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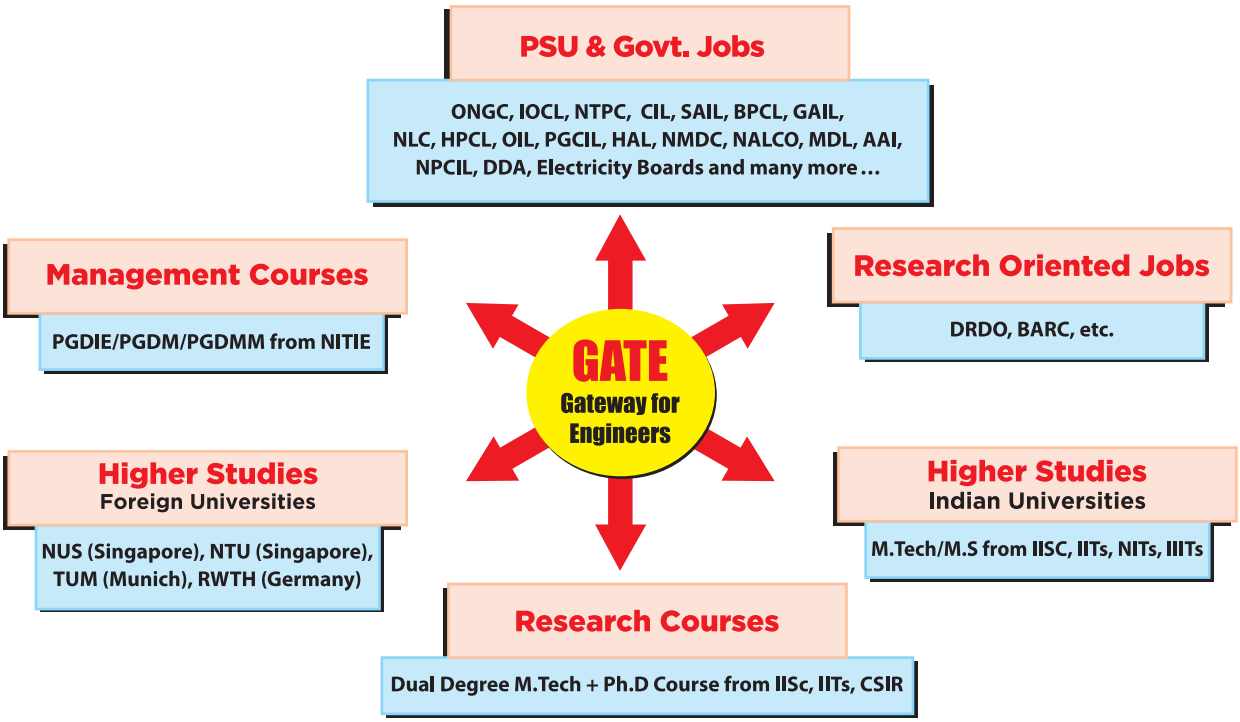
Revision *through* Questions *for* GATE 2020

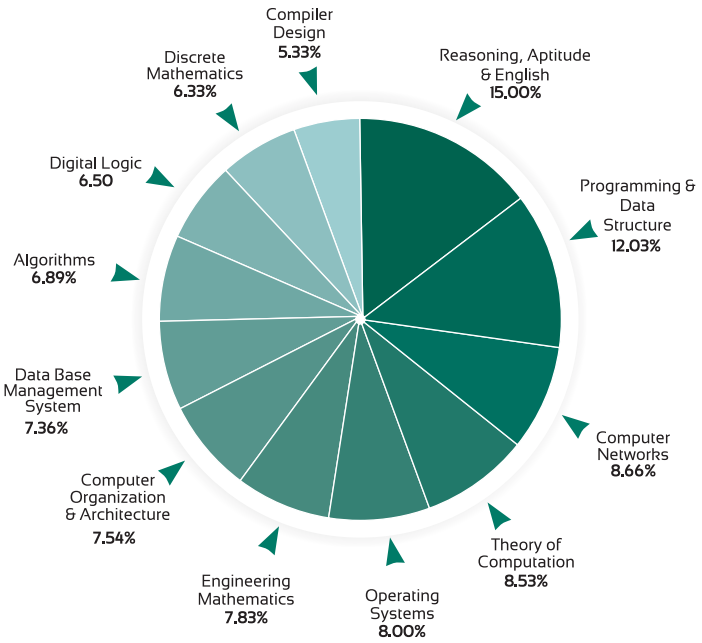
CS Computer Science

Q.1 - Q.25 out of 200 Questions

Day 1 of 8



SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	12.03%
Computer Networks	8.66%
Theory of Computation	8.53%
Operating Systems	8.00%
Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 1 : Q.1 to Q. 25 : General Aptitude

Q.1 Choose the correct set of words to complete the sentence:
Politicians must be _____ for the people, but they should never be _____ for public welfare.
(a) disinterested, uninterested (b) disinterested, disinterested
(c) uninterested, uninterested (d) uninterested, disinterested

Q.2 How many numbers between 1 to 300 are divisible by only 11 or only 13 but not by both?
(a) 45 (b) 46
(c) 48 (d) 50

Q.3 Triangles *ABC* and *CDE* have a common vertex *C* with side *AB* of triangle *ABC* being parallel to side *DE* of triangle *CDE*. If length of side *AB* = 4 cm and length of side *DE* = 10 cm and perpendicular distance between sides *AB* and *DE* is 9.8 cm, then the sum of areas of triangle *ABC* and triangle *CDE* is _____ cm^2.

Q.4 A and B will participate in a sack race (In a sack race, people hop to reach the finish line). In the time that A takes 3 hops, B takes 4 hops but the distance covered by A in 4 hops is equal to distance covered by B in 5 hops. What is the ratio of A's speed: B's speed?
(a) 3 : 5 (b) 12 : 20
(c) 15 : 16 (d) 1 : 1

Q.5 In the sentence given below, a part of sentence is underlined, choose the correct alternative of the phrasing of the underlined part:

While their ostrich like attitude is aggravating, what is very serious is loss of wealth and loss of business.
(a) their refusal to face facts (b) their heavy handedness
(c) their annoying behaviour (d) their big ego

Q.6 What is the sum of all possible solutions to $|x-3|^2 + |x-3| = 20$?
(a) –1 (b) 6
(c) 7 (d) 12

Q.7 A lizard is crawling up a minaret to reach the top. The top of the minaret is 1800 cm from its position. After every minute of crawling it halts for half a minute. In every halt it slides down by 30 cm from its position. Time the lizard will take to reach the top of the minaret if it can crawl 150 cm per minute is
(a) 21 minutes 48 seconds (b) 25 minutes
(c) 20 minutes (d) 32 minutes 40 seconds

Q.8 How many 5 letter words (with or without meaning) can be formed using all the following 5 letters A, B, C, D and E so that letter A is to the left of letter B?
(a) 120 (b) 60
(c) 48 (d) 24

Q.9 Choose the option that best substitutes the underlined part of the sentence:
TCS is edging closer to become the country's first 100 bn $ company. The company is fortunate to have excellent relationships among its employees:

they each have a relationship of respect for all the others.

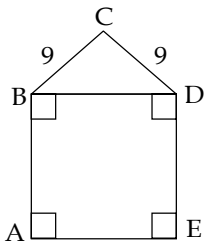
(a) they each have a relationship of respect for all the others.
(b) they have respect for one another.
(c) each one has respect for one another.
(d) they each have a relationship of respect for each other.

Q.10 What is the remainder when 1! + 2! + 3! … 100! is divided by 18?
(a) 0 (b) 1
(c) 5 (d) 9

Q.11 The percentage profit earned by selling an article for ₹1920 is equal in the percentage loss incurred by selling the same article for ₹1280. At what price (in ₹) should the article be sold to make 25% profit?

Q.12 A faulty wall clock is known to gain 15 minutes every 24 hours. It is synchronized to the correct time at 9 AM on 14th August. What will be the correct time to the nearest minute when the clock shows 2 PM on 18th August of the same year?
(a) 12:45 PM (b) 12:58 PM
(c) 1:00 PM (d) 2:00 PM

Q.13 As shown in the figure below, two sides of triangle BCD are each 9 feet long. Triangle BCD shares side BD with square ABDE, and angle CBD measures 45°. What is the total area of figure ABCDE in square feet? (Note: Figure not drawn to scale.)



(a) 121.5 (b) $40.5 + 81\sqrt{2}$
(c) 202.5 (d) 221

Q.14 A farmer can plow his wheat field in 12 days. After working for 5 days, his daughter joins him and together they finish plowing the field in 4 days. How many days would it take the daughter to plow the wheat field alone?

Q.15 A series of numbers are written using digits 1, 2, 3, 4 and 5 in the following pattern:

1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 1, 1, 1, 1, 1, 1, (six 1's) and so on. Which of the following digits will come at the 100th position in this sequence?
(a) 1 (b) 2
(c) 3 (d) 4

Q.16 A part has been omitted from the sentence given below and it is to be filled with idiom(s), to make the sentences grammatically meaningfully correct. Mark the answer accordingly.

Although Mr. Naipaul was _____, he never boasted about anything or try to use the resources available to him in an unethical way.

1. An armchair traveller
2. Born with a silver spoon
3. A big fish in a small pond

(a) Only 2 (b) Both 2 and 3
(c) Both 1 and 3 (d) None of these

Q.17 In the given question, a set of conclusions is given. There are four options comprising of three or more statements. You need to choose the option that contains the set of statements from which the given conclusions logically follow.

All horses cannot be cottages. No glance is a cottage.

(a) Some glances are horses. Some horses are blemishes. No blemish is a cottage.
(b) No horse is a blemish. All cottages are blemishes. All glances are horses.
(c) Some horses are blemishes. All glances are blemishes. Some cottages are not blemishes.
(d) All horses are blemishes. Some blemishes are not cottages. No blemish is a glance.

Q.18 Vessel A contains six green and four red balls and vessel B contains four green and six red balls. One ball is drawn at random from vessel A and placed in vessel B. Then one ball is transferred at random from vessel B to vessel A. If one ball is now drawn at random from vessel A, the probability that it is green is

(a) $\frac{23}{55}$ (b) $\frac{32}{65}$
(c) $\frac{33}{65}$ (d) $\frac{32}{55}$

Q.19 Four runners started running the race in the same direction along a circular path of 7 km. Their speed are 4, 3, 9, 3.5 km/hr. individually. If they started their race at 6 AM then at what time they all will be at the starting point?

(a) 2 PM (b) 8 PM
(c) 8 AM (d) 6 PM

Q.20 The average number of goals scored per match by Sunil Chhetri in matches where he was in the team of starting 11 is 1.5 and the average number of goals scored by him in matches where he came on as a substitute is 0.5. He scored 390 goals more in matches where he was in the team of starting 11 than in matches in which he came on as a substitute. If he played 388 matches in total, the average number of goals scored by him per match is

Q.21 In a family of 4 members, the eldest member expires after 5 years at the age of 88 and 10 years after that a baby is born in the family such that the difference of family's eldest to youngest member alive after 20 years from present is 57. At present, the age of youngest member is 14 years and the average age of remaining member is 54. The age of the two eldest members alive after 5 years would be

(a) 88, 47 (b) 42, 19
(c) 47, 42 (d) 37, 42

Q.22 Which of phrases given below should replace the phrase printed in **bold** type to make the sentence grammatically correct?
The **crime has growth rapidly** in Russia since the disintegration of the communist system.
(a) rapid crime has grown
(b) crime has grown rapidly
(c) crimes grow rapidly
(d) crimes have been rapidly grown

Q.23 A sphere is inscribed in a cube with an edge of 10 units. What is the shortest possible distance in units from one of the vertices of the cube to the surface of the sphere?
(a) $10\left(\sqrt{3}-1\right)$ (b) 5
(c) $10\left(\sqrt{2}-1\right)$ (d) $5\left(\sqrt{3}-1\right)$

Q.24 Based on the given statements, select the most appropriate option to solve the question.
Sheetal wants to sell her bicycle at either a profit of $K\%$ or a loss of $K\%$. What is the value of K?
Statement 1: Difference between the amount Sheetal gets in the 2 cases is ₹2560.
Statement 2: If Sheetal's profit is ₹ K, her profit in percentage is 7.5%.
(a) Statement 1 alone is sufficient, but statement 2 alone is NOT sufficient.
(b) Statement 2 alone is sufficient, but statement 1 alone is NOT sufficient.
(c) Both statements together are sufficient, but neither statement alone is sufficient.
(d) Statement 1 and 2 together are NOT sufficient.

Q.25 Select the pair which has the same relationship as the two words
IMPLAUSIBLE : ABSURD :: ?
(a) shadowy : illuminated (b) flamboyant : public
(c) surprising : shocking (d) superfluous : truncated

❍❍❍❍

Detailed Explanations

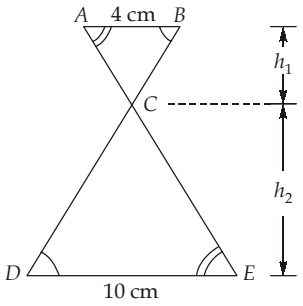
1. **(a)**

'Disinterested' means 'free from bias, free from personal/selfish motives'.
'Uninterested' means 'lacking interest'.

2. **(b)**

Between 1 to 300:
There are 27 multiples of 11.
There are 23 multiples of 13.
There are 2 multiples of 143 (of both 11 and 13).
So, there are 27 – 2 = 25 numbers divisible by 11 only.
And, there are 23 – 2 = 21 numbers divisible by 13 only.
In all, there are 25 + 21 = 46 numbers divisible by 11 or 13 but not by both.

3. **40.6 (40 to 41)**



Given $AB \parallel DE$

$\Rightarrow$ $\angle B = \angle D$ (Alternate angles)

and $\angle A = \angle E$ (Alternate angles)

$\therefore$ $\Delta ABC \sim \Delta EDC$ (AAA similarity)

$\Rightarrow$ $\frac{h_1}{h_2} = \frac{AB}{DE} = \frac{4}{10} = \frac{2}{5}$

and $h_1 + h_2 = 9.8$ cm (given)

$\therefore$ $h_1 = 2.8$ cm and $h_2 = 7$ cm

$$\text{Area of } \Delta ABC = \frac{1}{2} \times 4 \times 2.8 = 5.6 \text{ cm}^2$$

$$\text{Area of } \Delta EDC = \frac{1}{2} \times 10 \times 7 = 35 \text{ cm}^2$$

$\therefore$ Sum of areas of ΔABC and $\Delta EDC = 40.6$ cm^2

4. **(c)**

Let time taken by A and B to complete 3 and 4 hops respectively be 't'

Therefore time taken by A and B to do 1 hop is $\frac{t}{3}$ and $\frac{t}{4}$ respectively

Let distance covered in A and B's 4 and 5 hops respectively be 'd'

Therefore distance covered by A and B in 1 hop is $\frac{d}{4}$ and $\frac{d}{5}$ respectively

$$\text{A's speed: B's speed} = \frac{\left(\frac{d}{4}\right)}{\left(\frac{t}{3}\right)} : \frac{\left(\frac{d}{5}\right)}{\left(\frac{t}{4}\right)} = \left(\frac{3}{4}\right) \times \left(\frac{d}{t}\right) : \left(\frac{4}{5}\right) \times \left(\frac{d}{t}\right) = 15 : 16$$

5. **(a)**
'Ostrich like attitude' means 'when you overlook or ignore a problem'.

