [top](#)

<http://gateoverflow.in/108249>

The unruly crowd demanded that the accused be \_\_\_\_\_ without trial.

- A. Hanged
- B. Hanging
- C. Hankering
- D. Hung

[gate2016session2aptitude](#) [logical-reasoning](#) [verbal-ability](#)

[Answer](#)

### 9.6.11 Logical Reasoning: GATE2016-Session-2-GA-4 [top](#)

<http://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).

[gate2016session2aptitude](#) [logical-reasoning](#)

[Answer](#)

## 9.6.12 Logical Reasoning: GATE2016-Session-3-GA-3 [top](#)

<http://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

[gate2016session3aptitude](#) [verbal-ability](#) [logical-reasoning](#)

[Answer](#)

## 9.6.13 Logical Reasoning: GATE2016-Session-3-GA-8 [top](#)

<http://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

[gate2016session3aptitude](#) [logical-reasoning](#)

[Answer](#)

## 9.6.14 Logical Reasoning: GATE2016-Session-7-GA-10 [top](#)

<http://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

[gate2016session7aptitude](#) [logical-reasoning](#) [numerical-ability](#)

[Answer](#)

## 9.6.15 Logical Reasoning: gate2013-ce-10 [top](#)

<http://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 verbal-ability

[Answer](#)

## Answers: Logical Reasoning

### 9.6.1 Logical Reasoning: GATE 2013-ee-5 [top](#)



Selected Answer

C) seems to be an appropriate option.

14 votes

-- Monanshi Jain (8.4k points)

<http://gateoverflow.in/40292>

### 9.6.2 Logical Reasoning: GATE 2016-2-GA-08 [top](#)



Selected Answer

All hill stations have a lake.  $\Rightarrow$  For all  $x$  ( $h(x) \Rightarrow (\exists y, l(y) \wedge has(x,y))$ )  
 Ooty has two lakes  $\Rightarrow$  There exist  $x$  ( $o(x) \wedge \exists y,z$  ( $has(x,y,z) \wedge l(y) \wedge l(z) \wedge (y \neq z)$ ))  
 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.  $\Rightarrow$  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  $\Rightarrow$  (D) neither (i) nor (ii)

14 votes

-- Akash (43.8k points)

<http://gateoverflow.in/39534>

### 9.6.3 Logical Reasoning: GATE-2013-AE-GA-3 [top](#)

<http://gateoverflow.in/40244>

Answer C: He displayed modesty in his interactions.

hu·mil·i·ty

(h)yoo'-mildē/

noun

a modest or low view of one's own importance; humbleness.  
 synonyms: [modesty](#), humbleness, [meekness](#), [diffidence](#), unassertiveness; [More](#)

2 votes

-- Kathleen Bankson (64.5k points)

<http://gateoverflow.in/40250>

### 9.6.4 Logical Reasoning: GATE-2013-AE-GA-9 [top](#)



Selected Answer

Answer C: If some scientists are professors and all professors are researchers, then that means that some scientists are researchers.

2 votes

-- Kathleen Bankson (64.5k points)

<http://gateoverflow.in/40250>

### 9.6.5 Logical Reasoning: GATE2012-AR-8 [top](#)

<http://gateoverflow.in/40229>



**BALU IS TALLEST.**

Ravi cann't be the answer since its clearly mentioned that ravi < iqbal.

Iqbal and balu could be tallest as no comparison is provided where these two are smaller than anyone.

Since Iqbal is not mentioned in options. 😊

Hence we may conclude that Balu is tallest.

✍ 3 votes

-- Govind Krishna Tewari (1.3k points)

### 9.6.6 Logical Reasoning: GATE2016-1-GA04 [top](#)



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-zem" are the options. But "fer" means less.

Hence **answer is C**

✍ 22 votes

-- ryan sequeira (3k points)

### 9.6.7 Logical Reasoning: GATE2016-1-GA08 [top](#)



i think answer is d because

i) p is not likely to beat s because s only loses sometimes to p

ii) s is not worst player because he is likely to beat p

✍ 31 votes

-- Vaibhav Singh (601 points)

### 9.6.8 Logical Reasoning: GATE2016-Session-1-GA-5 [top](#)



c option is correct

michal -----10km-----I LIVE

AHMED-----5KM-----I LIVE

SUSAN-----7KM-----I LIVE

SUSAN--ARUN--AHMED-----ILIVE

SO ARUN IS BETWEEN 7 KM AND MORE THEN 5 KM SO HERE ANS IS LESS THEN 7 KM

ANS C 6KM

1 votes

-- AKANKSHA DEWANGAN (3.1k points)

### 9.6.9 Logical Reasoning: GATE2016-Session-2-GA-1 [top](#)



Selected Answer

The volume of a sphere of diameter 11 unit is **less** than the volume of a cube of side 11 unit.  
option B..

2 votes

-- Shobhit (17.8k points)

### 9.6.10 Logical Reasoning: GATE2016-Session-2-GA-2 [top](#)



Selected Answer

The unruly crowd demanded that the accused be **hanged** without trial.  
option A.

2 votes

-- Shobhit (17.8k points)

### 9.6.11 Logical Reasoning: GATE2016-Session-2-GA-4 [top](#)



Selected Answer

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.

0 votes

-- Bikram (44.7k points)

### 9.6.12 Logical Reasoning: GATE2016-Session-3-GA-3 [top](#)



Selected Answer

Ans: (C) rest is well known

1 votes

-- Arnabi (6.4k points)

### 9.6.13 Logical Reasoning: GATE2016-Session-3-GA-8 [top](#)



Selected Answer

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

2 votes

-- rajukalyadapu (117 points)

### 9.6.14 Logical Reasoning: GATE2016-Session-7-GA-10 [top](#)

<http://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 3rd hour, Bharath is left with 60 pages and ananth is left with 120 pages.

So, 3 is the answer.

Upvote 2 votes

-- Adithya Kasarla (151 points)

### 9.6.15 Logical Reasoning: gate2013-ce-10 [top](#)

<http://gateoverflow.in/40280>



D) No conclusion follows as we cannot derive any relationship between Abhishek and Anshul with the given data.

Upvote 5 votes

-- vamsi2376 (4.1k points)

## 9.7

### Meaning(16) [top](#)

#### 9.7.1 Meaning: GATE 2016-2-GA-02 [top](#)

<http://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.

[gate2016-2](#) [verbal-ability](#) [meaning](#) [normal](#)

Answer

#### 9.7.2 Meaning: GATE2010-57 [top](#)

<http://gateoverflow.in/2365>

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](#) [verbal-ability](#) [meaning](#) [normal](#)

Answer

#### 9.7.3 Meaning: GATE2011\_56 [top](#)

<http://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 verbal-ability meaning normal

Answer

**9.7.4 Meaning: GATE2012\_58** [top](#)

<http://gateoverflow.in/2197>

Which one of the following options is the closest in meaning to the word given below?

**Mitigate**

- (A) Diminsh
- (B) Divulge
- (C) Dedicate
- (D) Denote

gate2012 verbal-ability meaning easy

Answer

**9.7.5 Meaning: GATE2013-56** [top](#)

<http://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 verbal-ability meaning normal

Answer

**9.7.6 Meaning: GATE2014-1-GA-1** [top](#)

<http://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-ability gate2014-1 meaning easy

Answer

**9.7.7 Meaning: GATE2014-1-GA-3** [top](#)

<http://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

[gate2014-1](#) | [verbal-ability](#) | [normal](#) | [meaning](#)

[Answer](#)

## 9.7.8 Meaning: GATE2014-2-GA-3 [top](#)

<http://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

[gate2014-2](#) | [verbal-ability](#) | [meaning](#) | [normal](#)

[Answer](#)

## 9.7.9 Meaning: GATE2014-EC04-GA1 [top](#)

<http://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-ec04](#) | [verbal-ability](#) | [meaning](#) | [normal](#)

[Answer](#)

## 9.7.10 Meaning: GATE2014-EC04-GA2 [top](#)

<http://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-ec04](#) | [verbal-ability](#) | [meaning](#) | [easy](#)

[Answer](#)

## 9.7.11 Meaning: GATE2014-EC04-GA3 [top](#)

<http://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-ec04](#) | [verbal-ability](#) | [meaning](#) | [normal](#)

[Answer](#)

## 9.7.12 Meaning: GATE2015-1\_GA\_2 [top](#)

<http://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

gate2015-1 | verbal-ability | easy | meaning

Answer

### 9.7.13 Meaning: GATE2015-1\_GA\_7 [top](#)

<http://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

gate2015-1 | verbal-ability | meaning | easy

Answer

### 9.7.14 Meaning: GATE2015-2\_GA\_2 [top](#)

<http://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.

gate2015-2 | verbal-ability | meaning | normal

Answer

### 9.7.15 Meaning: GATE2016-1-GA02 [top](#)

<http://gateoverflow.in/3960>

A rewording of something written or spoken is a \_\_\_\_\_.