6. **(b)**
First of all $|x-3|^2 = (x-3)^2$, so we have: $(x-3)^2 + |x-3| = 20$.
when $x < 3$, $x-3$ is negative, thus $|x-3| = -(x-3)$. In this case we will have $(x-3)^2 - (x-3) = 20$
$\Rightarrow$ $x = -1$ or $x = 8$.
Discard $x = 8$ because it's not in the range we consider (< 3).
when $x >= 3$, $x-3$ is non-negative, thus $|x-3| = x-3$. In this case we will have $(x-3)^2 + (x-3) = 20$
$\Rightarrow$ $x = -2$ or $x = 7$.
Discard $x = -2$ because it's not in the range we consider ($> = 3$).
Thus there the two solutions: $x = -1$ and $x = 7$
$\Rightarrow$ The sum = 6.

7. **(a)**

$$\text{Number of trials} = \frac{1800}{150-30} = \frac{1800}{120} = 15$$

Let us take 14 trials of sliding up
For every trial of these 14 trials, its effective upward movement is (150 – 30) = 120 cm

$$\text{The time taken for this} = \left(14\times 1 + 14\times\frac{1}{2}\right) = 21 \text{ minutes}$$

Total distance = (14 × 120) = 1680 cm
Remaining = 1800 – 1680 = 120 cm

$$\text{Remaining 120 cm it can reach in } \frac{(60\times 120)}{150} = 48 \text{ seconds}$$

Total time = 21 minutes 48 seconds

8. **(b)**
Total ways of arranging 5 letters in any possible order = 5 × 4 × 3 × 2 × 1 = 5! = 120
In half of the cases A will be to the left of B and in other half A will be to the right of B
Hence, desired outcome

9. **(b)**
This is a situation in which there is the same relationship, respect, between any possible pair of people in the group. This is a saturation that calls for the structure "each other" or "one another". Choice (a) doesn't use this, and what is used is very wordy and awkward, so it is incorrect. These structures, "each other" and "one another", demand a plural subject. Choices (c) and (d) make the mistake of using a singular subject, so these are incorrect.
Option (b) is the right answer.

10. **(d)**
Factorial of the positive integers greater than 5 is divisible by 18.
So, we have to find out the remainder when 1! + 2! + 3! + 4! + 5! (= 153)is divided by 18. (All other terms yield zero remainder)
So, Remainder = 9.

11. **(2000)**

Let Percentage Profit/Loss = x and Cost Price = C

Now, $C + xC = 1920$

$C - xC = 1280$

Solving for $C \Rightarrow 2C = 3200 \Rightarrow C = 1600$

Sale Price with 25% profit $\Rightarrow 1.25 \times 1600 = 2000$.

12. **(b)**

9 AM of 14th August to 2 PM on 18th August = 101 hours

$\left(24 + \frac{15}{60}\right)$ hours of incorrect clock = 24 hours of correct clock

1 hour of incorrect clock = $\frac{96}{97}$ hours of correct clock

101 hours of incorrect clock = $\frac{96}{97} \times 101$ hours of correct clock

= 99 hours and approx 58 minutes

So, correct time will be

2 PM, 14th August + (99 hours and 58 minutes) = 12:58 PM on 18th August

13. **(c)**

The length of the hypotenuse of the triangle is the length of one of the sides multiplied by $\sqrt{2}$, i.e. $9\sqrt{2}$ feet. Therefore the area of the square is $9\sqrt{2} \times 9\sqrt{2} = 81 \times 2 = 162$ sq. feet.

The area of the triangle must be exactly one quarter of the area of the square. If you don't see that directly, imagine the triangle being flipped down into the square. Therefore, the total area is $\left(162 + \frac{162}{4}\right)$ sq. feet = 202.5 sq feet.

14. **(16)**

Farmer works for 5 + 4 = 9 days

If he completes entire work in 12 days, he will finish $\frac{9}{12}$ or $\frac{3}{4}$th work in 9 days.

Remaining work, $1 - \frac{3}{4} = \frac{1}{4}$, is done by daughter in 4 days..

So if daughter does $\frac{1}{4}$ work in 4 days, she will complete the whole work in 4 × 4 = 16 days.

15. **(d)**

We will be required to get the value of n such that $\frac{n(n+1)}{2} = 100$. If $n = 13$, $\frac{n(n+1)}{2} = 91$ which means that 100th digit will be occupied by 14th set of digits or it will be equal to 4.

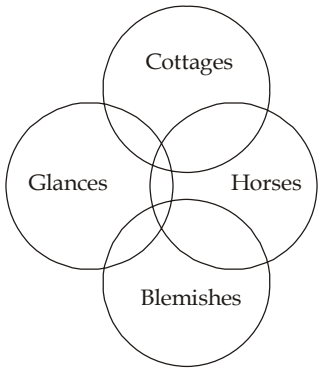
16. **(b)**

'Armchair traveller' = Someone who reads books or watches TV programmes about other places and countries, but doesn't actually travel anywhere. "Born with a silver spoon" = born into a very rich family. "A big fish in a small pond" = an important or highly-ranked person in a small group or organisation. Since, the sentence does not contain any reference about travelling, (1) cannot be true here.

17. **(b)**

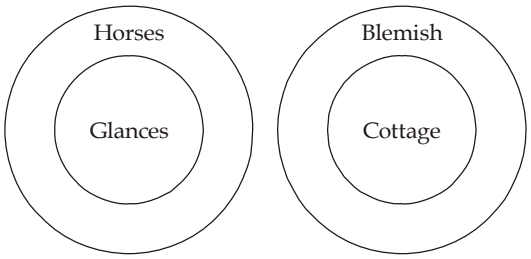
The statements given in option (b) lead to the required conclusions.

(a)



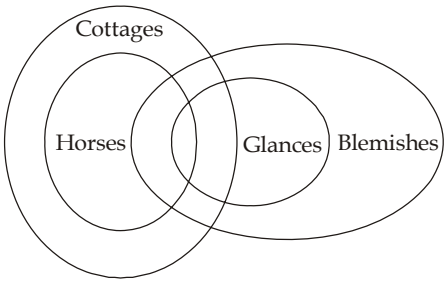
In this scenario conclusion II does not follow

(b)



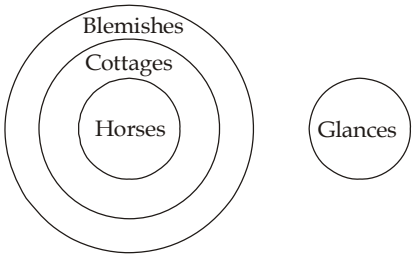
In this scenario both the conclusions are true

(c)



In this case we see that neither of the conclusions is true

(d)



In this scenario conclusion I does not follow

18. **(d)**

The probability that a green ball is transferred from A to B and a green ball is transferred from vessel B to vessel A, $P_{green,\ green} = \left(\frac{6}{10}\right)\times\left(\frac{5}{11}\right) = \frac{30}{110}$.

Similarly other cases, $P_{green,\ red} = \left(\frac{6}{10}\right)\times\left(\frac{6}{11}\right) = \frac{36}{110}$.

$$P_{red,\ green} = \left(\frac{4}{10}\right)\times\left(\frac{4}{11}\right) = \frac{16}{110}$$

$$P_{red,\ red} = \left(\frac{4}{10}\right)\times\left(\frac{7}{11}\right) = \frac{28}{110}$$

Probability of drawing a green ball from vessel A after the transfers in these four cases are $\frac{6}{10}, \frac{5}{10}, \frac{7}{10}, \frac{6}{10}$ respectively.

Therefore the required probability

$$= \left(\frac{30}{110}\right)\times\left(\frac{6}{10}\right)+\left(\frac{5}{10}\right)\times\left(\frac{36}{110}\right)+\left(\frac{7}{10}\right)\times\left(\frac{16}{110}\right)+\left(\frac{6}{10}\right)\times\left(\frac{28}{110}\right)=\frac{32}{55}$$

19. (b)

The time required by individual to complete one revolution is

$\frac{7}{4}, \frac{7}{3}, \frac{7}{9}, \frac{7}{3.5}$ hours

To reach at starting point, the time required is LCM of $\frac{7}{4}, \frac{7}{3}, \frac{7}{9}$ and $\frac{2}{1}$ hours.

$$= \frac{\text{LCM}(7,7,7,2)}{\text{HCF}(4,3,9,1)} = 14 \text{ hours}$$

After 14 hours, all 4 will be at starting point.

or, $6 + 14 = 20 = 8$ PM

all will be at starting point.

20. 1.253 (1.2 to 1.3)

Let the number of matches in which he was in the team of starting 11 be x and the matches in which he came on as a substitute be y.

Thus, $x + y = 388$ ...(i)

Number of goals scored in matches in which he was in the team of starting 11 = Average × number of matches = $1.5x$

Number of goals scored in matches in which he came on as a substitute = $0.5y$

Thus, $1.5x = 0.5y + 390$ ...(ii)

Solving both equations for x and y, we have $x = 292$ and $y = 96$

So, the total number of goals scored by him = $1.5 \times 292 + 0.5 \times 96 = 486$ goals

Therefore, average number of goals scored per match = $486 \div 388 = 1.253$

21. (c)

At present,

Let the members be M, N, O and P

Where age of P > O > N > M

Since P died after 5 years at the age of 88. So, present age of P = 88 – 5 = 83

Youngest member = M = 14 years

$N + O + P = 54 \times 3$

$N + O = 162 - 83 = 79$ ...(i) (O > N)

10 years after the death of P means 15 years hence from present, let Q be born.

20 years from present means at that time Q = 5 years and is youngest.

Eldest member at that time = O (age = O + 20)

$(O + 20) - 5 = 57$

O = 57 – 15 = 42 years

So, N = 79 – 42 = 37 years

After 5 years, members alive are = M, N, O

M = 14 + 5 = 19 years

N = 37 + 5 = 42 years

O = 42 + 5 = 47 years

Required ages of N and O are 42 and 47.

22. **(b)**

23. **(d)**

It would be easier if we visualize this problem. As sphere is inscribed in cube then the edges of the cube equal to the diameter of sphere,

Diameter = 10 units

Next, Diagonal of a cube = $\sqrt{10^2+10^2+10^2} = 10\sqrt{3}$.

Now, half of (Diagonal minus Diameter) is the gap between the vertex of cube and surface of the sphere, which will be the shortest distance:

$$x = \frac{\text{Diagonal} - \text{Diameter}}{2} = \frac{10\sqrt{3}-10}{2} = 5\left(\sqrt{3}-1\right)$$

24. **(c)**

Let us assume $k = \frac{K}{100}$ and the cost price = C

Based on S1, we can write $C\times\left(1+\frac{K}{100}\right)-C\times\left(1-\frac{K}{100}\right)=2560$

i.e. $\frac{2CK}{100} = 2560$ or $Ck = 1280$ which does not give the value of k or K. Hence Statement 1 is NOT sufficient.

Based on S2, $C \times 0.075 = K$ which gives $C = 40K/3 = 4000k/3$ which will NOT give the value of k or K.

When we combine the information given in both the statements, we will be able to find C as well as k or K. Hence option (c) is the correct option.

25. **(c)**

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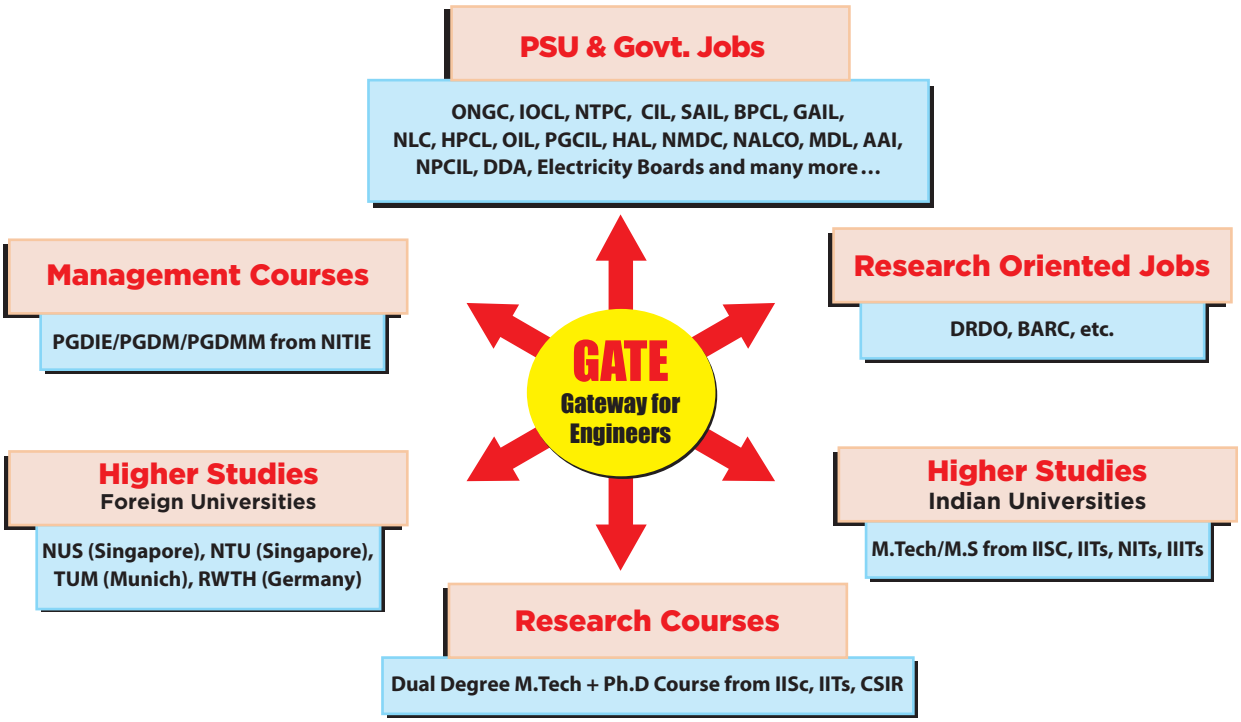
Q.26 - Q.50 out of 200 Questions

Day 2 of 8



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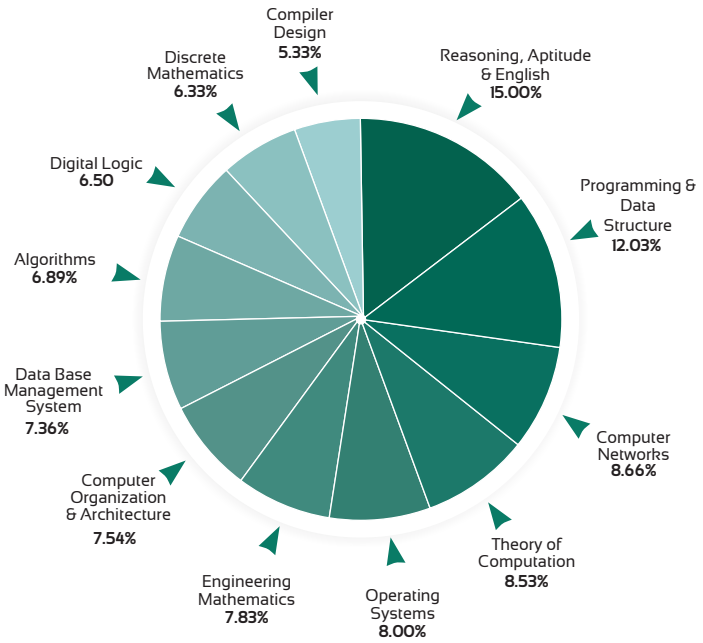

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Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 2 : Q.26 to Q. 50 : Programming

Q.26 Analyze the code fragment given below in which size represent the size of array named as value:

```
for(int i = 0; i < size – 1; i++) {
    minindex = i;
for(int j = 0; j < size; j++) {
    if(value [j] < value [minindedx]) {
    minindex = j;
    }
}
swap(value, i, minindex);
}
```

Which of the following sorting algorithm represented by above code?

(a) Insertion sort (b) Selection sort

(c) Bubble sort (d) Bucket sort

Q.27 Consider the function given below, which should return the index of first zero in input array of length 'n' if present else return –1.

```
int index of zero (int[ ] array, int n) {
for (int i = 0; [ P ]; i++);
    if (i = = n)
        return –1;
    return i;
}
```

Which of the should be place in code at [P], so that code will work fine?

(a) array[i]! = 0 && i ≤ n (b) array[i]! = 0 && i < n

(c) ! array[i] = 0 && i < n (d) ! array[i] = = 0 || i < n

Q.28 Consider a single array A[0..... n – 1] is used to implement two stacks. Two stacks grows from opposite ends of the array. Variables top1 and top2 points to the location of the top most element in each of the stacks with initial values of –1 and n respectively and top1 < top2 always. If certain push and pop operations are performed at either end, then which of the following represents the number of elements are present in the array at any time?

(a) top1 – top2 + n (b) n – top2 + top1

(c) n + 1 – top2 + top1 (d) n – 1 – top2 + top1

Q.29 Consider the following C-program:

```
#include <stdio.h>
int main ( ) {
char *arr[ ] = {"GATE", "CAT", "IES", "IAS", "PSU", "IFS"};
      call (arr);
      return 0;
}
void call (char **ptr) {
      char ** ptr1;
      ptr1 = (ptr+ = size of (int)) –2;
      printf("%s\n", *ptr1);
}
```

Which of the following represents the output of above program? (Assume size of int, pointer is 4B)

(a) IES
(b) IAS
(c) CAT
(d) PSU

Q.30 Consider the following C program:

```
int x = 10;
Void Part1(int *a) {
      *a + = x ++;
      printf("%d" *a);
}
Void Part2(int *b) {
      static x = 15;
      *b = *b × x;
      Part1(&x);
      printf("%d" *x);
}
Void main ( ) {
      Part2(&x);
      Part1(&x);
}
```

What will be the output using static scoping and dynamic scoping respectively?

(a) Static: 165, 303, 303
    Dynamic: 31, 301, 301
(b) Static: 165, 165, 165
    Dynamic: 31, 31, 31
(c) Static: 303, 303, 303
    Dynamic: 301, 301, 301
(d) Static: 165, 165, 303
    Dynamic: 31, 31, 301

Q.31 Consider the following C function, where size represent number of elements in an array:

```
int Random (int a[ ], int size) {
    int max1 = 0,  min1 = 0, max2 = 0, start = 0, end = 0, s = 0;
for (int i = 0; i < size; i++) {
    max2 = max2 + a[i];
    if (max1 < max2) {
        max1 = max2;
        start = s;
        end = i;
    }
    if (max2 < 0) {
        max2 = 0;
        s = i + 1;
    }
}
return max1;
}
```

The output return by above function "Random" is _____.

(a) Size of maximum possible sum of array
(b) Size of largest sum of contiguous sub-array
(c) Maximum element in any sub-array $a[\ ]$
(d) Sum of all the elements in the array $a[\ ]$

Q.32 Consider the following code fragment where head of the 2 sorted linked list is passed as an argument:

```
struct node * fun (struct node * x, struct node * y) {
    struct node * z = NULL;
    if (x = = NULL) return (y);
    else if (y == NULL) return (x);
    if (x → data < = y → data) {
        z = x;
        z → next = fun (x → next, y);
    }
    else
    {   z = y;
        z → next = fun (x, y → next);
    }
    return(z);
}
```

Which of the following is correct about fun ( )?

(a) Returns the list which concatenates the given two lists
(b) Returns the smallest list of given two lists
(c) Returns the sorted list of given two lists
(d) None of these

Q.33 Consider the following code snippet called 'Program X':

```
void f(int n)
{
    if (n <= 1) printf("%d", n);
    else
    {
    f(n/3);
    printf("%d", n% 3);
    }
}
```

Which of the following implementations will produce the same output for $f(1023)$ as the above code?

Program P_1:

```
void f(int n)
{
    if (n/3)  {
    f(n/3);
    }
    printf("%d", n% 3);
}
```

Program P_2:

```
void f(int n)
{
    if (n <= 1) printf("%d", n);
    else
    {
    printf("%d", n% 3);
    f(n/3);
    }
}
```

(a) Both P_1 and P_2
(b) Only P_1
(c) Only P_2
(d) None of these

Q.34 Consider a hypothetical machine which supports the following data types:
unsigned char: 1 Byte
unsigned short: 2 Bytes
int: 4 Bytes
Consider the following function red( )

```
int red(unsigned char a, unsigned short b)
{
    if (a = = 0) return b;
    else {
        a = a + 1;
        b = b * 2;
        return red(a, b); }
}
int main( ) {
    printf("%d", red((char) 240, 1));
    return 0;
}
```

What will be the output of the following program?

(a) The program terminates abnormally
(b) The program goes into infinite loop
(c) The program outputs 65536 (2^{16})
(d) None of these

Q.35 Consider the following C code:

```
#include <stdio.h>
int sum(int A[ ], int n) {
    int s = 0;
    for (int i = 0; i < n; i++)
    s+ =A[i];
    return s; }
    int main(void) {
    int a[6] = {000, 001, 010, 011, 012, 100};
    printf("%d", sum(a, 6));
    return 0;
}
```

Let X be the output produced by the program. Let log(*n*) denote the logarithm of the given number *n* in base 2. Then log(X) will be equal to

(a) 6 (b) 7
(c) 8 (d) 9

Q.36 Consider the C functions foo and bar given below:

```
int foo (int val)
{
    int x = 0;
    while (val > 0)
    {
        x = x + foo (val --);
    }
        return val;
    }
    int bar (int val)
    {
        int x = 0;
        {
        while (val > 0)
        x = x + bar (val - 1);
        }
    return  val;
}
```

Invocations of foo (3) and bar (3) will result in:
(a) Return of 6 and 6 respectively.
(b) Infinite loop and abnormal termination respectively.
(c) Abnormal termination and infinite loop respectively.
(d) Both terminating abnormally.

Q.37 Consider the following C program segment:

```
# include <stdio.h>
int main( ) {
    char s1[7] = "1234", * p;
    p = s1 + 2;
    *p = '0' ;
    printf ("%s", s1);
}
```

What will be printed by the program?
(a) 12 (b) 120400
(c) 1204 (d) 1034

Q.38 Which of the following is correct output for the program code given below?
code given below?

```
main ( )
{
    void fun ( );
    fun( );
    fun ( );
}
void fun ( );
{
    static int i = 1;
    auto int j = 5;
    printf ("%d", (i++));
    printf ("%d", (j++));
}
```

(a) 1 5 2 6 3 7 (b) 2 6 3 7 4 8
(c) 1 5 6 1 7 1 (d) 1 5 2 5 3 5

Q.39 Consider the following program:

```
main ( )
{
    int i, j;
    int A[m][n] = {{1, 2, 3} {4, 5, 6}}
    for (i = 0; i < n; i ++)
    for (j = 0; j < m; j ++)
    printf("%d", * (A[j] + i));
}
```

For the output printed by the above program.

(a) 1 2 3 4 5 6 (b) 1 4 2 5 3 6

(c) 4 5 6 7 8 9 (d) 4 5 6 4 5 6

Q.40 Consider the following C program segment:

```
# include <stdio.h>
main( )
{
    static char *s[ ] = {"madeeasy", "online", "test", "series"};
    char ** ptr[ ] = {s + 3, s + 2, s + 1, s}, *** p;
    p = ptr;
    ++p;
    printf("%s", * – – *++p + 3)
}
```

What will be printed by the program?

(a) line (b) ies

(c) test (d) eeasy

Q.41 What will be the output of the following C program:

```
# include <stdio.h>
void print 1 (void)
{
    static int x = 10;
    x+ = 5;
    printf("%d", x);
}
Void print 2 (void)
{
    static int x;
    x = 10;
    x+ = 5;
    printf("%d", x);
}
int main ( )
{
    print 1( ); print 1( ); print 2( ); print 2 ( );
    return 0;
}
```

(a) 15, 20, 25, 30 (b) 15, 20, 15, 20

(c) 15, 15, 15, 15 (d) None of these

Q.42 Consider the following C program:

```
main ( )
  {
      int p = –3, q = 2, r = 0, s, t ;
      s = ++ p && ++ q || r ++ ;
      t = p + q + s ++ ;
      printf("\n % d % d", s, t) ;
  }
```

Which of the following represents output of above program ?

(a) 1 2 (b) 0 2

(c) 1 3 (d) 0 3

Q.43 Consider the following C program execute on a singly linked list numbered from 1 to n containing atleast 2 nodes:

```
struct Listnode
{
    int data;
    struct Listnode *next;
} ;
void fun (struct Listnode *head)
{
    if (head == NULL || head → next ==NULL) return;
    struct Listnode *tmp = head → next;
    head → next = tmp → next;
    free (tmp);
    fun (head → next);
}
```

Which of the following represents the output of above function 'fun' ?

(a) It reverses the every 2 adjacent nodes linked list

(b) Every odd number nodes of given linked list will be deleted

(c) Every even number nodes of given linked list will be deleted

(d) It reverses the linked list and delete alternate nodes

Q.44 Consider the following C code snippet:

```
main ( )
{
    int S[6] = {128, 256, 512, 1024, 2048, 4096};
    int *x = (int *) (& S + 1);
    printf ("%d", x);
}
```

Let the size of int is 4 bytes; the array starts from 2000 onwards. Then the o/p generated by the above code is _____.

Q.45 Consider the following program segment:

```
int main ( )
{
    char * str = "GATECS";
    printf ("%d", madeeasy (str));
    return 0;
}
int madeeasy (int * p1)
{
    int * p2 = p1;
    while (*++p1);
    return (p1 – p2);
}
```

The output of the above program will be _____. Assume that the object of data type int occupies 2 bytes.

Q.46 Consider the following program along with push and pop operations on stack which can contain atmost 8 element at a time:

```
void main ( )
{   stack S;
    int num;
    printf ("enter the input");
    scanf ("%d", & num);
    while (num! = 0)
    {
        if (!full (S))
        {
            push (S, num %2);
            num = num / 2;
        }
    else
    {
        printf ("stack overflow");
        exit (0);
    }
}
```

The value 156 is given as input to the program then value present in stack from top to bottom will be _____.

Q.47 The output of following program is _____.

```
# include <stdio.h>
int main( )
{
    static int a[ ] = {90, 98, 99, 96, 84, 70};
    static int *p[ ] = {a + 2, a + 1, a, a + 3, a + 4, a + 5};
    static int ** S[ ] = {p + 4, p + 5, p + 1, p, p + 2, p + 3};
    int *** ptr; ptr = S + 2;
    printf("%d", ***(ptr + 3) – **(p + 1));
}
```

Q.48 Consider the given function magic ( ):

```
int magic (int n)
{
    static int r = 5;
    if (n <= 0) return 10;
    if (n > 3)
{
    r = 50;
    return (r + magic (n – 1));
}
    return (r – magic (n – 1));
}
```

The output corresponding to the function call magic (8) is _____.

Q.49 Consider the following C program segment:

```
# include <stdio.h>
# define MUL (a, b) a * b
# define pow (a) a * a
int main ( )
{
    int a = 3;
    int b = 2;
    printf("%", MUL (MUL (a+1, b), pow (b + 1)));
    return 0;
}
```

The output of the above program is _____.

Q.50 Consider the following function that computes the value of $\binom{m}{n}$ correctly for all legal values m and n ($m \geq 1$, $n \geq 0$) 0 and $m > n$)

```
int func (int m, int n)
{
    if [(n == 0)||(m == n) return 1;
    else return (E);
}
```

In the function, which of the following is the correct expression for E?

(a) func ($m - 1$, n) + func ($m - 1$, $n - 1$)

(b) func ($m - 1$, $n + 1$) + func ($m - 1$, n)

(c) func (m, n) + func (m, $n - 1$)

(d) None of these

❍❍❍❍

Detailed Explanations

26. **(b)**

The code represent is the selection sort algorithm on an array.

27. **(b)**

For every index in input array we need to check given index contain '0' or not if current index contains 0 then get out of loop and print index and if current index do not contains 0 then check it for the next index element.

$$\text{array}[i]! = 0$$

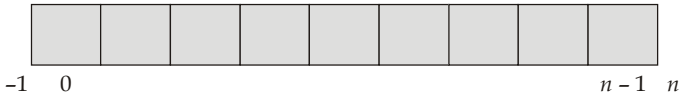
Also check index should be less than total number of elements in array i.e.

$$i < n$$

So, condition must be array[i]! = 0 && $i < n$.