- A. paraphrase
- B. paradox
- C. paradigm
- D. paraffin

gate2016-1 | verbal-ability | meaning | normal

Answer

### 9.7.16 Meaning: GATE2016-Session-1-GA-2 [top](#)

<http://gateoverflow.in/108064>

The policeman asked the victim of a theft, "What did you \_\_\_ ?"

- A. Loose
- B. Lose
- C. Loss
- D. Louse

gate2016session1aptitude | verbal-ability | meaning

[Answer](#)

## Answers: Meaning

### 9.7.1 Meaning: GATE 2016-2-GA-02 [top](#)

<http://gateoverflow.in/3951>

Selected Answer

but 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.

[11 votes](#)

-- UK (2k points)

option d

put up with: tolerate  
put in with: to partner with  
put down to: attribute  
put up against: to place someone into competition with someone else

[11 votes](#)

-- Mohit Kumar Gupta (245 points)

### 9.7.2 Meaning: GATE2010-57 [top](#)

<http://gateoverflow.in/2365>

Selected Answer

B Indirect

Synonyms for circuitous

adj going around, indirect

[5 votes](#)

-- Kathleen Bankson (64.5k points)

### 9.7.3 Meaning: GATE2011\_56 [top](#)

<http://gateoverflow.in/2165>

Selected Answer

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

[8 votes](#)

-- Kalpana Bhargav (3.2k points)

### 9.7.4 Meaning: GATE2012\_58 [top](#)

<http://gateoverflow.in/2197>

Selected Answer

A. Diminish

[5 votes](#)

-- Kathleen Bankson (64.5k points)

### 9.7.5 Meaning: GATE2013-56 [top](#)

<http://gateoverflow.in/1559>

Selected Answer

B, the lowest point

1 upvotes

-- Kathleen Bankson (64.5k points)

### 9.7.6 Meaning: GATE2014-1-GA-1 [top](#)

<http://gateoverflow.in/55>

Selected Answer

Answer is Adapt to. Often seen in newspaper "Indian players couldn't 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."

1 upvotes

-- Arjun Suresh (294k points)

### 9.7.7 Meaning: GATE2014-1-GA-3 [top](#)

<http://gateoverflow.in/772>

Selected Answer

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.

1 upvotes

-- Kathleen Bankson (64.5k points)

### 9.7.8 Meaning: GATE2014-2-GA-3 [top](#)

<http://gateoverflow.in/1940>

Selected Answer

**Answer is A**

1 upvotes

-- Poshita Shrivastava (1k points)

### 9.7.9 Meaning: GATE2014-EC04-GA1 [top](#)

<http://gateoverflow.in/41463>

Selected Answer

Ans will be (A) Dissent , which means disagree

1 upvotes

-- srestha (58.3k points)

### 9.7.10 Meaning: GATE2014-EC04-GA2 [top](#)

<http://gateoverflow.in/41464>

Selected Answer

Revert means to get back..  
Answer B) Get back to him

1 upvotes

-- Abhilash Panicker (8.8k points)

### 9.7.11 Meaning: GATE2014-EC04-GA3 [top](#)

<http://gateoverflow.in/41465>

Selected Answer

**option B****Vindicated means to free from allegation(unproved) and substantiate means prove the truth of.**

↳ 2 votes

-- Prateek Banra (205 points)

**9.7.12 Meaning: GATE2015-1\_GA\_2 [top](#)**<http://gateoverflow.in/8003>

Selected Answer

C. She had a terrific time at the party

↳ 5 votes

-- Kathleen Bankson (64.5k points)

**9.7.13 Meaning: GATE2015-1\_GA\_7 [top](#)**<http://gateoverflow.in/8011>

Selected Answer

C Took to flight

↳ 7 votes

-- Kathleen Bankson (64.5k points)

**9.7.14 Meaning: GATE2015-2\_GA\_2 [top](#)**<http://gateoverflow.in/8029>

Selected Answer

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.

↳ 6 votes

-- Rajarshi Sarkar (35k points)

**9.7.15 Meaning: GATE2016-1-GA02 [top](#)**<http://gateoverflow.in/39607>

Selected Answer

paraphrase

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

↳ 11 votes

-- Pooja Palod (32.4k points)

**9.7.16 Meaning: GATE2016-Session-1-GA-2 [top](#)**<http://gateoverflow.in/108064>

Selected Answer

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 .

↳ 1 votes

-- Bikram (44.7k points)

**9.8****Median(1)** [top](#)**9.8.1 Median: GATE2016-Session-2-GA-6** [top](#)<http://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.

[gate2016session2aptitude](#) [median](#) [engineering-mathematics](#) [probability](#)

[Answer](#)

**Answers: Median****9.8.1 Median: GATE2016-Session-2-GA-6** [top](#)<http://gateoverflow.in/108297>

Selected Answer

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.

0 votes

-- Bikram (44.7k points)

**9.9****Most Appropriate Alternative(4)** [top](#)**9.9.1 Most Appropriate Alternative: GATE-2012-AE-1** [top](#)<http://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](#) [most-appropriate-alternative](#) [verbal-ability](#)

[Answer](#)

**9.9.2 Most Appropriate Alternative: GATE-2012-AE-2** [top](#)<http://gateoverflow.in/40213>

Choose the most appropriate alternative from the options given below to complete the following sentence:

Food prices \_\_\_ again this month.

(A) have raised (B) have been raising  
(C) have been rising (D) have arose

gate2012-ae | verbal-ability | most-appropriate-alternative

[Answer](#)

### 9.9.3 Most Appropriate Alternative: GATE2012-CY-GA-5 [top](#)

<http://gateoverflow.in/40236>

Q.60 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.**

- (A) should take
- (B) shall take
- (C) should have taken
- (D) will have taken

gate2012-cy | most-appropriate-alternative | english-grammar | verbal-ability

[Answer](#)

### 9.9.4 Most Appropriate Alternative: GATE2012\_57 [top](#)

<http://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.**

- (A) attempts
- (B) setbacks
- (C) meetings
- (D) delegations

gate2012 | verbal-ability | easy | most-appropriate-alternative

[Answer](#)

## Answers: Most Appropriate Alternative

### 9.9.1 Most Appropriate Alternative: GATE-2012-AE-1 [top](#)

<http://gateoverflow.in/40212>



Selected Answer

Ans C

I **would like** to have bought a diamond ring.

1 votes

-- Abhilash Panicker (8.8k points)

### 9.9.2 Most Appropriate Alternative: GATE-2012-AE-2 [top](#)

<http://gateoverflow.in/40213>



Selected Answer

Food price **have been rising again** this month.

Answer C.

- A) wrong - have risen
- B) wrong
- D) wrong - have risen

0 votes

-- Abhilash Panicker (8.8k points)

### 9.9.3 Most Appropriate Alternative: GATE2012-CY-GA-5 [top](#)

<http://gateoverflow.in/40236>



Selected Answer

**Answer C:** If the tired soldier wanted to lie down, he should have taken the mattress out on the balcony.

3 votes

-- Kathleen Bankson (64.5k points)

#### 9.9.4 Most Appropriate Alternative: GATE2012\_57 [top](#)



Selected Answer

B...setbacks

6 votes

-- Kathleen Bankson (64.5k points)

9.10

#### Most Appropriate Word(27) [top](#)

##### 9.10.1 Most Appropriate Word: GATE 2013-ee-3 [top](#)

<http://gateoverflow.in/40290>

Complete the sentence:

Dare \_\_\_\_\_ mistakes.