28. **(c)**

Consider array representation of stacks:



top1 = –1 represents no element in stack –1
top2 = n represents no element in stack –2

So, check option one by one when both stacks are empty:

(a) $-1 - n + n$ = –1 not possible
(b) $n - n + -1$ = –1 not possible
(c) $n + 1 - n + (-1)$ = 0 only possible option
(d) $n - 1 - n + (-1)$ = –2 not possible

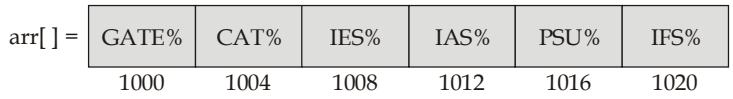
Now consider for both stack has '2' elements each:

Apply in option (c)

$$= n + 1 - (n - 2) + 1$$
$$= n + 1 - n + 2 + 1 = 4$$

So, option (c) is correct.

29. **(a)**



**ptr = arr ⇒ **ptr = 1000;
*ptr1 = (ptr+ = size of (int)) [–2];
= (1000 + 4) [–2] = [1000 + 4 × 4] [–2]
= [1016] [–2] = [1015 – 2 × 4]
*ptr1 = [1008]
print(*ptr1) = IES

30. (d)

1. Using static scoping:

x | ~~10~~ | ~~150~~ | ~~151~~ | ~~302~~ | 303 — Global variable
1000

Part 2 (1000)

x | 15 — Local variable
2000

b (1000)
= 10 × 15
= 150

Part 1 (2000)
*a (*2000)
= 15 + (150 ++)
= 165
print (165)

---

print (165)
Part 1 (1000)
*a (*1000)
= 151 + (151 ++)
= 302
print (303)
"165, 165, 303"

2. Using dynamic scoping:

x | ~~10~~ | ~~150~~ | ~~300~~ | 301
1000

Part 2 (1000)

x | ~~15~~ ~~30~~ | 31
2000

*b = 10 × 15
= 150
Part 1 (2000)
*a = 15 + (15 ++)
= 30
print (31)
print (31)

Part 1 (1000)
*a = 150 + (150 ++)
= 300
print (301)
"31, 31, 301"

31. **(b)**

Consider Random array $a[\ ] = \{1, -2, 1, 1, -2, 1\}$

Output is 2 i.e. $\{1, 1\} = 2$

Consider Random array $a[\ ] = \{-2, -3, 4, -1, -2, 1, 5\}$

Output is 7 i.e. $\{4, -1, -2, 1, 5\} = 7$

i.e. sum of largest sum of contiguous sub array.

32. **(c)**

It merges the two sorted lists.

In every recursion, z gets a node which is smallest node from x and y.

$\therefore$ Finally z gets entire sorted list of given two sorted lists of x and y.

So option (c) is correct.

33. **(b)**

The program X prints the ternary equivalent of 1023. Program P_1 also prints the ternary equivalent of 1023. However, program P_2 prints the ternary equivalent of 1023 in reverse order.

Hence the answer is (b).

34. **(d)**

The value returned by the above program will be zero. To understand this, here's the sequence of the recursive calls.

Output:

$a = 240$ and $b = 1$
$a = 241$ and $b = 2$
$a = 242$ and $b = 4$
$a = 243$ and $b = 8$
$a = 244$ and $b = 16$
$a = 245$ and $b = 32$
$a = 246$ and $b = 64$
$a = 247$ and $b = 128$
$a = 248$ and $b = 256$
$a = 249$ and $b = 512$
$a = 250$ and $b = 1024$
$a = 251$ and $b = 2048$
$a = 252$ and $b = 4096$
$a = 253$ and $b = 8192$
$a = 254$ and $b = 16384$
$a = 255$ and $b = 32768$
$a = 0$ and $b = 0$

The key here is that the range of unsigned char is [0 – 255] and that of unsigned short is [0 – 65535].

Hence when $a = 255$ and $b = 32768$, $a + 1$ should be 256 and $b * 2$ should be 65536; however due to overflow, a and b both become equal to zero as they are unsigned.

35. **(b)**

The catch here is that, some of the contents of the array are written in octal format. If a number is preceded by a zero, then the number is interpreted as an octal number in C. The code simply adds all the numbers up, and produces the output in decimal format.

Hence, the output will be:

$(0 + 1 + 8 + 9 + 10 + 100) = 128$

Thus $\log(128) = 7$

36. **(c)**

In foo (int var) function, variable 'val' is created for every function call and foo (val −−) means first call is made after that 'val' values is decremented by 1 i.e.,

```
foo (3)
int val = 3-2;
int x = 0;
x = x + foo (3 --);
        ↓
        foo (3)
        int val = 3;
        int x = 0;
        x = x + foo (3 --);
```

which makes stack overflow, so abnormal termination.

In bar (int val) function, variable 'val' is created for every function call and bar (val – 1) means new call is made with 1 less than previous value of 'val' i.e.,

```
bar (3)
int val = 3-2;
int x = 0;
x = x + bar (2);  {infinite loop}
        ↓
        bar (2)
        int val = 3;
        int x = 0;
        x = x + bar (1);  {infinite loop}
                ↓
                bar (1)
                int val = 3;
                int x = 0;
                x = x + bar (0);  terminate
```

If we see while (var > 0) is make infinite loop since 'val' value is not decremented in bar( ) function for value of variable val > 0, it created infinite loop.

37. **(c)**

1	2	3	4	\0		
1000	1001	1002	1003	1004	1005	1006

s_1 1000

$p =$ 1002

$*p = '0';$ ⇒

1	2	0	4	\0		
1000	1001	1002	1003	1004	1005	1006

Therefore the output is 1204

38. **(d)**

An object whose storage class is auto, is reinitialized at every function call whereas an object whose storage class static persist its value between different function calls.

When the function fun ( ) is called for the first time, value of i and j are printed and sequentially incremented. During the second function call, i retains its incremented value whereas j is reinitialized, hence i will print 2 and j will print 5 again. The same will happen at third function call, i will print 3 and j will print 5.

39. **(b)**

Here m represent the number of rows and n represents the number of column.

m = 2, n = 3

∗ (A[0] + 0) = A[0][0] = 1

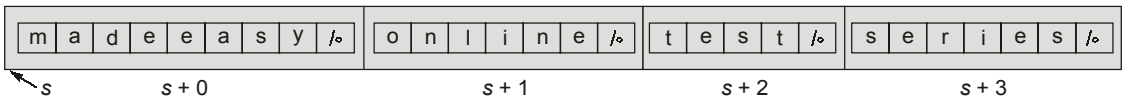
∗ (A[1] + 0) = A[1][0] = 4

Similarly it will access all the element.

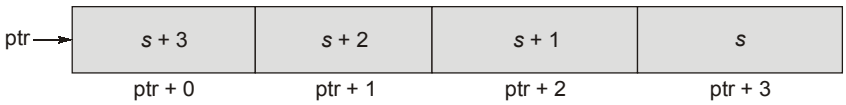
∴ 1 4 2 5 3 6 is the output printed by the program.

40. **(d)**

In this problem we have an array of char pointers pointing to start of 4 strings i.e.,



We have ptr which is pointer to a pointer of type char and a variable p which is a pointer to a pointer of type char.



p = ptr; p [ptr]

++p; p [ptr+1]

Printf("%s", ∗ – – ∗ ++ p + 3);

In printf statement the expression is evaluated ∗++p cause gets value (s + 1) then now pre-decrement is executed and we get (s + 1) – 1 = s. The indirection pointer now gets the value from the array of s and add 3 to the starting address. The string is printed starting from this position. Thus, the output is 'eeasy'.

41. **(d)**

- **print 1( ):** x = 10 + 5 = 15; since the variable is of static storage class, hence it will retain its value between different function calls.
- **print 1( ):** x = 15 + 5 = 20; since it has retained its value 15.
- **print 2( ):** x is defined again inside the function and hence will print, $x = x + 5 = 10 + 5 = 15$. Again when the function will be called, x = 10 + 5 = 15. Here second time also x = 10 will be there because it is not initialized at the time of definition.

Hence output 15, 20, 15, 15.

42. **(a)**

Initial value are $p = -3$

$q = 2$

$r = 0$

&& has more priority than ++

$++p = -2$

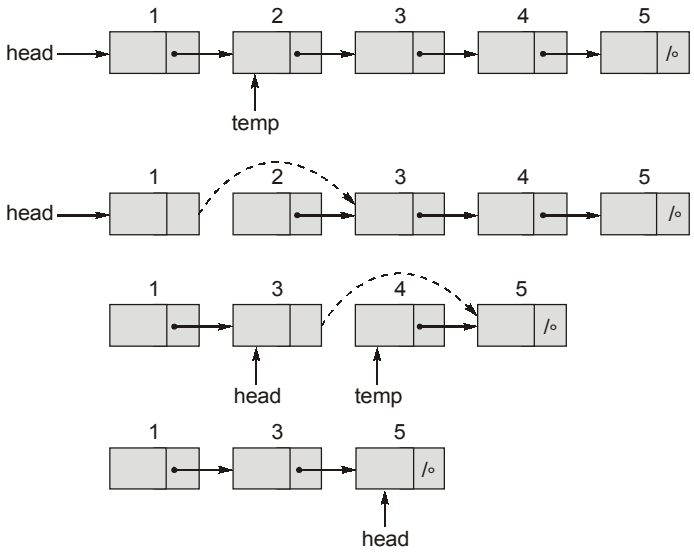
$++q = 3$

Since, both are non zero, hence expression becomes true. r++ need not be checked for calculating 's' because it's an OR operation so $s = 1$ i.e. the truth value of the expression.

$t = p + q + s++$

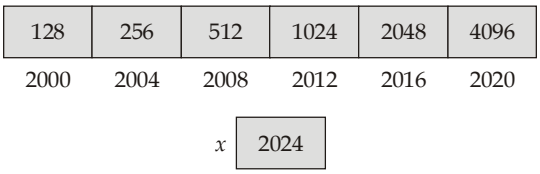
$= -2 + 3 + 1 = 2$

43. **(c)**



The above program deletes every even number node in the linked list (In particular second, fourth, sixth... soon nodes will be deleted).

44. **(2024)**



= (int *) (& S + 1);

= (int *) (Base address of S + 1 * size of (S))

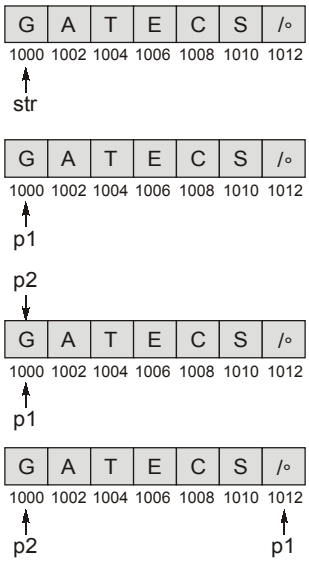
= 2000 + (24 bytes) * 1

⇓

(6 ints, 4 bytes each)

= 2024

45. **(6)**



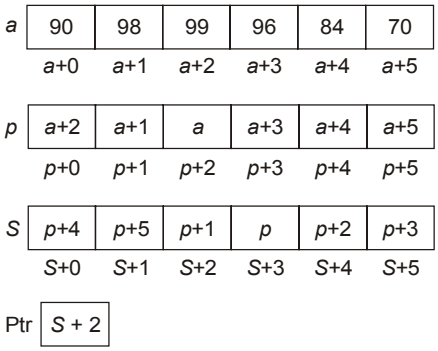
$\frac{\text{Address of } p1 - \text{Address of } p2}{\text{Size}} = \frac{12}{2} = 6$ (which is nothing number of character between first and last pointer)

46. **(10011100)**

The given program compute the binary value of decimal number 156.

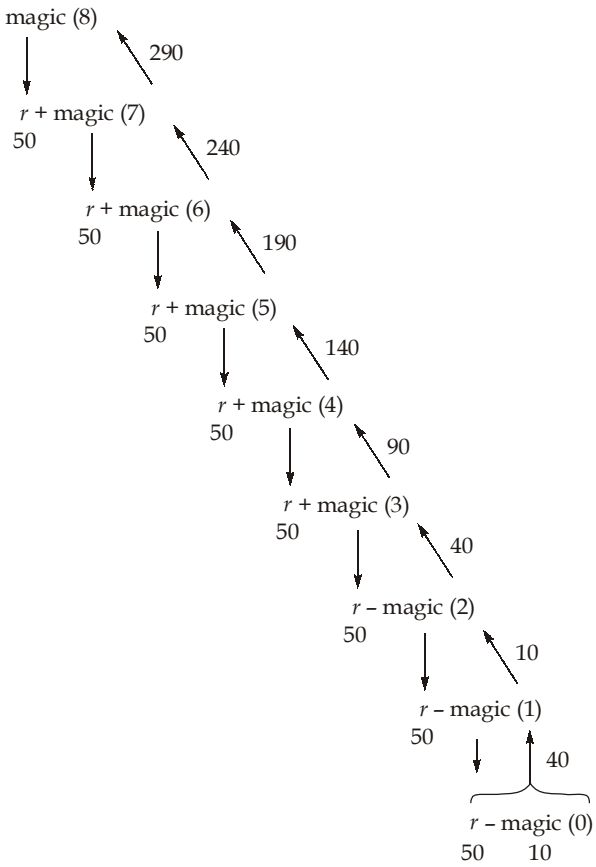
Hence, the output received will be 10011100.

47. **(–2)**



$$\begin{aligned} *** (\text{ptr} + 3) - **(p + 3) &= (*(*(*(S + 3 + 2)))) - (*(*(p + 1))) \\ &= (*(*(p + 3))) - (*(a + 1)) \\ &= 96 - 98 = -2 \end{aligned}$$

48. **(290)**



49. **(10)**

MUL (MUL (a + 1, b), pow (b + 1))

MUL ([a + 1 * b], [b + 1 * b + 1])

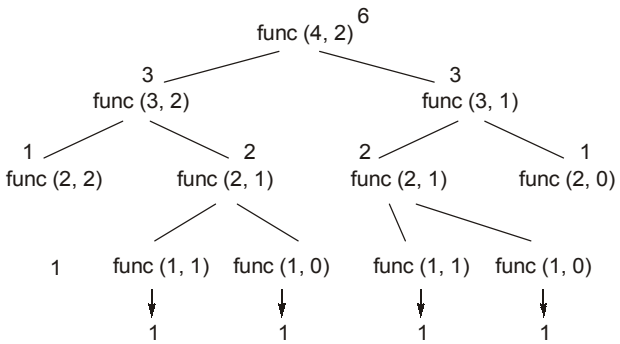
$\Rightarrow$ a + 1 * b * b + 1 * b + 1

$\Rightarrow$ 3 + 1 * 2 * 2 + 1 * 2 + 1

$\Rightarrow$ 3 + 4 + 2 + 1 = 10

50. **(a)**

Take m = 4 and n = 2



So, correct value of E is func (m – n, n) + func (m – 1, n – 1).