- A. commit
- B. to commit
- C. committed
- D. committing

[gate2013-ee](#) [most-appropriate-word](#) [easy](#) [verbal-ability](#)

Answer

##### 9.10.2 Most Appropriate Word: GATE-2012-AE-3 [top](#)

<http://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-ability](#)

Answer

##### 9.10.3 Most Appropriate Word: GATE-2012-AE-4 [top](#)

<http://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-ability](#) [most-appropriate-word](#)

Answer

##### 9.10.4 Most Appropriate Word: GATE2010-56 [top](#)

<http://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 | verbal-ability | most-appropriate-word | normal

Answer

### 9.10.5 Most Appropriate Word: GATE2010-58 [top](#)

<http://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 | verbal-ability | most-appropriate-word | easy

Answer

### 9.10.6 Most Appropriate Word: GATE2011-MN-57 [top](#)

<http://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-ability | most-appropriate-word

Answer

### 9.10.7 Most Appropriate Word: GATE2011-MN-60 [top](#)

<http://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-ability | gate2011-mn | most-appropriate-word

Answer

### 9.10.8 Most Appropriate Word: GATE2011\_58 [top](#)

<http://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 verbal-ability most-appropriate-word easy

Answer

### 9.10.9 Most Appropriate Word: GATE2011\_59 [top](#)

<http://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 verbal-ability most-appropriate-word normal

Answer

### 9.10.10 Most Appropriate Word: GATE2011\_GG\_GA\_1 [top](#)

<http://gateoverflow.in/4020>

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-ability most-appropriate-word

Answer

### 9.10.11 Most Appropriate Word: GATE2011\_GG\_GA\_5 [top](#)

<http://gateoverflow.in/40205>

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-ability

Answer

### 9.10.12 Most Appropriate Word: GATE2012-AR-2 [top](#)

<http://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-ability | normal

Answer

### 9.10.13 Most Appropriate Word: GATE2012-CY-GA-4 [top](#)

<http://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

### 9.10.14 Most Appropriate Word: GATE2012\_60 [top](#)

<http://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 | verbal-ability | most-appropriate-word | normal

Answer

### 9.10.15 Most Appropriate Word: GATE2013-CE-4 [top](#)

<http://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-ability

Answer

### 9.10.16 Most Appropriate Word: GATE2014-1-GA-2 [top](#)

<http://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

gate2014-1 | verbal-ability | most-appropriate-word | easy

Answer

### 9.10.17 Most Appropriate Word: GATE2014-2-GA-1 [top](#)

<http://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

gate2014-2 | verbal-ability | most-appropriate-word | easy

Answer

### 9.10.18 Most Appropriate Word: GATE2014-AG-GA1 [top](#)

<http://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-ability | most-appropriate-word | normal

Answer

### 9.10.19 Most Appropriate Word: GATE2014-AG-GA2 [top](#)

<http://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-ability | most-appropriate-word | easy

Answer

### 9.10.20 Most Appropriate Word: GATE2014-EC01-GA1 [top](#)

<http://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-ec01 | verbal-ability | most-appropriate-word | easy

Answer

### 9.10.21 Most Appropriate Word: GATE2014-EC01-GA3 [top](#)

<http://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-ec01](#) [most-appropriate-word](#) [verbal-ability](#)**Answer****9.10.22 Most Appropriate Word: GATE2014-EC02-GA3** [top](#)<http://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-ec02](#) [most-appropriate-word](#)**Answer****9.10.23 Most Appropriate Word: GATE2014-EC03-GA2** [top](#)<http://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-ec03](#) [most-appropriate-word](#) [verbal-ability](#)**Answer****9.10.24 Most Appropriate Word: GATE2015-2\_GA\_4** [top](#)<http://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

[gate2015-2](#) [verbal-ability](#) [easy](#) [most-appropriate-word](#)**Answer****9.10.25 Most Appropriate Word: GATE2015-3\_GA\_3** [top](#)<http://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

[gate2015-3](#) [verbal-ability](#) [normal](#) [most-appropriate-word](#)**Answer****9.10.26 Most Appropriate Word: GATE2016-Session-3-GA-2** [top](#)<http://gateoverflow.in/108478>

The students \_\_\_\_\_ the teacher on teachers' day for twenty years of dedicated teaching.

- A. Facilitated
- B. Felicitated
- C. Fantasized
- D. Facillitated

[gate2016session3aptitude](#) [verbal-ability](#) [most-appropriate-word](#)
[Answer](#)

### 9.10.27 Most Appropriate Word: gate-2014-ae-2 [top](#)

<http://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

[gate-2014-ae](#) [most-appropriate-word](#)
[Answer](#)

## Answers: Most Appropriate Word

### 9.10.1 Most Appropriate Word: GATE 2013-ee-3 [top](#)

<http://gateoverflow.in/40290>


Selected Answer

commit

Dare commit mistakes. Option A

4 votes

-- Sreyas S (1.7k points)

### 9.10.2 Most Appropriate Word: GATE-2012-AE-3 [top](#)

<http://gateoverflow.in/40214>

(D)

unpopular seems to be the most suitable alternative to unreasonable

2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.10.3 Most Appropriate Word: GATE-2012-AE-4 [top](#)

<http://gateoverflow.in/40215>

(A)

Explanation : Timid means fearful and Intrepid means fearless which is the most suitable contrast.

2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.10.4 Most Appropriate Word: GATE2010-56 [top](#)

<http://gateoverflow.in/2364>


Selected Answer

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**

8 votes

-- Kalpana Bhargav (3.2k points)

### 9.10.5 Most Appropriate Word: GATE2010-58 [top](#)

<http://gateoverflow.in/2368>



Selected Answer  
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**

7 votes

-- Kalpana Bhargav (3.2k points)

### 9.10.6 Most Appropriate Word: GATE2011-MN-57 [top](#)

<http://gateoverflow.in/31522>

Ans => B

B) Delivered on is most appropriate.

A) Delivered this is not correct because of "The" in next part. Does not sound appropriate.

(C) forgot Does not fit properly

(D) reneged on => This does not seem appropriate, As he nevergo back on a promise then we should not loose confidence !

2 votes

-- Akash (43.8k points)

### 9.10.7 Most Appropriate Word: GATE2011-MN-60 [top](#)

<http://gateoverflow.in/31533>

Ans => (C)

preponderance => the quality or fact of being greater in number, quantity, or importance.

"the preponderance of women among older people" C is correct option.

Here plaintiff => a person who brings a case against another in a court of law.

"the plaintiff commenced an action for damages"

3 votes

-- Akash (43.8k points)

### 9.10.8 Most Appropriate Word: GATE2011\_58 [top](#)

<http://gateoverflow.in/2167>



Selected Answer  
Answer "**Visiting**"

**some Verbs Followed by Gerunds, not infinitives**

eg. 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.**

eg 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>

1 3 votes

-- Preetek kumar (6k points)

### 9.10.9 Most Appropriate Word: GATE2011\_59 [top](#)



Selected Answer

**restrained -showing careful self-control**

synonyms: - sober, quite, calm, steady

1 1 votes

-- Preetek kumar (6k points)

### 9.10.10 Most Appropriate Word: GATE2011\_GG\_GA\_1 [top](#)

<http://gateoverflow.in/40202>

(C)

The environmentalists hope to restore the lake to its pristine condition.

Pristine means original condition.

2 2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.10.11 Most Appropriate Word: GATE2011\_GG\_GA\_5 [top](#)

<http://gateoverflow.in/40205>

(D)

Explanation : As the sentence reveals both the words should be contrasting in nature.

Among the options given (querulous,affable) is the only contrasting pair.

2 2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.10.12 Most Appropriate Word: GATE2012-AR-2 [top](#)

<http://gateoverflow.in/40223>



Selected Answer

(A) difficulty, compensated

3 3 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.10.13 Most Appropriate Word: GATE2012-CY-GA-4 [top](#)

<http://gateoverflow.in/40235>

**Beggary is poverty which seems wrong**

**Nomenclature is choosing names for things which also seems wrong**

**jealousy Wrong**

**So The Correction Option is D**

**Nonchalance which means casualness or the state of being relaxed...**

2 2 votes

-- saif ahmed (3.8k points)

### 9.10.14 Most Appropriate Word: GATE2012\_60 [top](#)

<http://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.