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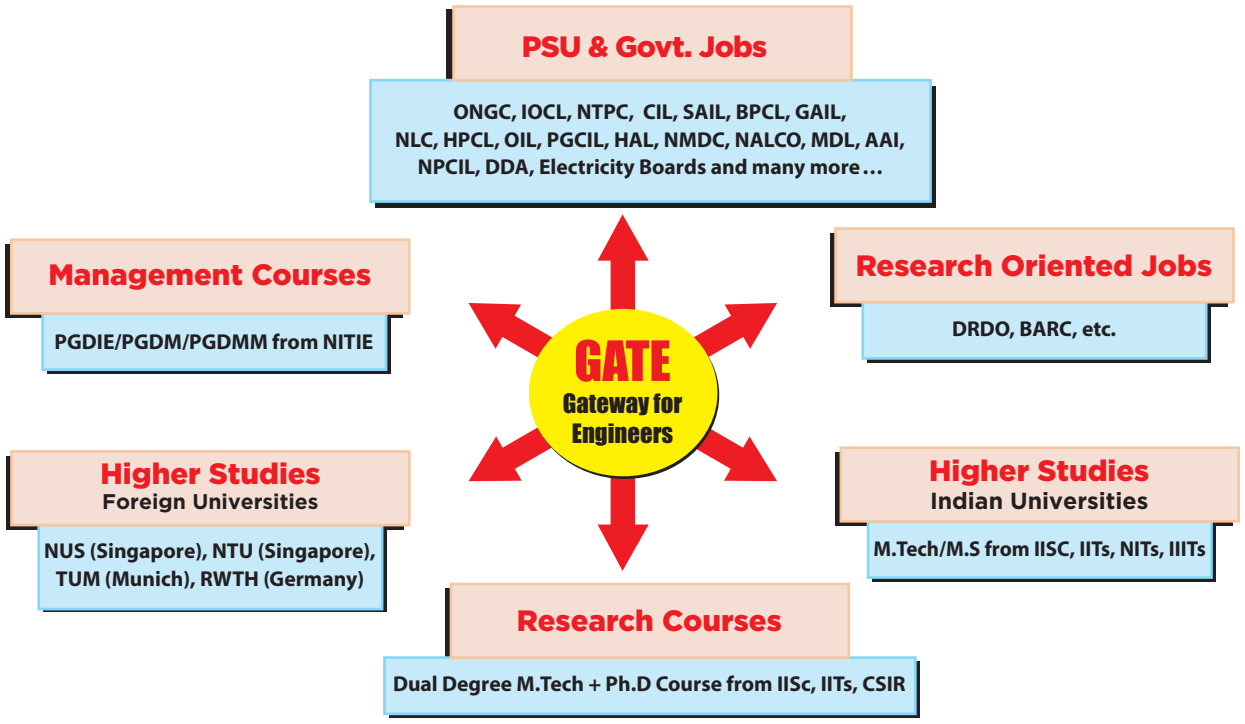
Revision through Questions for GATE 2020

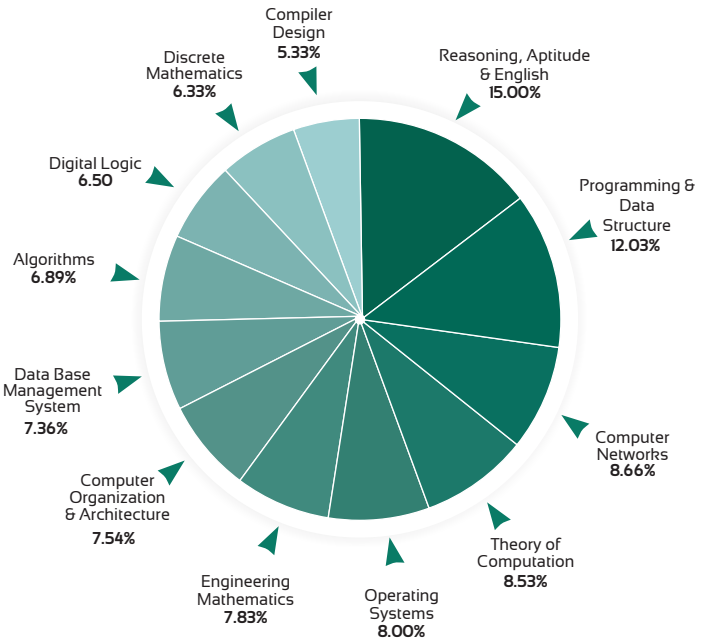
CS Computer Science

Q.51 - Q.75 out of 200 Questions

Day 3 of 8



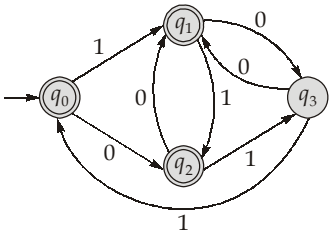
SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	12.03%
Computer Networks	8.66%
Theory of Computation	8.53%
Operating Systems	8.00%
Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 3 : Q.51 to Q. 75 : Theory of Computation

Q.51 Consider the following DFA:



Which of the following string is not accepted by above DFA?

(a) 011001110 (b) 11011011001

(c) 1010101011 (d) 1001110

Q.52 Which of the following language is regular?

(a) $\{wxw^R \mid w \in (a+b)^*, x \in \{a, b\}\}$ (b) $\{wxw^R \mid w, x \in (a+b)^+\}$

(c) $\{ww^Rx \mid w, x \in (a+b)^+\}$ (d) $\{ww^R \mid w \in (a+b)^*\}$

Q.53 Consider the following statements:

S_1: DFA for language which contain '$\in$' must have initial state as final state.

S_2: For any language either a language L or its complement L' must be finite.

S_3: If L is set of all string ending with atleast n b's then minimum number of states in non deterministic finite automata that accept L is $n + 2$.

S_4: Non deterministic finite automata is more powerful than deterministic finite automata.

Which of the above statement is true?

(a) S_1 only (b) S_2, S_3 only

(c) S_2, S_3, S_4 only (d) S_1, S_3 only

Q.54 Consider P and Q be language over $\Sigma = \{0, 1\}$ represented by the regular expression 0* (10*)* and (0* + 1*)* respectively. Which of the following is true?

(a) $P \subset Q$ (b) $Q \subset P$

(c) $P = Q$ (d) $P \cap Q = 0^*1^*$

Q.55 Consider the following statements:

S_1 : $\{(a^n)^m \mid n \le m \ge 0\}$

S_2 : $\{a^n b^n \mid n \ge 1\} \cup \{a^n b^m \mid n \ge 1, m \ge 1\}$

Which of the following is regular?

(a) Only S_1 (b) Only S_2

(c) Both S_1 and S_2 (d) Neither S_1 nor S_2

Q.56 Consider a Push Down Automata (PDA) below which runs over the input alphabet (a, b). It has the stack alphabet $\{z_0, X\}$ where z_0 is the bottom of stack marker. The set of states of PDA is $\{q_0, q_1\}$ where q_0 is the start state.

$\delta\{q_0, b, z_0\} = \{(q_0, Xz_0)\}$
$\delta\{q_0, b, X\} = \{(q_0, XX)\}$
$\delta\{q_0, a, X\} = \{(q_1, X)\}$
$\delta\{q_0, \in, z_0\} = \{(q_0, \in)\}$
$\delta\{q_1, b, X\} = \{(q_1, \in)\}$
$\delta\{q_1, a, z_0\} = \{(q_0, z_0)\}$

The language accepted by PDA is

(a) $L = \{(b^n ab^n a)^m \mid m, n \geq 0\}$
(b) $L = \{(b^n ab^n a)^m \mid n, m \geq 0\} \cup \{b^n \mid n \geq 0\}$
(c) $L = \{(b^n ab^n)^m a \mid n, m \geq 0\}$
(d) None of the above

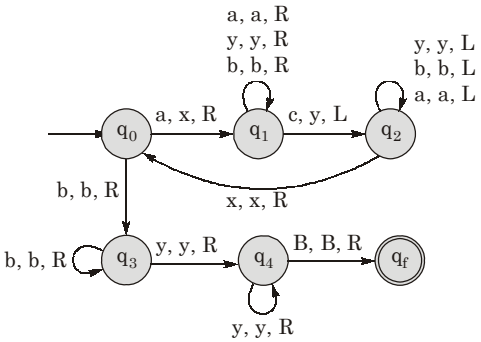
Q.57 Consider the following three languages:

- $L_1 = \{w \mid w \in \{a, b\}^* \text{ and } w = w^R\}$
- $L_2 = \{ww^R \mid w \in \{a, b\}^*\}$
- $L_3 = \{w\ (a + b)\ w^R \mid w \in \{a, b\}^*\}$

What is the relation between L_1, L_2 and L_3?

(a) $L_2 \subset L_1$ and $L_3 \subset L_1$ and $L_1 = L_2 \cup L_3$
(b) $(L_2 = L_3) \subset L_1$
(c) $L_2 \cap L_1 = L_3$
(d) $L_2 \subset L_1$ and $L_3 \subset L_1$ but $L_1 \neq L_2 \cup L_3$

Q.58 Consider the following TM:



Note: (a, b, c) represents: by reading input 'a', it replaces 'a' by 'b' and moves to 'c' direction. Which of the following language accepted by above TM?

(a) $\{a^m b^n c^k \mid m, n, k \geq 0, m = k\}$
(b) $\{a^m b^n c^k \mid m, n, k \geq 0, m = n\}$
(c) $\{a^m b^n c^k \mid m, n, k > 0, m = k\}$
(d) $\{a^m b^n c^k \mid m, n, k > 0, m = n\}$

Q.59 Which of the following represents the grammar for language $L = \{w \mid n_a(w)$ and $n_b(w)$ are both even$\}$?}

(a) $S \to aA \mid bB$
$A \to bC \mid aS$
$B \to aC \mid bS$
$C \to aB \mid bA$

(b) $S \to aA \mid bB \mid \in$
$A \to bC \mid aS$
$B \to aC \mid bS$
$C \to aB \mid bA$

(c) $S \to aA \mid bB \mid \in$
$A \to bS \mid aS$
$B \to aS \mid bS$

(d) $S \to aA \mid bB \mid \in$
$A \to bS \mid aC$
$B \to bC \mid aS$
$C \to aB \mid bA$

Q.60 Consider <M> be the encoding of a Turing Machine as a string over alphabet $\sum = \{0, 1\}$. Consider L = {<M> | M is TM that halt on all input and L(M) = L' for some undecidable language L'}. Then L is

(a) Decidable and recursive
(b) Decidable and non-recursive
(c) Undecidable and recursively enumerable
(d) Undecidable and non-recursively enumerable

Q.61 Consider the following statements:

S_1 : Pumping lemma can be used to prove given language is regular.
S_2 : Given a grammar, checking if the grammar is not regular is decidable problem.
S_3 : If L is a regular and M is not a regular language then L.M. is necessarily non-regular.
S_4 : The number of derivations step for any strings W of length n is grammar is CNF and GNF form is $(2n - 1)$ and (n) respectively.

Which of the following statement is correct?

(a) Only S_1, S_3 is correct
(b) Only S_2, S_4 is correct
(c) Only S_3 is correct
(d) Only S_2, S_3 is correct

Q.62 Consider L_1, L_2 be any two context sensitive languages and R be any regular language. Then which of the following is/are correct?

I. $L_1 \cup R$ is regular.
II. $\bar{L}_2$ is context sensitive language.
III. $L_1 \cap L_2$ is context sensitive.
IV. $L_1 - L_2$ is non-CSL.

(a) I, II and IV only
(b) II and III only
(c) I and IV only
(d) II, III and IV only

Q.63 Which of the following are context free?

L_1 : $\{a^n b^m a^k \mid k = mn$ and $k, m, n \geq 1\}$
L_2 : $\{a^{m+n} b^{n+m} c^m \mid n, m \geq 1\}$
L_3 : $\{a^n b^n c^m \mid m < n$ and $m, n \geq 1\}$

(a) L_1 and L_2 only
(b) L_2 and L_3 only
(c) L_1, L_2 and L_3 only
(d) None of the language

Q.64 Which of the following regular expressions describes the language over {0, 1} consisting of string 'w' where w starts with 0 and has odd length, or starts with 1 and has even length?

(a) $(0\ ((0+1)\ (0+1))^* + 1\ (0+1))^*$ (b) $(0\ (0+1)+1)\ (0+1)^*$

(c) $(0+1\ (0+1))\ ((0+1)\ (0+1))^*$ (d) $0\ (0+1)^*\ (0+1)^* + 1\ (0+1)^*$

Q.65 Consider $L_1 = \{0^n \mid n \geq 0\}$, $L_2 = \{1^n \mid n \geq 0\}$, $L_3 = \{2^n \mid n \geq 0\}$

S_1 : $L_1 \cdot L_2 \cdot L_3$ is a context-sensitive language.

S_2 : $L_1 \cdot L_2 \cdot L_3 \neq \{0^n\ 1^n\ 2^n \mid n \geq 0\}$

S_3 : Complement of $L_1 \cdot L_2 \cdot L_3$ is regular language.

Which one of the above statement is correct?

(a) Only S_2 (b) Only S_1 and S_2

(c) All S_1, S_2 and S_3 (d) Neither of S_1, nor S_2, nor S_3

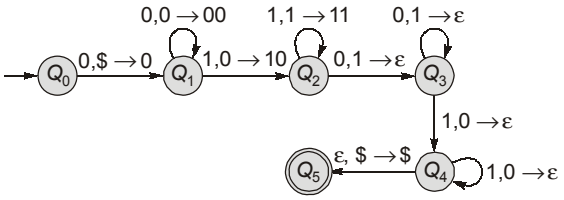
Q.66 Let $L = \{a^m b^n b^k d^l \mid (n + k = \text{odd})$ only if $m = l$; $m, n, k, l > 0\}$.

Which of the following is true about L?

(a) L is CFL but not DCFL (b) L is regular but not CFL

(c) L is DCFL but not regular (d) None of these

Q.67 Consider the following PDA:



The language accepted by above PDA is equivalent to the following grammar.