11 votes

-- Kathleen Bankson (64.5k points)

### 9.10.15 Most Appropriate Word: GATE2013-CE-4 [top](#)

<http://gateoverflow.in/4027>



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.

3 votes

-- vamsi12376 (4.1k points)

### 9.10.16 Most Appropriate Word: GATE2014-1-GA-2 [top](#)

<http://gateoverflow.in/771>



C. Mediocre meaning not very good, not up to par, average. Her performance was average and not worthy of 1st prize.

9 votes

-- Kathleen Bankson (64.5k points)

### 9.10.17 Most Appropriate Word: GATE2014-2-GA-1 [top](#)

<http://gateoverflow.in/1938>



Ans is A

4 votes

-- Keith Kr (6.3k points)

### 9.10.18 Most Appropriate Word: GATE2014-AG-GA1 [top](#)

<http://gateoverflow.in/41660>



d) experiences. reason:we should generally use simple present tense for describing FACTUAL information.

3 votes

-- ashishkr73 (199 points)

### 9.10.19 Most Appropriate Word: GATE2014-AG-GA2 [top](#)

<http://gateoverflow.in/41665>

Ans : A

contentment means a state of happiness and satisfaction.

9 votes

-- Marylyn Joseph (229 points)

### 9.10.20 Most Appropriate Word: GATE2014-EC01-GA1 [top](#)

<http://gateoverflow.in/41490>

Option C

4 votes

-- saif ahmed (3.8k points)

### 9.10.21 Most Appropriate Word: GATE2014-EC01-GA3 [top](#)

<http://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"

2 votes

-- Prateek kumar (6k points)

### 9.10.22 Most Appropriate Word: GATE2014-EC02-GA3 [top](#)

<http://gateoverflow.in/41510>

Ans : Option C

bear means to carry (*in this context*)

losing OR loosing ?

loose is opposite of tight. Hence losing

4 votes

-- Desert\_Warrior (9.6k points)

### 9.10.23 Most Appropriate Word: GATE2014-EC03-GA2 [top](#)

<http://gateoverflow.in/41141>Ans: B) **Depreciated** meaning diminish in value over a period of time.

2 votes

-- biranchi (2.4k points)

### 9.10.24 Most Appropriate Word: GATE2015-2\_GA\_4 [top](#)

<http://gateoverflow.in/8032>

its 'D' apparel

7 votes

-- Anoop Sonkar (4.8k points)

**9.10.25 Most Appropriate Word: GATE2015-3\_GA\_3** [top](#)<http://gateoverflow.in/8301>

Selected Answer

answer is b

7 votes

-- naresh1845 (1.4k points)

**9.10.26 Most Appropriate Word: GATE2016-Session-3-GA-2** [top](#)<http://gateoverflow.in/10847>

Selected Answer

- A. **Facilitated:** to make easier or less difficult; help forward (an action, a process, etc.)
- B. **Felicitated:** to compliment upon a happy event; congratulate.
- C. **Fantasized:** to create in one's fancy, daydreams, or the like; imagine
- D. **Facillitated:** incorrect word

So only suitable option is B.

3 votes

-- सरामीत (947 points)

**9.10.27 Most Appropriate Word: gate-2014-ae-2** [top](#)<http://gateoverflow.in/40301>

Selected Answer

B) Virtues

Virtues is related to moral standards while strength is related to physical ability.

3 votes

-- Monanshi Jain (8.4k points)

**9.11****Noun Verb Adjective(1)** [top](#)**9.11.1 Noun Verb Adjective: GATE2014-EC03-GA3** [top](#)<http://gateoverflow.in/41142>

'Advice' is \_\_\_\_\_.

- A. A verb
- B. A noun
- C. An adjective
- D. Both a verb and a noun

[gate2014-ec03](#) [verbal-ability](#) [noun-verb-adjective](#)

Answer

**Answers: Noun Verb Adjective****9.11.1 Noun Verb Adjective: GATE2014-EC03-GA3** [top](#)<http://gateoverflow.in/41142>

Selected Answer

**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

1 votes

-- Prateek kumar (6k points)

**9.12**

## Odd One(3) top

### 9.12.1 Odd One: GATE 2016-2-GA-03 top

<http://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

[gate2016-2](#) [verbal-ability](#) [odd-one](#) [easy](#)

Answer

### 9.12.2 Odd One: GATE2014-AE-6 top

<http://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](#) [verbal-reasoning](#) [verbal-ability](#)

Answer

### 9.12.3 Odd One: GATE2014-EC02-GA6 top

<http://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-ec02](#) [verbal-ability](#) [verbal-reasoning](#) [odd-one](#) [normal](#)

Answer

## Answers: Odd One

### 9.12.1 Odd One: GATE 2016-2-GA-03 top

<http://gateoverflow.in/39530>



Selected Answer

Ans C , praise. Rest all have same meaning.

7 votes

-- UK (2k points)

## 9.12.2 Odd One: GATE2014-AE-6 [top](#)

<http://gateoverflow.in/40306>



Selected Answer

here, ans is D

for all words except D, i th letter of word and i th letter of its previous word is differing by 3 letters.

1 votes

-- Sanju Rakonde (361 points)

## 9.12.3 Odd One: GATE2014-EC02-GA6 [top](#)

<http://gateoverflow.in/41513>



Selected Answer

Here in each option

1st letter and 2nd letter difference = 6 letters

2nd and 3rd letter diff = 3 letters

3rd and 4th letter diff = 2 letters

but option (C) is not matching these all criteria

So,

Ans is (C)

6 votes

-- srestha (58.3k points)

## 9.13

## Opposite(2) [top](#)

### 9.13.1 Opposite: GATE2011\_60 [top](#)

<http://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](#) [verbal-ability](#) [opposite](#) [normal](#)

Answer

### 9.13.2 Opposite: GATE2014-3-GA-3 [top](#)

<http://gateoverflow.in/2026>

Choose the word that is opposite in meaning to the word "coherent".

- A. sticky
- B. well-connected
- C. rambling
- D. friendly

[gate2014-3](#) [verbal-ability](#) [opposite](#) [easy](#)

Answer

## Answers: Opposite

### 9.13.1 Opposite: GATE2011\_60 [top](#)

<http://gateoverflow.in/2170>



(D) separate

#### amalgamate

/ə'malɡəmeɪt/

verb

verb: amalgamate; 3rd person present: amalgamates; past tense: amalgamated; past participle: amalgamated; gerund or present participle: amalgamating

combine or unite to form one organization or structure.

"he amalgamated his company with another"

synonyms: combine, merge, unite, integrate, fuse, blend, mingle, coalesce, consolidate, meld, intermingle, mix, intermix, incorporate, affiliate; join (together), join forces, band (together), club together, get together, link (up), team up, go into partnership, pool resources, unify, informal gang up, gang together, literary commingle

"the two departments were amalgamated"

antonyms: separate

• CHEMISTRY

alloy (a metal) with mercury.