(a) $S \to 0S\,1 \mid 0T\,1$
$T \to 1T\,0$

(b) $S \to 0S\,1 \mid 1S\,0 \mid \varepsilon$

(c) $S \to 0S\,1 \mid 0T\,1 \mid 0$
$T \to 1T\,0 \mid 0 \mid 1 \mid \varepsilon$

(d) $S \to 0S\,1 \mid 0T1$
$T \to 1T\,0 \mid 10$

Q.68 Consider the language L:

$$L = \{< M > \mid M \text{ is a Turing machine and } L(M) \leq_p \{0^p\ 1^{2p} \mid p > 0\}\}$$

Where the symbol '$\leq_p$' refers to polynomial time reducible which of the following is true regarding the above language?

(a) L is undecidable (b) L is decidable

(c) L is regular (d) None of these

Q.69 Assume that G be a grammar:

$G = (\{E, X\}, \{0, 1, 2\}, P, E)$ where P is the set of production.

$P = \{E \to 0XE2,\ E \to 0X2,\ X0 = 0X,\ X2 \to 12,\ X1 \to 11\}$

Which of the following language generated by above grammar G.

(a) $L = \{0^m\ 1^n\ 2^k \mid m, n, k \geq 0\}$ (b) $L = \{0^n\ 1^n\ 2^n \mid n \geq 0\}$

(c) $L = \{0^m\ 1^n\ 2^k \mid m, n, k > 0\}$ (d) $L = \{0^n\ 1^n\ 2^n \mid n > 0\}$

Q.70 Which of the following language is decidable?
(a) {(M)| M is a TM and there exist an input whose length is less than 100, on which M halts}
(b) {(M)| M is a TM and L(M) = {00, 11}}
(c) Both (a) and (b)
(d) None of the above

Q.71 Consider the following types of languages L_1: Regular, L_2: Context-free, L_3: Recursive, L_4: Recursively enumerable.
Which of the following is/are **TRUE**?
I. $\overline{L_3} \cup L_4$ is recursively enumerable. **II.** $\overline{L_2} \cup L_3$ is recursive.
III. $L_1^* \cap L_2$ is context-free. **IV.** $L_1 \cup \overline{L_2}$ is context-free.
(a) I only (b) I and III only
(c) I and IV only (d) I, II and III only

Q.72 Let L be a regular language and M be a context-free language, both over the alphabet Σ. Let L^c and M^c denote the complements of L and M respectively.
Which of the following statements about the language $L^c \cup M^c$ is TRUE?
(a) It is necessarily regular but not necessarily context-free.
(b) It is necessarily context-free.
(c) It is necessarily non-regular.
(d) None of the above

Q.73 Let $L = L_1 \cap L_2$, where L_1 and L_2 are languages as defined below:
$L_1 = \{a^m b^m c\, a^n b^n \mid m, n \geq 0\}$
$L_2 = \{a^i b^j c^k \mid i, j, k \geq 0\}$
Then L is
(a) Not recursive (b) Regular
(c) Context-free but not regular (d) Recursively enumerable but not context-free

Q.74 Consider the language $L_1 = \{0^i 1^j \mid i \neq j\}$, $L_2 = \{0^i 1^j \mid i = j\}$, $L_3 = (0^i 1^j \mid i = 2j + 1\}$, $L_4 = \{0^i 1^j \mid i \neq 2j\}$.
Which one of the following statements is true?
(a) Only L_2 is context free (b) Only L_2 and L_3 are context free
(c) Only L_1 and L_2 are context free (d) All are context free

Q.75 Let $L = \{\omega \in (0 + 1)^* \mid \omega$ has even number of 1's$\}$, i.e., L is the set of all bit strings with even number of 1's. Which one of the regular expressions below represents L?
(a) (0 *10*1)* (b) 0*(10*10*)*
(c) 0*(10*1)*0* (d) 0*1(10*1)*10*

❍❍❍❍

Detailed Explanations

51. **(c)**

(a) Accepted
(b) Accepted
(c) Not accepted
(d) Accepted

52. **(b)**

- Option (a) represents DCFL since string matching is done i.e. before 'x' and after 'x'.
- Option (b) represents regular for which regular expression $a(a+b)^+ a + b(a+b)^+ b$.
- Option (c) represents CFL since ww^R is done first, hence needs a comparison, which cannot be done via finite automata.
- Option (d) represents CFL since ww^R contains string matching, which can not be done via finite automata.

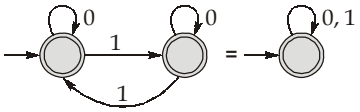
53. **(a)**

- If DFA accept a null, then initial state must be final state.
- Consider a language $L = \{a^n\}$ on alphabet {a, b} and its complement $\Sigma^* - \{a^n\}$ both are infinite. Hence false.
- If L is set of all string ending with atleast n b's then minimum number of states in non deterministic finite automata that accept L is $n + 1$. Hence false.
- Since every language accepted by a NFA is also accepted by some DFA, hence non deterministic finite automata has same power as deterministic finite automata. Hence false.

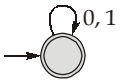
54. **(c)**

$$L(P) = 0^*(10^*)^*$$
$$= \{\in, 0, 1, 10, 01, 00, 11, ...\}$$
$$L(Q) = (0^* + 1^*)^*$$
$$= \{\in, 0, 1, 10, 01, 00, 11, ...\}$$

DFA for L(P) $\Rightarrow$



DFA for L(Q) $\Rightarrow$



So, both language are equivalent to each other.

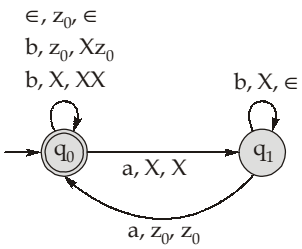
55. **(c)**

Put $n = 1$ in S_1 we get $\{(a^1)^m \mid 1 \le m\} \cup \{\in\}$
$= \{a^m \mid m \ge 0\} = a^*$

- Therefore S_1 is regular.
- S_2 represents $a^n b^n \cup a^+ b^+ = a^+ b^+$ which is regular. Hence regular.

56. **(a)**

The PDA for given transition function is:



$$L = \{(b^n ab^n a)^m \mid m, n \geq 0\}$$

For clearer understanding, kindly refer the solution video of this question.

57. **(a)**

L_2 is even palindrome on $\{a, b\}^*$

L_3 is odd palindrome on $\{a, b\}^*$

L_1 is any palindrome on $\{a, b\}^*$

Clearly, $L_2 \subset L_1$ and $L_3 \subset L_1$ and $L_1 = L_2 \cup L_3$

58. **(c)**

$$L = \{a^m b^n c^k \mid m, n, k > 0 \text{ and } m = k\}$$

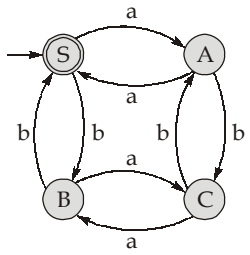
Here, a's are replaced by x and c's are replaced by y in every scan from $q_0 \to q_1 \to q_2 \to q_0$

To reach final state, atleast one b should appear and atleast one y (y represents c hence a also must appear) should appear.

$\therefore$ $L = a^i b^j c^i \mid i, j > 0\}$ is accepted by TM

So option (c) is correct.

59. **(b)**



Option (b) can be obtained from the DFA given above.

Therefore (b) is correct.

60. **(a)**

Since M is a TM that halts on all input, so L(M) is decidable. So, L(M) ≠ L'. Since decidable language cannot be equal to some undecidable language.

So, $L = \phi$

Hence decidable and recursive.

61. **(b)**

S_1 : Pumping lemma can prove that language is not regular but can't prove that the language is regular. Hence this is false.

S_2 : We can check regular grammar by following productions $V \rightarrow T^* V + T^*$ or $V \rightarrow V T^* + T^*$.

S_3 : Consider 'L' to be ϕ and 'M' to $\{a^n b^n \mid n \leq 0\}$
L.M. = ϕ, which is regular

S_4 : In case of CNF, $(n-1)$ derivations are required to generate a string with (n) Non-Terminals, since only one Non-Terminals is added during each derivation.
Further, (n) derivations are required to convert those Non-Terminals to terminals.
So, in total, to generate a string of n terminals:

$$\underset{\text{To generate string with } n \text{ Non-Terminals}}{(n-1)} + \underset{\text{To convert NT} \rightarrow \text{T}}{(n)} = \underset{\text{Total}}{(2n-1)}$$

However, in case of GNF: In a single derivation, we get a terminal in addition to our Non-Terminals. **S → T(NT)***
Therefore, no need for $(n-1)$ derivations to increase length.
Hence, only (n) derivations are required.

62. **(b)**

- $L_1 \cup R = CSL \cup Reg = CSL$ but need not regular.
- $\overline{L_2} = \overline{CSL} = CSL$, since CSL closed under complement.
- $L_1 \cap L_2 = CSL \cap CSL = CSL$, since CSL closed under intersection.
- $L_1 - L_2 = CSL - CSL = CSL \cap \overline{CSL} = CSL$, since CSL are closed under intersection and complement.

So, only II and III are true.

63. **(d)**

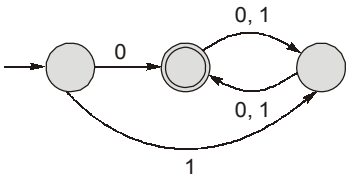
L_1 : $\{a^n b^m a^k \mid k = mn\}$ is not CFL, since we can not implement it with single stack.

L_2 : $\{a^{m+n} b^{n+m} c^m \mid n, m \geq 1\}$ is non-CFL since here more than 1 comparison present i.e., $\{a^m a^n b^n b^m c^m\}$. Hence cannot be implement by single stack.

L_3 : $\{a^n b^n c^m \mid m < n$ and $m, n \geq 1\}$ is non-CFL since more than 1 comparison are present simultaneously i.e. after comparison of $n = n$, we left with only c^m and we cannot compare $m < n$ or not.

So, none of the language is CFL.

64. **(c)**



$= 0((0+1)(0+1))^* + 1(0+1)((0+1)(0+1))^*$
$= (0+1(0+1))((0+1)(0+1))^*$

65. **(c)**

- $L_1 \cdot L_2 \cdot L_3 = \{0^p\, 1^q\, 2^r \mid p, q, r \geq 0\} = 0^*\, 1^*\, 2^*$ is regular.
  Since regular, hence context-sensitive too.
- $L_1 \cdot L_2 \cdot L_3 \neq \{0^n\, 1^n\, 2^n \mid n \geq 0\}$
- Since it is a regular language and regular languages are closed under complement, hence complement of $L_1 \cdot L_2 \cdot L_3$ is regular language.

66. **(c)**

$$L = \{a^m b^n b^k d^l \mid (n + k = \text{odd}) \text{ only if } m = l\}$$

If, we check the condition carefully, the condition is actually logical implication.

$$L = \{a^m b^n b^k d^l \mid (n + k = \text{odd}) \rightarrow m = l\}$$

Either $n + k$ will be odd or it will be even, if $(n + k)$ is odd, then it's necessary that m should be equal to l, if $(n + k)$ is even then l can be any number.

$$L = \{a^m\, b^{2n+1}\, d^l \text{ and } l = m\} \text{ or } \{a^m\, b^{2n}\, d^l\}$$
$$= \{a^m\, b^{2n+1}\, d^m\} \cup \{a^m\, b^{2n}\, d^l\}$$

$\Rightarrow$ DCFL $\cup$ regular = DCFL

67. **(d)**

$Q_0 \rightarrow Q_1$: Pushes '0' to the stack when stack initially contain \$.
$Q_1 \rightarrow Q_1$: Pushes all '0' of the string to the stack.
$Q_1 \rightarrow Q_2$: Pushes '1' to the stack, when stack initially contains 0.
$Q_2 \rightarrow Q_3$: Pop '1' from the stack, when string has 0.
$Q_3 \rightarrow Q_3$: Pop all 1's from the stack, till the string symbol is 0.
$Q_3 \rightarrow Q_4$: Pop 0's from the stack, when string actually has 1.
$Q_4 \rightarrow Q_4$: Pop all the 0's from the stack, till the string symbol is 1.
$Q_4 \rightarrow Q_5$: Stack contains \$ and string symbol is $\in$, means the string is accepted.

Hence, $L = \{0^m\, 1^n\, 0^n\, 1^m \mid n, m > 0\}$

68. **(a)**

The language $\{0^p\, 1^{2p}\}$ is context-free language, hence it is recursive also. Since $L(M) \leq_p$ REC, so $L(M)$ also recursive, now given input (i.e. recursive language) to Turing machine and finding it is accept or not is non-trivial property so it is undecidable by Rice's theorem.

69. **(d)**

The given grammar G:

$$E \rightarrow 0XE2$$
$$E \rightarrow 0X2$$
$$X0 \rightarrow 0X$$
$$X2 \rightarrow 12$$
$$X1 \rightarrow 11$$

$L(G) = \{012, 001122, \ldots\}$

$E \rightarrow 0X2 \Rightarrow 012$

$E \rightarrow 0XE2 \Rightarrow 0X0X22 \Rightarrow 0X0122 \Rightarrow 00X122 \Rightarrow 001122$

$\therefore\ L = \{0^n\, 1^n\, 2^n \mid n > 0\}$

70. **(a)**

For an input whose length is less than 100 on which Turing machine halt or not can be decidable by running Turing machine for 100 steps. So, it is decidable language.

Whether a Turing machine accept a given language is non-trivial question so by Rice's theorem it is undecidable problem.

71. **(d)**

$L_1 \rightarrow$ Regular, $L_2 \rightarrow$ CFL, $L_3 \rightarrow$ REC, $L_4 \rightarrow$ RE

I: $\bar{L}_3 \cup L_4$ is RE

$$\begin{aligned} \bar{L}_3 \cup L_4 &= \overline{\text{REC}} \cup \text{RE} \\ &= \text{REC} \cup \text{RE} \\ &= \text{RE} \cup \text{RE} = \text{RE} \end{aligned}$$

So I is true

II: $\bar{L}_2 \cup L_3$ is recursive

$$\begin{aligned} \bar{L}_2 \cup L_3 = \overline{\text{CFL}} \cup \text{REC} &= \overline{\text{CSL}} \cup \text{REC} \\ &= \text{CSL} \cup \text{REC} \\ &= \text{REC} \cup \text{REC} = \text{REC} \end{aligned}$$

So II is True.

III: $L_1^* \cap L_2$ is CFL

$$\begin{aligned} L_1^* \cap L_2 &= (\text{REG})^* \cap \text{CFL} \\ &= \text{REG} \cap \text{CFL} = \text{CFL} \end{aligned}$$

So III is True.

IV: $L_1 \cup \bar{L}_2$ is CFL

$$\begin{aligned} L_1 \cup \bar{L}_2 &= \text{REG} \cup \overline{\text{CFL}} \\ &= \text{REG} \cup \overline{\text{CSL}} \\ &= \text{REG} \cup \text{CSL} = \text{CSL} \end{aligned}$$

Since, A CSL need not be a CFL, so IV is False.

So only I, II and III are true.

72. **(d)**

$$\begin{aligned} L^c \cup M^c &= (\text{Reg})^c \cup (\text{CFL})^c = \text{Reg} \cup (\text{CSL})^c \\ &= \text{Reg} \cup \text{CSL} = \text{CSL} \end{aligned}$$

A CSL may or may not be regular. So, options (a) and (c) are false.

A CSL need not be a CFL. So, option (b) is false.

So, answer is (d) none of these.

73. **(c)**

$$L_1 = \{a^m\, b^m\, c\, a^n\, b^n \mid m, n \geq 0\}$$
$$L_2 = \{a^i\, b^j\, c^k \mid i, j, k \geq 0\}$$
$$L = L_1 \cap L_2$$

L_1 is CFL. L_2 is regular. First use closure property to get a estimate.

$$L = L_1 \cap L_2 = \text{CFL} \cap \text{Reg} = \text{CFL}$$

However, since one of the option (b) is regular is stronger than CFL answer obtained by closure property, we need to find the actual intersection.

Any string belonging to both must have equal number of a's & b's followed by a single c followed by no a's or b's; which is the only string allowed by both L_1 and L_2.

i.e. $L = L_1 \cap L_2 = \{a^m b^m c\}$

Now this is clearly context free, but not regular.

74. **(d)**

$$L_1 = \{0^i\, 1^j\, ;\, i \neq j\}$$
$$L_2 = \{0^i\, 1^j\, ;\, i = j\}$$
$$L_3 = \{0^i\, 1^j\, ;\, i = 2j + 1\}$$
$$L_4 = \{0^i\, 1^j\, ;\, i \neq 2j\}$$

All of L_1, L_2, L_3 and L_4 are context free, since, each of these languages has a single linear comparison between i and j and any linear comparison between i and j can be performed, in a PDA.

75. **(b)**

Choice (a) (0* 1 0* 1)*

will always generate strings ending with 1. But we want an expression for bit strings with even no of 1's, which includes strings like "110" which ends with 0.

So, choice (a) is not correct.

Choice (c) 0* (1 0* 1)* 0*

"1010101" $\notin$ 0*(1 0* 1)* 0*

but "1010101" has even number of 1's. So choice (c) is incorrect.

Choice (d) $\lambda \notin$ 0* 1(1 0* 1)* 10*

but "λ" is a bit string with even no of 1's (zero 1's). So choice (d) is incorrect.

Choice (b) can generate all bit strings with even no of 1's. So choice (b) is correct.

❍❍❍❍

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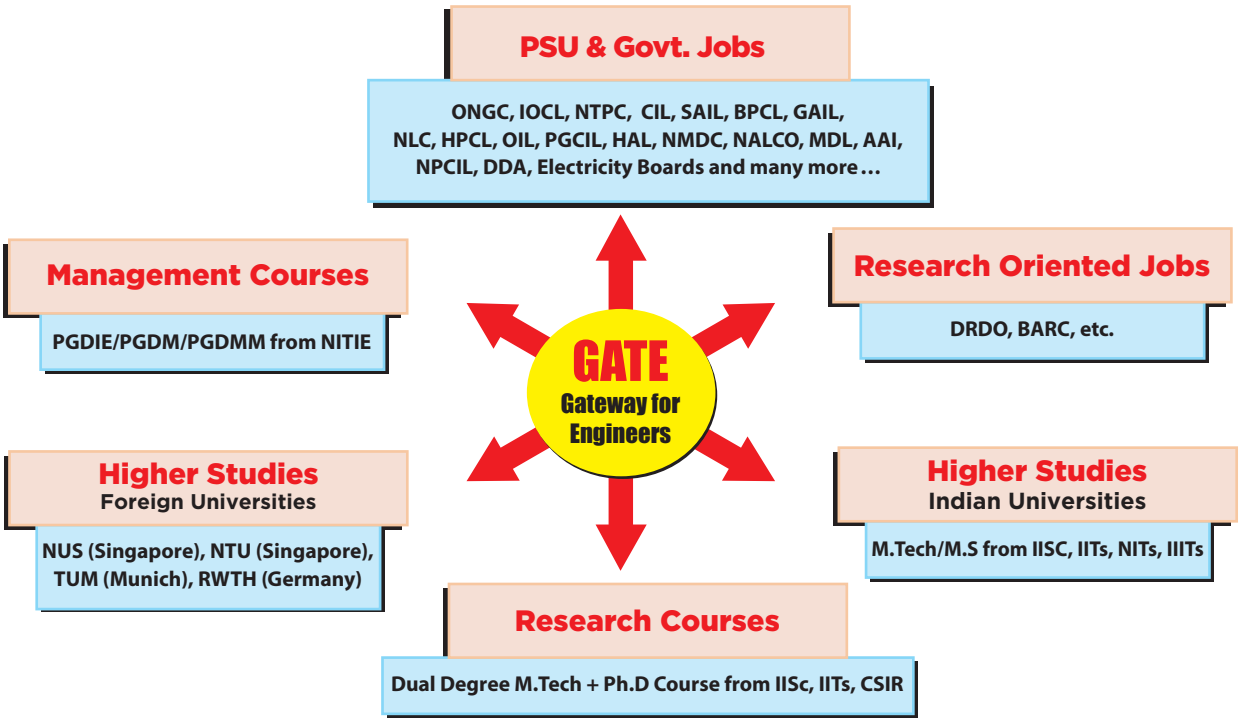
Revision through Questions for GATE 2020

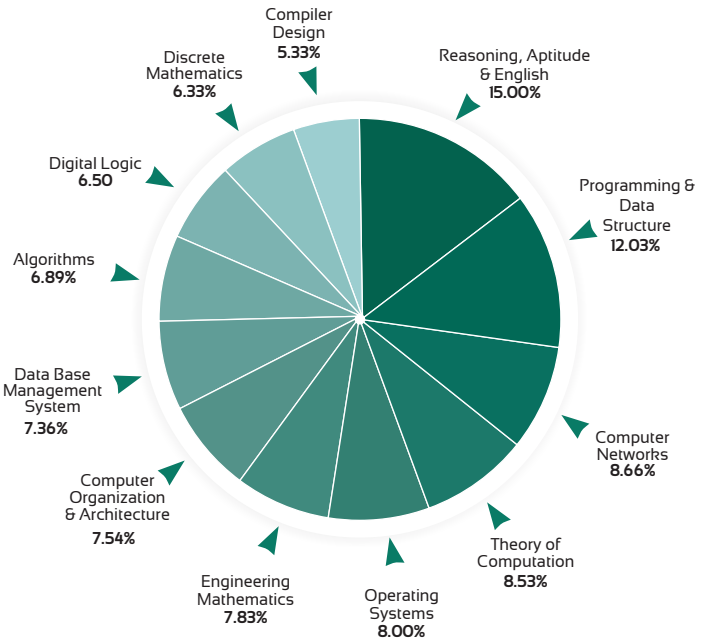
CS Computer Science

Q.76 - Q.100 out of 200 Questions

Day 4 of 8



SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	12.03%
Computer Networks	8.66%
Theory of Computation	8.53%
Operating Systems	8.00%
Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 4 : Q.76 to Q. 100 : Computer Networks + Algorithms

Q.76 In a block of addresses, we know the IP address of one of the host is 128.44.82.16 / 25. Which of the following represent first address and last addresses that can be assign to host in the block?

(a) 128.44.82.0 and 128.44.82.126
(b) 128.44.82.1 and 128.44.82.127
(c) 128.44.82.1 and 128.44.82.126
(d) 128.44.82.0 and 128.44.82.127

Q.77 Let $g(x) = x^3 + x^2 + 1$. Consider the information bits (1, 1, 0, 1, 1, 0). Find the codeword corresponding to these information bits if $g(x)$ is used as the generating polynomial.

(a) 110110111
(b) 110110110
(c) 110110100
(d) 110110101

Q.78 Match **List-I** (Networking devices) with **List-II** (property) and select the correct answer using the codes given below the lists:

List-I	**List-II**
A. Hub	**1.** Broadcast domain separator
B. Bridge	**2.** Collision domain separator
C. Switch	**3.** Broadcasting device

Codes:

	A	**B**	**C**
(a)	3	1	2
(b)	1	2	3
(c)	3	2	1
(d)	2	3	1

Q.79 Computer A has 30 MB to send on a network and transmits the data in burst at 6 Mbps. The maximum transmission rate across routers in the network is 4 Mbps. If computer A's transmission is shaped using a leaky bucket. What is the capacity that the queue in the bucket must hold so that no data is discarded?

(a) 2 MB
(b) 5 MB
(c) 8 MB
(d) 10 MB

Q.80 Consider GBN protocol in which sender window size (SWS) is 5 and receiver window size (RWS) is 5. Suppose client sends date 0, 1, 2, 3, 4 and only data packet 2 is lost and all ACKs are lost. What will be the contents in the receiver window and sender window before sender's timeout value expires?

(a) Sender window : 01234 and Receiver window : 01234
(b) Sender window : 23456 and Receiver window : 01234
(c) Sender window : 23456 and Receiver window : 23456
(d) Sender window : 01234 and Receiver window : 23456

Q.81 Which of the following is true?
(a) A secure hash function will not produce any collisions.
(b) A cyptographic hash function is deterministic i.e. given the same input, it always produce same output.
(c) Host that use DHCP on a wired networking technology such as Ethernet are protected against possible DHCP spoofing attacks.
(d) Both (b) and (c)

Q.82 Consider an instance of TCP's Additive Increase Multiplicative Decrease (AIMD) algorithm where the window size at the start of slow start phase is 1 MSS and the threshold at the start is 1st transmission is 16 MSS. Assume TCP use over a lossy link i.e., timeout occur after transmission of 7th packet . What is the congestion window size at the end of 14 RTT (in MSS)?
(a) 9 (b) 11
(c) 12 (d) 14

Q.83 Which of the following is true?
(a) The count to infinity problem may arise in distance vector routing protocol when network gets disconnected.
(b) The "path vector" enhancement to a distance vector protocol always enables the protocol to converge without counting to infinity.
(c) The count to infinity problem may arise in distance vector routing protocol even when the network never get disconnected.
(d) Both (a) and (b)

Q.84 Consider an IP router with Maximum Transferable Unit (MTU) of 500 B has received an IP datagram of size 3000 B with an IP header of length 15 B. Which of the following is true about IP fragments generated by router for this packet?
(a) Number of fragments = 6, last fragment offset and datagram length 306 and 120
(b) Number of fragments = 7, last fragment offset and datagram length 300 and 120
(c) Number of fragments = 7, last fragment offset and datagram length 360 and 120
(d) Number of fragments = 6, last fragment offset and datagram length 300 and 120

Q.85 Consider the following statements:
S_1 : Ring topology of N-devices contains (N – 1) dropline and N-Ring cables.
S_2 : Bus topology of N-devices needs 1 dropline and N-Backbone cables.
Which of the above statements is correct?
(a) Only S_1 and S_2 (b) Only S_1
(c) Only S_2 (d) None of these

Q.86 Assume a hypothetical computer network in which the protocol hierarchy has 10 layer. If the application layer generates a 200 KB message. What is the size of the header if 20% of the network bandwidth is filled with header ?
(a) 5 KB (b) 6 KB
(c) 10 KB (d) 15 KB

Q.87 An upper layer packet is split into 8 frames each of which has 40% chance of arriving damaged. Also assume that no error control is done at data link layer. How many times the message is sent on an average to get the entire message through?

(a) 24.65 (b) 13.33
(c) 59.54 (d) 20

Q.88 A broadcast LAN has 10^8 bps bandwidth and uses CSMA/CD. The signal travels along the wire at 2×10^8 m/sec. What must be the length of cable such that a frame of size 64 B is used on the network ?

(a) 512 meters (b) 206 meters
(c) 502 meters (d) None of these

Q.89 Four hundred airline reservation stations are competing for the use of a single slotted ALOHA channel. An average station makes 16 request/hour where the slot is of 1000 μs. What is the approximate total channel load?

(a) 0.015 (b) 0.0017
(c) 0.032 (d) 0.064

Q.90 Consider a channel connecting two systems located 60 kms apart. The channel is operating at 5000 bps. The propagation speed of the media is 4×10^6 m/sec. What would be the minimum frame size for stop and wait flow control to get 60% link utilization efficiency?

(a) 225 bits (b) 400 bits
(c) 450 bits (d) 500 bits

Q.91 Match **List-I** and **List-II** and select the correct answer using the codes given below the lists:

List-I (Packets)

A.

	Source IP	Destination IP
Data	250.255.255.255	50.50.50.50

B.

	Source IP	Destination IP
Data	24.50.48.30	255.255.255.255

C.

	Source IP	Destination IP
Data	24.66.50.77	24.50.30.20

List-II

1. Unicast packet within network

2. This packet never exists

3. Limited broadcasting

Codes:

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	3	1	2
(d)	2	1	3

Q.92 Which one of the following is the recurrence equation for the worst case time complexity of finding K^{th} smallest element in an array of size 'n' using partition function? Assume 'c' is constant.

(a) $T(n) = 2T(n/2) + c \cdot n$ (b) $T(n) = 2T(n-1) + c$
(c) $T(n) = T(n-1) + c \cdot n$ (d) $T(n) = T(n/2) + c \cdot n$

Q.93 Which one of the following correctly determines the solution of the recurrence relation with $T(1) = 1$?

$$T(n) = 2T(n/4) + \sqrt{n}$$

(a) $O(n)$ (b) $O(\sqrt{n}\log n)$

(c) $O(n^2)$ (d) $O(\log n)$

Q.94 The difference between maximum possible profit for 0/1 Knapsack and fractional Knapsack problem with capacity (W) = 200.

Item	a	b	c	d	e	f	g	h	i	j
Weight	30	50	20	10	120	100	90	90	40	10
Profit	70	95	30	30	260	190	180	170	50	40

Q.95 Consider the following functions:

$f(n) = 2^{\log_2 n}$

$g(n) = n^{\log_2 n}$

$h(n) = n^{1/\log_2 n}$

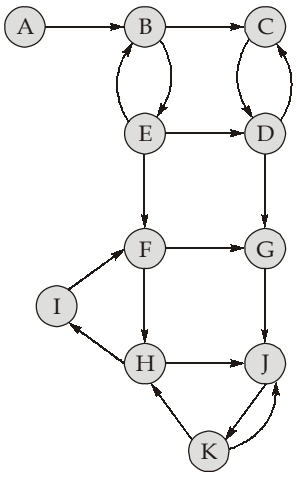
Which of the following statements about the asymptotic behaviour of $f(n)$, $g(n)$ and $h(n)$ is true?