"amalgamated zinc"

#### Origin



early 17th century: from medieval Latin *amalgamat-* 'formed into a soft mass', from the verb *amalgamare*, from *amalgama* (see *amalgam*).

reg@https://www.google.co.in/search?

q=Amalgamate&rlz=1C1GIWA\_enIN597IN597&oq=Amalgamate&aqs=chrome..69i57&sourceid=chrome&es\_sm=93&ie=UTF-8

4 votes

-- Kathleen Bankson (64.5k points)

### 9.13.2 Opposite: GATE2014-3-GA-3 [top](#)

<http://gateoverflow.in/2026>



C) Rambling

coherent = Logical and clear

Rambling = Confused

5 votes

-- Srinath Jayachandran (3.7k points)

## 9.14

## Passage Reading(21) [top](#)

### 9.14.1 Passage Reading: GATE 2016-2-GA-07 [top](#)

<http://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)

gate2016-2 | verbal-ability | passage-reading | normal

Answer

### 9.14.2 Passage Reading: GATE-2012-AE-10 [top](#)

<http://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-ability | passage-reading | normal

Answer

### 9.14.3 Passage Reading: GATE2010-63 [top](#)

<http://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 | verbal-ability | passage-reading | normal

Answer

### 9.14.4 Passage Reading: GATE2011-GG-GA-10 [top](#)

<http://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-gq](#) [logical-reasoning](#) [passage-reading](#)

[Answer](#)

## 9.14.5 Passage Reading: GATE2011\_61 [top](#)

<http://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](#) [verbal-ability](#) [passage-reading](#) [normal](#)

[Answer](#)

## 9.14.6 Passage Reading: GATE2012-AR-10 [top](#)

<http://gateoverflow.in/4023>

**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-ability](#) [passage-reading](#)

[Answer](#)

## 9.14.7 Passage Reading: GATE2012-CY-GA-6 [top](#)

<http://gateoverflow.in/4023>

**Q.61 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 led to the odds and conditions being against them.

[gate2012-cy](#) [verbal-ability](#) [passage-reading](#)

[Answer](#)

## 9.14.8 Passage Reading: GATE2013\_63 [top](#)

<http://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](#) [verbal-ability](#) [passage-reading](#) [normal](#)

**Answer**

### 9.14.9 Passage Reading: GATE2014-1-GA-6 [top](#)

<http://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

[gate2014-1](#) [verbal-ability](#) [passage-reading](#) [normal](#)

**Answer**

### 9.14.10 Passage Reading: GATE2014-2-GA-6 [top](#)

<http://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

[gate2014-2](#) [verbal-ability](#) [passage-reading](#) [normal](#)

**Answer**

### 9.14.11 Passage Reading: GATE2014-2-GA-7 [top](#)

<http://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

[gate2014-2](#) [verbal-ability](#) [passage-reading](#) [normal](#)

**Answer**

### 9.14.12 Passage Reading: GATE2014-3-GA-6 [top](#)

<http://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.

[gate2014-3](#) | [verbal-ability](#) | [passage-reading](#) | [easy](#)

[Answer](#)

### 9.14.13 Passage Reading: GATE2014-3-GA-7 [top](#)

<http://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

[gate2014-3](#) | [verbal-ability](#) | [passage-reading](#) | [easy](#)

[Answer](#)

### 9.14.14 Passage Reading: GATE2014-ae-3 [top](#)

<http://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.

[gate-2014-ae](#) | [passage-reading](#) | [logical-reasoning](#)

[Answer](#)

### 9.14.15 Passage Reading: GATE2015-3\_GA\_9 [top](#)

<http://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

[gate2015-3](#) [verbal-ability](#) [normal](#) [passage-reading](#)**Answer**

### 9.14.16 Passage Reading: GATE2016-Session-3-GA-7 [top](#)

<http://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.

[gate2016session3aptitude](#) [logical-reasoning](#) [passage-reading](#)**Answer**

### 9.14.17 Passage Reading: GATE2016-Session-4-GA-7 [top](#)

<http://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.

[gate2016session4aptitude](#) [verbal-ability](#) [passage-reading](#)**Answer**

### 9.14.18 Passage Reading: GATE2016-Session-8-GA-4 [top](#)

<http://gateoverflow.in/111283>

R2D2 is a robot. R2D2 can repair aeroplanes. No other robot can repair aeroplanes. Which of the following can be logically inferred from the above statements?

- A. R2D2 is a robot which can only repair aeroplanes.
- B. R2D2 is the only robot which can repair aeroplanes.
- C. R2D2 is a robot which can repair only aeroplanes.
- D. Only R2D2 is a robot.

[gate2016session8aptitude](#) [passage-reading](#) [logical-reasoning](#)**Answer**

### 9.14.19 Passage Reading: GATE2016-Session-8-GA-7 [top](#)

<http://gateoverflow.in/111294>

A poll of students appearing for masters in engineering indicated that 60% of the students believed that mechanical engineering is a profession unsuitable for women. A research study on women with masters or higher degrees in mechanical engineering found that 99% of such women were successful in their professions.

Which of the following can be logically inferred from the above paragraph?

- A. Many students have misconceptions regarding various engineering disciplines.
- B. Men with advanced degrees in mechanical engineering believe women are well suited to be mechanical engineers.

- C. Mechanical engineering is a profession well suited for women with masters or higher degrees in mechanical engineering.  
 D. The number of women pursuing higher degrees in mechanical engineering is small.

[gate2016session8aptitude](#) [logical-reasoning](#) [passage-reading](#)

**Answer**

### 9.14.20 Passage Reading: GATE2016-Session-8-GA-8 [top](#)

<http://gateoverflow.in/111300>

Sourya committee had proposed the establishment of Sourya Institutes of Technology (SITs) in line with Indian Institutes of Technology (IITs) to cater to the technological and industrial needs of a developing country.

Which of the following can be logically inferred from the above sentence?

Based on the proposal,

- (i) In the initial years, SIT students will get degrees from IIT.
  - (ii) SITs will have a distinct national objective.
  - (iii) SIT like institutions can only be established in consultation with IIT.
  - (iv) SITs will serve technological needs of a developing country.
- A. (iii) and (iv) only.  
 B. (i) and (iv) only.  
 C. (ii) and (iv) only.  
 D. (ii) and (iii) only.

[gate2016session8aptitude](#) [logical-reasoning](#) [passage-reading](#)

**Answer**

### 9.14.21 Passage Reading: GATE2017-1-GA-6 [top](#)

<http://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.

[gate2017-1](#) [verbal-ability](#) [passage-reading](#)

**Answer**

## Answers: Passage Reading

### 9.14.1 Passage Reading: GATE 2016-2-GA-07 [top](#)

<http://gateoverflow.in/39533>



Selected Answer

"Many believe that the internet itself is unintended consequence of the original invention. So (ii) statement does not follow from the passage."

The author has nowhere 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.

7 votes

-- Ashish Deshmukh (1.5k points)

### 9.14.2 Passage Reading: GATE-2012-AE-10 [top](#)

<http://gateoverflow.in/40221>

A : Did not question that progress was a fact. **True** They took progress for granted.

B: Did not approve of Biology : **False** . No mention regarding this in paragraph. It's mention that it was not inspired from biology and that's a different thing.

C: Framed the laws of progress : **False** They attempted to discover its laws. Frame and discover are different things.

D: Clearly false.

Upvote 2 votes

-- Mojo Jojo (4.2k points)

### 9.14.3 Passage Reading: GATE2010-63 [top](#)



Selected Answer

D. People in military establishments like to use chemical agents in war.

Upvote 8 votes

-- Kathleen Bankson (64.5k points)

### 9.14.4 Passage Reading: GATE2011-GG-GA-10 [top](#)

(B)

This is the best possible explanation.

Upvote 2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.14.5 Passage Reading: GATE2011\_61 [top](#)



Selected Answer

(C) what the leading causes of death are

Upvote 5 votes

-- Kathleen Bankson (64.5k points)

### 9.14.6 Passage Reading: GATE2012-AR-10 [top](#)



Selected Answer

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**

Upvote 3 votes

-- rajan (4k points)

### 9.14.7 Passage Reading: GATE2012-CY-GA-6 [top](#)

(A)

This is the best possible option.

Upvote 2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.14.8 Passage Reading: GATE2013\_63 [top](#)



Selected Answer

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!

12 votes

-- Kathleen Bankson (64.5k points)

### 9.14.9 Passage Reading: GATE2014-1-GA-6 [top](#)

<http://gateoverflow.in/774>



Selected Answer

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)

10 votes

-- Kathleen Bankson (64.5k points)

### 9.14.10 Passage Reading: GATE2014-2-GA-6 [top](#)

<http://gateoverflow.in/1943>



Selected Answer

Answer is B.

3 votes

-- chetna (465 points)

### 9.14.11 Passage Reading: GATE2014-2-GA-7 [top](#)

<http://gateoverflow.in/1944>



Selected Answer

**Answer should be D)**

4 votes

-- Poshita Shrivastava (1k points)

### 9.14.12 Passage Reading: GATE2014-3-GA-6 [top](#)

<http://gateoverflow.in/2029>



Selected Answer

It will be B.

8 votes

-- Gate Keeda (19.1k points)

### 9.14.13 Passage Reading: GATE2014-3-GA-7 [top](#)

<http://gateoverflow.in/2031>



Selected Answer

A paradigm shift means a fundamental change in approach or underlying assumptions.

And a change in paradigm happens only when we have an experimental 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.

6 votes

-- Srinath Jayachandran (3.7k points)

### 9.14.14 Passage Reading: GATE2014-ae-3 [top](#)

<http://gateoverflow.in/40302>



Selected Answer

Answer : [D]

Read passage again. you will get my point.

4 votes

-- Desert\_Warrior (9.6k points)

### 9.14.15 Passage Reading: GATE2015-3\_GA\_9 [top](#)



Selected Answer

"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.

9 votes

-- Arjun Suresh (294k points)

### 9.14.16 Passage Reading: GATE2016-Session-3-GA-7 [top](#)



Selected Answer

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) .

0 votes

-- Bikram (44.7k points)

### 9.14.17 Passage Reading: GATE2016-Session-4-GA-7 [top](#)

The number of people in India infected with rabies is high  
**option A**

2 votes

-- Shobhit (17.8k points)

### 9.14.18 Passage Reading: GATE2016-Session-8-GA-4 [top](#)



Selected Answer

Option A and option C , says same thing , it means R2D2 can repair one and only Aeroplanes, no other things it can repair. There is no mention in passage about other tasks that R2D2 can perform . So this makes option A and C false.

But passage says R2D2 is the only robot which can repair Aeroplanes . And confirm it by stating " No other robot can repair aeroplanes." So option B directly inferred from the passage.

Also this passage does not state that there are others robots not exit except R2D2 , this makes Stament D false .

0 votes

-- Bikram (44.7k points)

### 9.14.19 Passage Reading: GATE2016-Session-8-GA-7 [top](#)

<http://gateoverflow.in/111294>



Selected Answer

This sentence in passage " A research study on women with masters or higher degrees in mechanical engineering found that 99% of such women were successful in their professions." directly supports option C .

Option D and option A are false as no relation with passage.

Option B said about men with advanced degree but what stated in passage is about a group of students, so this option is false.

Only option C is correct.

0 votes

-- Bikram (44.7k points)

## 9.14.20 Passage Reading: GATE2016-Session-8-GA-8 [top](#)



Selected Answer

Statement (i) - nothing is mention in passage from where SIT students will get degree . So it is wrong statement.

Statement (ii) - " to cater to the technological and industrial needs of a developing country." this line supports statement (ii).It means Sourya have distinct national objectives.

Statement (iii) - Nothing is mention about consultation with IIT so this makes statement (iii) false.

Statement (iv) - Again this statement " to cater to the technological and industrial needs of a developing country." directly supports statement (iv) .

So, only statement (ii) and (iv) is correct , this makes option C correct .

1 votes

-- Bikram (44.7k points)

## 9.14.21 Passage Reading: GATE2017-1-GA-6 [top](#)



Selected Answer

it says that we try to overlook facts of history which is not in favour of our nationalisim intrest

so B) history is viewd through nationalism

so B is correct answer here

3 votes

-- Aboveallplayer (18.5k points)

## 9.15

## Percentage(1) [top](#)

### 9.15.1 Percentage: GATE2016-Session-7-GA-4 [top](#)

<http://gateoverflow.in/110885>

$(x \% \text{ of } y) + (y \% \text{ of } x)$  is equivalent to \_\_\_\_\_.

- A. 2 % of  $xy$
- B. 2 % of  $(xy/100)$
- C.  $xy \% \text{ of } 100$
- D. 100 % of  $xy$

[gate2016session7aptitude](#) [numerical-ability](#) [percentage](#)

[Answer](#)

## Answers: Percentage

### 9.15.1 Percentage: GATE2016-Session-7-GA-4 [top](#)

<http://gateoverflow.in/110885>



Selected Answer

Ans :A

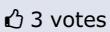
$$X\% \text{ of } Y = X/100 * Y = X*Y/100 \quad \text{-- (1)}$$

&amp;

$$Y\% \text{ of } X = Y/100 * X = Y*X/100 \quad \text{-- (2)}$$

So, From equation 1 and 2 it is clear that  $X\% \text{ of } Y + Y\% \text{ of } X = 2*X*Y/100$  which is equivalent to 2% of XY

Thus answer is option A



3 votes

-- Arnabi (6.4k points)

## 9.16

Phrasal Verbs(1) [top](#)9.16.1 Phrasal Verbs: GATE2016-Session-8-GA-1 [top](#)<http://gateoverflow.in/111274>

The chairman requested the aggrieved shareholders to \_\_\_\_\_ him.

- A. Bare with
- B. Bore with
- C. Bear with
- D. Bare

[gate2016session8aptitude](#) [verbal-ability](#) [english-grammar](#) [phrasal-verbs](#)

Answer

## Answers: Phrasal Verbs

9.16.1 Phrasal Verbs: GATE2016-Session-8-GA-1 [top](#)<http://gateoverflow.in/111274>

Selected Answer

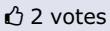
A) **Bare with** - invitation to undress, thus not appropriate here.

B) **Bore with** - past tense of bear with

e.g He bore with me for twenty minutes as I searched for the information he wanted, but then he could stand it no longer and he hung up the phone

C) **Bear with** - request for patience or tolerance. appropriate in this context and hence correct answer.

D) **Bare** - Bare is an adjective and is defined as lacking the usual or appropriate covering or clothing. This is not suitable in this context..



2 votes

-- Arnabi (6.4k points)

## 9.17

Probability(1) [top](#)9.17.1 Probability: GATE2016-Session-1-GA-6 [top](#)<http://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

gate2016session1aptitude numerical-ability probability

Answer

## Answers: Probability

### 9.17.1 Probability: GATE2016-Session-1-GA-6 [top](#)



Selected Answer

option c- 35

$$P(\text{infected}) = 0.5 ,$$

$$P(\text{No disease/Infected}) = 0.7 * 0.5 = .35$$

1 2 votes

-- Riya Khandelwal (215 points)

### 9.18

## Speed Time Distance(1) [top](#)

### 9.18.1 Speed Time Distance: GATE2016-Session-3-GA-9 [top](#)

<http://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

gate2016session3aptitude speed-time-distance numerical-ability

Answer

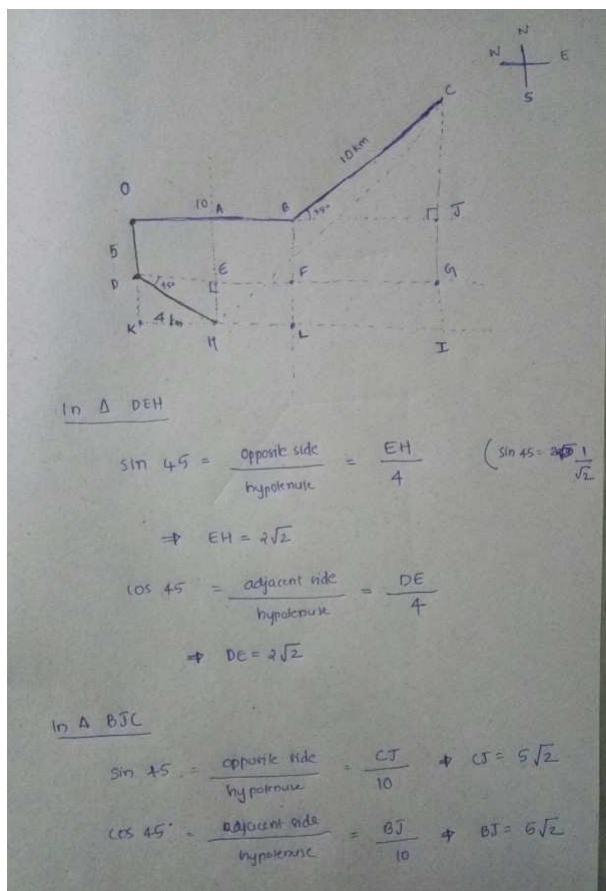
## Answers: Speed Time Distance

### 9.18.1 Speed Time Distance: GATE2016-Session-3-GA-9 [top](#)

<http://gateoverflow.in/108726>



Selected Answer



## 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  $LI = 5\sqrt{2}$

$$HI = 10 - 2\sqrt{2} + 5\sqrt{2} = 10 + 3\sqrt{2}$$

$$CI = CJ + JG + GI$$

From Figure,  $CJ = 5\sqrt{2}$ ,  $JG = 5$ ,  $GI = 2\sqrt{2}$

$$CI = 5\sqrt{2} + 5 + 2\sqrt{2} = 5 + 7\sqrt{2}$$

Therefore ,

$$HC = \sqrt{(10 + 3\sqrt{2})^2 + (5 + 7\sqrt{2})^2} = 20.61 \text{ km}$$

 2 votes

-- pC (21.3k points)

9.19

## Statements Follow(1) top

### **9.19.1 Statements Follow: GATE2015-1-GA-8**

<http://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.

[gate2015-1](#) [verbal-ability](#) [normal](#) [statements-follow](#)

[Answer](#)

## Answers: Statements Follow

### 9.19.1 Statements Follow: GATE2015-1-GA-8 [top](#)



Selected Answer

Statements I and II are correct measures. Option A,

5 votes

-- Arjun Suresh (294k points)

## 9.20

## Synonym(4) [top](#)

### 9.20.1 Synonym: GATE2011-GG-GA\_2 [top](#)

[http://gateoverflow.in/8012](#)

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-ability](#) [synonym](#)

[Answer](#)

### 9.20.2 Synonym: GATE2012-AR-1 [top](#)

[http://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-ability](#) [synonym](#)

[Answer](#)

### 9.20.3 Synonym: GATE2012-CY-GA-3 [top](#)

[http://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-ability](#) [synonym](#)

[Answer](#)

### 9.20.4 Synonym: GATE2017-2-GA-1 [top](#)

<http://gateoverflow.in/116415>

Choose the option with words that are not synonyms.

- A. aversion, dislike
- B. luminous, radiant
- C. plunder, loot
- D. yielding, resistant

[gate2017-2](#) [verbal-ability](#) [synonym](#)

[Answer](#)

## Answers: Synonym

### 9.20.1 Synonym: GATE2011-GG-GA\_2 [top](#)

<http://gateoverflow.in/40203>

(B)

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.

2 votes

-- Sourav Mishra (सौरव मिश्रा) (8.9k points)

### 9.20.2 Synonym: GATE2012-AR-1 [top](#)

<http://gateoverflow.in/40222>



Selected Answer

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.

2 votes

-- Desert\_Warrior (9.6k points)

### 9.20.3 Synonym: GATE2012-CY-GA-3 [top](#)

<http://gateoverflow.in/40234>



Selected Answer

**Latitude** means scope for freedom of action or thought.

Option B.

1 votes

-- Monanshi Jain (8.4k points)

### 9.20.4 Synonym: GATE2017-2-GA-1 [top](#)

<http://gateoverflow.in/116415>



Selected Answer

Yield means to give in and resistance means to not give in.  
Rest are all synonyms.

Hence, (D) is correct.

5 votes

-- Kloseup (369 points)

**9.21**

**Tenses(3)** [top](#)

### 9.21.1 Tenses: GATE2013-59 [top](#)

<http://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](#) [verbal-ability](#) [tenses](#) [normal](#)

Answer

### 9.21.2 Tenses: GATE2014-2-GA-2 [top](#)

<http://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

[gate2014-2](#) [verbal-ability](#) [tenses](#) [normal](#)

Answer

### 9.21.3 Tenses: GATE2017-1-GA-1 [top](#)

<http://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

[gate2017-1](#) [verbal-ability](#) [tenses](#) [english-grammar](#) [normal](#)

Answer

## Answers: Tenses

### 9.21.1 Tenses: GATE2013-59 [top](#)

<http://gateoverflow.in/1563>



Selected Answer

A...would fly

8 votes

-- Kathleen Bankson (64.5k points)

### 9.21.2 Tenses: GATE2014-2-GA-2 [top](#)

<http://gateoverflow.in/1939>

**Answer should be B)**

4 votes

-- Poshita Shrivastava (1k points)

### 9.21.3 Tenses: GATE2017-1-GA-1 [top](#)

<http://gateoverflow.in/118403>

C) wished.

7 votes

-- Sandeep Suri (661 points)

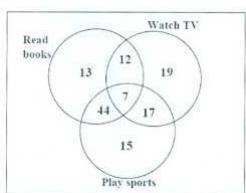
9.22

### Venn Diagrams(1) [top](#)

#### 9.22.1 Venn Diagrams: GATE2016-Session-3-GA-6 [top](#)

<http://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

[gate2016session3aptitude](#) [venn-diagrams](#) [logical-reasoning](#)

**Answer**

### Answers: Venn Diagrams

#### 9.22.1 Venn Diagrams: GATE2016-Session-3-GA-6 [top](#)

<http://gateoverflow.in/108484>



Selected Answer

The number of students who like to read books **or** play sports will be sum of students who belong to both sets  **$13+12+44+7+17+15 = 108$** .  
So answer will be D

1 votes

-- **ਜગમીર** (947 points)

9.23

### Verbal Reasoning(17) [top](#)

#### 9.23.1 Verbal Reasoning: GATE 2013-ee-7 [top](#)

<http://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-ability](#) [verbal-reasoning](#)

[Answer](#)

## 9.23.2 Verbal Reasoning: GATE2014-AG-GA3 [top](#)

<http://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](#) [verbal-ability](#) [verbal-reasoning](#) [normal](#)

[Answer](#)

## 9.23.3 Verbal Reasoning: GATE2014-AG-GA7 [top](#)

<http://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-ability](#) [verbal-reasoning](#) [passage-reading](#) [normal](#)

[Answer](#)

## 9.23.4 Verbal Reasoning: GATE2014-EC01-GA2 [top](#)

<http://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?

- A. All women are doctors
- B. All doctors are entrepreneurs
- C. All entrepreneurs are women
- D. Some entrepreneurs are doctors

[gate2014-ec01](#) [verbal-ability](#) [mathematical-logic](#) [verbal-reasoning](#) [easy](#)

[Answer](#)

## 9.23.5 Verbal Reasoning: GATE2014-EC01-GA6 [top](#)

<http://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-ec01](#) [verbal-ability](#) [verbal-reasoning](#) [normal](#)

[Answer](#)

## 9.23.6 Verbal Reasoning: GATE2014-EC02-GA1 [top](#)

<http://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-ec02](#) [verbal-ability](#) [verbal-reasoning](#) [most-appropriate-word](#) [normal](#)

[Answer](#)

## 9.23.7 Verbal Reasoning: GATE2014-EC03-GA1 [top](#)

<http://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-ec03](#) [verbal-reasoning](#) [verbal-ability](#)

[Answer](#)

## 9.23.8 Verbal Reasoning: GATE2014-EC04-GA7 [top](#)

<http://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-ec04](#) [verbal-ability](#) [verbal-reasoning](#) [normal](#)

[Answer](#)

## 9.23.9 Verbal Reasoning: GATE2015-3\_GA\_6 [top](#)

<http://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.

[gate2015-3](#) [verbal-ability](#) [normal](#) [verbal-reasoning](#)

[Answer](#)

## 9.23.10 Verbal Reasoning: GATE2016-1-GA07 [top](#)

<http://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.

[gate2016-1](#) [verbal-ability](#) [verbal-reasoning](#) [normal](#)

Answer

### 9.23.11 Verbal Reasoning: GATE2016-Session-1-GA-3 [top](#)

<http://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

[gate2016session1aptitude](#) [verbal-ability](#) [verbal-reasoning](#)

Answer

### 9.23.12 Verbal Reasoning: GATE2016-Session-1-GA-7 [top](#)

<http://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

[gate2016session1aptitude](#) [passage-reading](#) [verbal-reasoning](#)

Answer

### 9.23.13 Verbal Reasoning: GATE2016-Session-1-GA-8 [top](#)

<http://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.

[gate2016session1aptitude](#) [verbal-ability](#) [passage-reading](#) [verbal-reasoning](#)

Answer

### 9.23.14 Verbal Reasoning: GATE2016-Session-2-GA-3 [top](#)

<http://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

[gate2016session2aptitude](#) [verbal-reasoning](#) [verbal-ability](#)

[Answer](#)

### 9.23.15 Verbal Reasoning: GATE2016-Session-2-GA-7 [top](#)

<http://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?

- (i) All smart cities encourage the formation of surveillance states.
  - (ii) Surveillance is an integral part of a smart city.
  - (iii) Sustainability and surveillance go hand in hand in a smart city.
  - (iv) 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

[gate2016session2aptitude](#) [passage-reading](#) [verbal-reasoning](#)

[Answer](#)

### 9.23.16 Verbal Reasoning: GATE2016-Session-7-GA-3 [top](#)

<http://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

[gate2016session7aptitude](#) [verbal-reasoning](#) [verbal-ability](#)

[Answer](#)

### 9.23.17 Verbal Reasoning: GATE2017-2-GA-6 [top](#)

<http://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'

[gate2017-2](#) [passage-reading](#) [verbal-reasoning](#)

[Answer](#)

## Answers: Verbal Reasoning

### 9.23.1 Verbal Reasoning: GATE 2013-ee-7 [top](#)

<http://gateoverflow.in/40294>



Selected Answer

Option D. Hetero means different.

It's clearly mentioned that the movement comprised of moderates, liberals, radicals, socialists and so on.

1 votes

-- Mojo Jojo (4.2k points)

### 9.23.2 Verbal Reasoning: GATE2014-AG-GA3 [top](#)



Selected Answer

You can surely go with option (3). That Woman's solidarity knows no national boundaries.

Because option (1) and (2) are surely not correct & option (4) is not suitable, in my views.

Thx. All the best.

7 votes

-- Muktinath Vishwakarma (34.1k points)

### 9.23.3 Verbal Reasoning: GATE2014-AG-GA7 [top](#)



Selected Answer

Option C :

**Exactitude is not critical in dealing with big data**

3 votes

-- Pratik Agrawal (187 points)

### 9.23.4 Verbal Reasoning: GATE2014-EC01-GA2 [top](#)



Selected Answer

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.

10 votes

-- Muktinath Vishwakarma (34.1k points)

### 9.23.5 Verbal Reasoning: GATE2014-EC01-GA6 [top](#)



Selected Answer

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.

4 votes

-- srestha (58.3k points)

### 9.23.6 Verbal Reasoning: GATE2014-EC02-GA1 [top](#)



Selected Answer

Answer will be (B)

5 votes

-- srestha (58.3k points)

### 9.23.7 Verbal Reasoning: GATE2014-EC03-GA1 [top](#)

<http://gateoverflow.in/41140>



Selected Answer

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,

4 votes

-- Abhilash Panicker (8.8k points)

### 9.23.8 Verbal Reasoning: GATE2014-EC04-GA7 [top](#)

<http://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 :)

3 votes

-- Abhilash Panicker (8.8k points)

### 9.23.9 Verbal Reasoning: GATE2015-3\_GA\_6 [top](#)

<http://gateoverflow.in/8306>



Selected Answer

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 = ~Q implies ~P.

~P is "Alexander would not have turned his attention towards India"

~Q is "he had not conquered Persia"

19 votes

-- Srijay Deshpande (377 points)

### 9.23.10 Verbal Reasoning: GATE2016-1-GA07 [top](#)

<http://gateoverflow.in/39613>



Selected Answer

Answer is (D) Linguistic pluralism is strong evidence of India's diversity.

18 votes

-- sushma nayak (181 points)

### 9.23.11 Verbal Reasoning: GATE2016-Session-1-GA-3 [top](#)

<http://gateoverflow.in/108069>



Selected Answer

Despite the new medicine's **effectiveness** in treating diabetes, it is not **prescribed** widely.  
option A

3 votes

-- Shobhit (17.8k points)

### 9.23.12 Verbal Reasoning: GATE2016-Session-1-GA-7 [top](#)



Selected Answer

- (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..**

2 votes

-- Shobhit (17.8k points)

### 9.23.13 Verbal Reasoning: GATE2016-Session-1-GA-8 [top](#)



Selected Answer

**shiva>leela>pavithra**  
 pavithra is the youngest..option D

2 votes

-- Shobhit (17.8k points)

### 9.23.14 Verbal Reasoning: GATE2016-Session-2-GA-3 [top](#)



Selected Answer

- prone means :
- likely or liable to suffer from, which is option (iii)
  - 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.

0 votes

-- Bikram (44.7k points)

### 9.23.15 Verbal Reasoning: GATE2016-Session-2-GA-7 [top](#)



Selected Answer

"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 .

0 votes

-- Bikram (44.7k points)

### 9.23.16 Verbal Reasoning: GATE2016-Session-7-GA-3 [top](#)



Selected Answer

Option A and B clearly disqualified at first look due to the fact that **Where** is not mentioned in both of them .

Then among option 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 only .

Where there is a will there is a way means If one really wants to do something, one can do it .

0 votes

-- Bikram (44.7k points)

### 9.23.17 Verbal Reasoning: GATE2017-2-GA-6 [top](#)



Selected Answer

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's not so urgent .

So, ideology is not as important as literature is revealed by the word "seemingly" only .

0 votes

-- Bikram (44.7k points)

## 9.24

### Word Pairs(6) [top](#)

#### 9.24.1 Word Pairs: GATE-2013-AE-GA-5 [top](#)

<http://gateoverflow.in/40246>

Q.60 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-ability](#) [word-pairs](#)

Answer

#### 9.24.2 Word Pairs: GATE2010-60 [top](#)

<http://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](#) [verbal-ability](#) [word-pairs](#) [normal](#)[Answer](#)

### 9.24.3 Word Pairs: GATE2013-57 [top](#)

<http://gateoverflow.in/1560>

Complete the sentence:

Universalism is to particularism as diffuseness is to \_\_\_\_\_.

- A. specificity
- B. neutrality
- C. generality
- D. adaptation

[gate2013](#) [verbal-ability](#) [normal](#) [word-pairs](#)[Answer](#)

### 9.24.4 Word Pairs: GATE2013-CE-5 [top](#)

<http://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-ability](#)[Answer](#)

### 9.24.5 Word Pairs: GATE2015-1\_GA\_5 [top](#)

<http://gateoverflow.in/8008>

Which one of the following combinations is incorrect?

- A. Acquiescence - Submission
- B. Wheedle - Roundabout
- C. Flippancy - Lightness
- D. Profligate - Extravagant

[gate2015-1](#) [verbal-ability](#) [difficult](#) [word-pairs](#)[Answer](#)

### 9.24.6 Word Pairs: GATE2015-3\_GA\_4 [top](#)

<http://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

[gate2015-3](#) [verbal-ability](#) [easy](#) [word-pairs](#)[Answer](#)

## Answers: Word Pairs

### 9.24.1 Word Pairs: GATE-2013-AE-GA-5 [top](#)

<http://gateoverflow.in/40246>



Selected Answer

Answer B: Water runs through a pipe like electricity runs through a wire.

12 votes

-- Kathleen Bankson (64.5k points)

### 9.24.2 Word Pairs: GATE2010-60 [top](#)

<http://gateoverflow.in/2368>



Selected Answer

#### A. Fallow: Land

**Fallow** is **land** that is uncultivated

**Unemployed** is a **worker** without a job

12 votes

-- Kathleen Bankson (64.5k points)

### 9.24.3 Word Pairs: GATE2013-57 [top](#)

<http://gateoverflow.in/1560>



Selected Answer

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

9 votes

-- Kathleen Bankson (64.5k points)

### 9.24.4 Word Pairs: GATE2013-CE-5 [top](#)

<http://gateoverflow.in/40272>



Selected Answer

c as medicine improves health .... similarly education improves knowlege

6 votes

-- Rahul Singla (233 points)

### 9.24.5 Word Pairs: GATE2015-1\_GA\_5 [top](#)

<http://gateoverflow.in/8008>



Selected Answer

B Wheedle - Roundabout

5 votes

-- Kathleen Bankson (64.5k points)

### 9.24.6 Word Pairs: GATE2015-3\_GA\_4 [top](#)

<http://gateoverflow.in/8302>



Selected Answer

**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 practise 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 correct option

11 votes

-- Anoop Sonkar (4.8k points)

Brought to you by GATE Overflow  
<http://gateoverflow.in/>