(a) $f(n) = \Omega(g(n))$ and $g(n) = O(h(n))$ (b) $g(n) = \Omega(h(n))$ and $f(n) = O(f(n))$

(c) $f(n) = O(g(n))$ and $g(n) = \Omega(h(n))$ (d) $g(n) = O(h(n))$ and $h(n) = O(g(n))$

Q.96 Consider two strings A = "abbaccda" and B = "abcaa" consider "x" be length of the longest common subsequence between A and B and "y" be the number of distinct such longest common subsequences between A and B. Then $10x + 2^y$ is _____.

Q.97 Consider the following graph:



The number of strongly connected components of the graph are _____.

Q.98 The post order traversal of binary search tree is given by 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12. The height of the tree is _____.

Q.99 Consider two Person (Person X, Person Y). Person X who was given a problem to calculate $A_1 \times A_2 \times A_3$ with dimension 3×100, 100×2 and 2×2 in minimum multiplication. Person X is the knows only Greedy algorithm (multiply matrix which gives less number of multiplication) and solve $A_1 \times A_2 \times A_3$ with M_1 multiplications. Person Y solved the same problem using Dynamic algorithm with M_2 multiplications. How many number of multiplications saved by Person Y than Person X?

(a) 368 (b) 388

(c) 420 (d) 488

Q.100 The number of different orders are possible for elements 1, 2, 3, 4, 5, 6, 7 to be inserted in to empty AVL tree such that no rotation will be done and element '4' is root are _____.

❍❍❍❍

Detailed Explanations

76. **(c)**

IP of block: 128.44.82.16 /25

Subnet mask: 255.255.255.128

Perform 'AND' operation between IP of block and subnet mask to get subnet id.

128.44.82.16
255.255.255.128

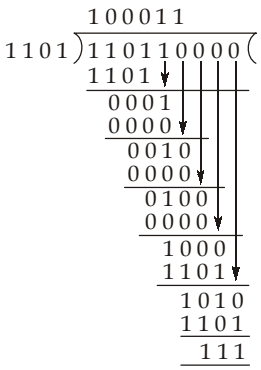
128.44.82.0

First assigned address to host: 128.44.82.1

Last assigned address to host: 128.44.82.126

128.44.82.0 is subnet id and 128.44.82.127 is direct broadcast address, so cannot assigned to any host.

77. **(a)**



Hence, the codeword will be 110110111.

78. **(c)**

- Hub is the broadcasting device i.e. transmitted data in all direction which can leads to collision.
- Bridge is the collision domain separator i.e. reduced collision domain.
- Switch is the collision domain separator as well as broadcast domain separate.

79. **(d)**

$$\text{Total data} = 30 \times 8 \text{ Mb}$$

$$\text{Time for computer to transmit data} = \frac{30 \times 8 \text{ Mb}}{6 \text{ Mb}} \text{sec} = 40 \text{ sec}$$

Maximum transmission rate = 4 Mbps

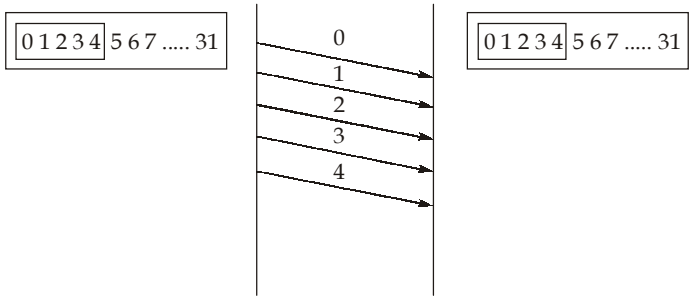
Actual data sent on network in 40 sec

$$= 4 \text{ Mbps} \times 40 = 160 \text{ Mb} = 20 \text{ MB}$$

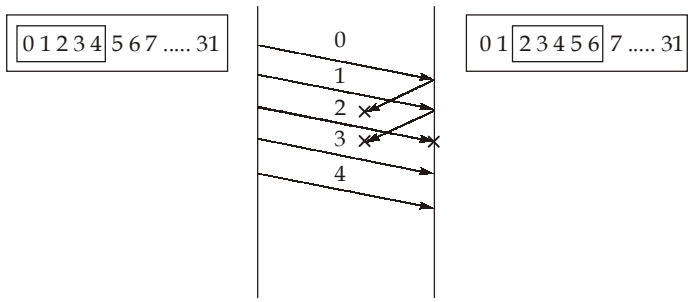
$$\text{Bucket size} = 30 \text{ MB} - 20 \text{ MB} = 10 \text{ MB}$$

80. **(d)**

Before sending



After sending and before time out.



Sender window will be 0, 1, 2, 3, 4 and Receiver window will be 2, 3, 4, 5, 6.

81. **(b)**

(a) A secure hash function may produce collision.

(b) A cryptographic hash function is deterministic.

(c) DHCP requests are broadcast, regardless of networking technology. Hence cannot be protected against DHCP spoofing attacks.

82. **(c)**

RTT No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cong. window	1	2	4	8	16	17	18	1	2	4	8	9	10	11
Threshold	16	16	16	16	16	16	16	9	9	9	9	9	9	9

So, after 14 RTT congestion window size will be = 12 MSS.

83. **(d)**

- Count to infinity problem in distance vector routing protocol arise when network gets disconnected. But this problem does not occur in such cases when the network not get disconnected.
- To make distance vector routing protocol coverage without count to infinity problem, enhancement to distance vector routing protocol is used i.e. path vector routing.

84. **(c)**

Maximum Transferable Unit = 500 B

Data bytes that can be transferred in 1 fragment = 500 – 15 = 485

$$\text{Number of fragments} = \left\lceil \frac{3000-15}{480} \right\rceil = \left\lceil \frac{2985}{480} \right\rceil = \lceil 6.218 \rceil = 7$$

Since 485 is not divided by 8. So, 480 is sent in one fragment

1st fragment = offset = 0, datagram length = 480 + 15 = 495

2nd fragment = offset = 60, datagram length = 480 + 15 = 495

3rd fragment = offset = 120, datagram length = 480 + 15 = 495

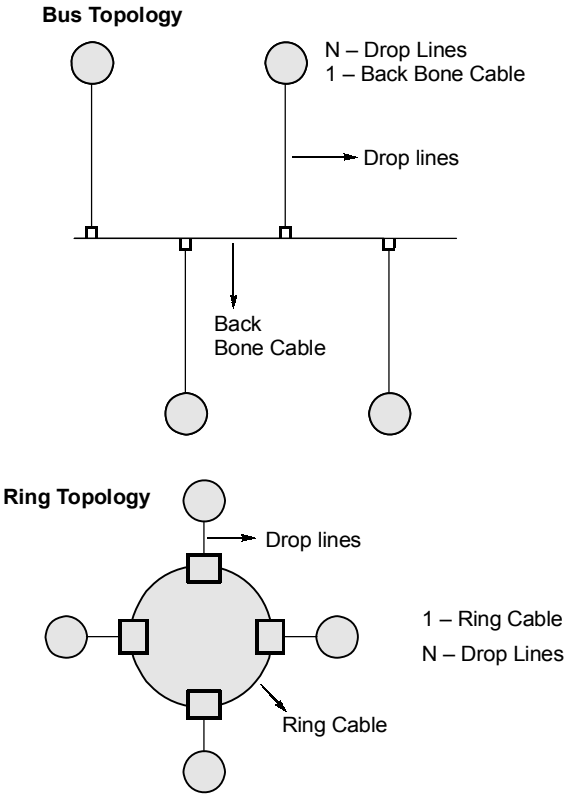
4th fragment = offset = 180, datagram length = 480 + 15 = 495

5th fragment = offset = 240, datagram length = 480 + 15 = 495

6th fragment = offset = 300, datagram length = 480 + 15 = 495

7th fragment = offset = 360, datagram length = 105 + 15 = 120

85. **(d)**



86. **(a)**

Fraction of network bandwidth which is filled with headers = 20% = $\frac{1}{5}$

i.e. $$\frac{1}{5} = \frac{10\times\text{header\_size}}{200\text{ KB}+10\times\text{header\_size}}$$

$$200\text{ KB} + 10\times\text{Header-size} = 50\times\text{Header-size}$$
$$200\text{ KB} = 40\times\text{Header-size}$$
$$\text{Header-size} = 5\text{ KB}$$

87. **(c)**

Chance of a frame of getting through undamaged = 0.6

Chance of whole message getting through is

$$P = (0.6)^8 = 0.01679616$$

Mean number of transmissions

$$= \frac{1}{P} = \frac{1}{0.01679616} = 59.54$$

88. **(a)**

$$\text{Transmission Time} = 2\times\text{Propagation Time}$$
$$\frac{\text{Frame size}}{\text{Bandwidth}} = 2\times\frac{d}{v}$$
$$\frac{64\times8\text{ bits}}{10^8\text{ bits/sec}} = 2\times\frac{x}{2\times10^8\text{ m/sec}}$$
$$\Rightarrow \quad x = 512\text{ meters}$$

89. **(b)**

For shared channel average request for 400 stations

$$= \frac{400\times16}{60\times60}\text{request/sec} = 1.77\text{ request/sec}$$
$$\text{Slot time} = 1000\ \mu\text{sec}$$
$$1\text{ slot} = 1000\times10^{-6}\text{ sec}$$
$$\text{Number of slots in 1 sec} = \frac{1}{1000\times10^{-6}} = \frac{1}{1000}\times10^6 = 1000\text{ slots/sec}$$
$$G = \text{Channel load} = \frac{\text{Number of request/sec}}{\text{Number of slots/sec}} = \frac{1.77}{1000} = 0.0017$$

90. **(a)**

For stop and wait

Data rate $r = 5000$ bps

Propagation delay $T_p = \dfrac{\text{Distance}}{\text{Speed}} = \dfrac{60\times10^3 \text{ meters}}{4\times10^6 \text{ meters}}\text{sec} = 15 \text{ msec}$

Utilization $(U) = 60\%$

Bandwidth $(B) = 5000$ bps

Frame size $F = ?$

$U = 60\%$

Transmission delay $T_t = \dfrac{F}{B}$

$$\Rightarrow \quad 0.6 = \frac{T_t}{T_t + 2T_p} = \frac{1}{1+2\dfrac{T_p}{T_t}}$$

$$\Rightarrow \quad 0.6 = \frac{1}{1+\dfrac{2\times15}{F}\times5}$$

$$\Rightarrow \quad F = 225 \text{ bits}$$

91. **(b)**

Packet A: The source IP contain direct broad cast address and we never use direct broadcast address in source IP. It is always used in destination IP. Hence packet A never exists.

Packet B: If destination IP address contain all 1's then it broadcasts within same network (Limited Broadcasting).

Packet C: It is a unicast packet within the same network as network ID 24.0.0.0 is same for both source and destination IP.

92. **(c)**

Worst case for finding K^{th} smallest element in array of size 'n' using partition function is when every time partition function split array into two part one with n – 1 elements and other with 1 element i.e., $T(n-1)$ and we have to do atmost n comparison for one partition i.e.

$$T(n) = T(n-1) + n$$

93. **(b)**

Apply Master Theorem:

$$T(n) = aT(n/b) + f(n)$$

$$f(n) = n^{1/2}$$

and here $a = 2, b = 4$

So, $(n^{\log_b a}) = (n^{\log_4 2})$

Will gives $(n^{1/2})$

So, $f(n) = \theta(n^{1/2})$

So, $T(n) = O(\sqrt{n}\log n)$

94. **(30)**

Item	a	b	c	d	e	f	g	h	i	j
Weight	30	50	20	10	120	100	90	90	40	10
Profit	70	95	30	30	260	190	180	170	50	40
Per Unit Profit	2.33	1.9	1.5	3	2.16	1.9	2	1.88	1.25	4

Fractional Knapsack problem:

Select all of item '*a*', '*d*', '*e*', '*j*' and 1/3 of item 'g'

Total weight = $30 + 10 + 120 + 10 + 1/3 \times 90 = 200$

Total profit = $70 + 30 + 260 + 40 + 1/3 \times 180 = 460$

0/1 Knapsack problem:

Select all of item *j*, *d*, *a*, *e* and *c*.

Total weight = $30 + 10 + 120 + 10 + 20 = 190$

Total profit = $70 + 30 + 260 + 40 + 30 = 430$

Difference = Total profit [using fractional Knapsack – Using 0/1 Knapsack]

= $460 - 430 = 30$

95. **(c)**

$$f(n) = 2^{\log_2 n} = n^{\log_2 2} = n$$

$$g(n) = n^{\log n}$$

$$h(n) = n^{1/\log n} = \sqrt[\log n]{n} \left[n > \sqrt[\log n]{n} \text{ for all large value of } n \right]$$

[It is less than n since max power of n is always less than 1 for large value of n]

So, $g(n) \geq f(n \geq h(n)$

So, $f(n) = O(g(n))$ and $g(n) = \Omega(h(n))$

96. **(44)**

A = "abbaccda"

B = "abcaa"

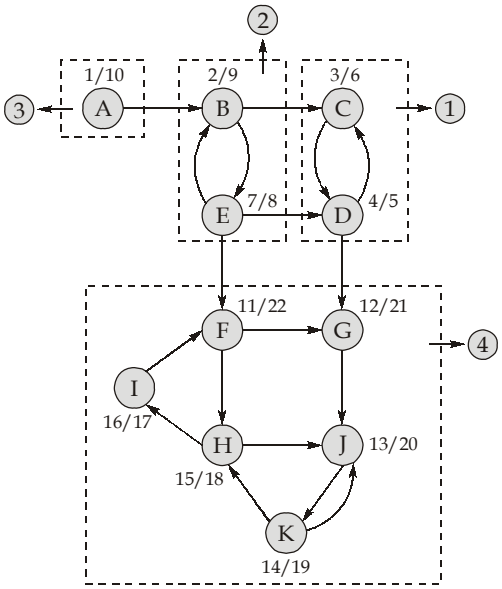
Length will be "abca" i.e. 4

Number of such strings = "abca", "abaa"

So, $10x + 2^y = 10 \times 4 + 2^2$

$= 40 + 4 = 44$

97. **(4)**



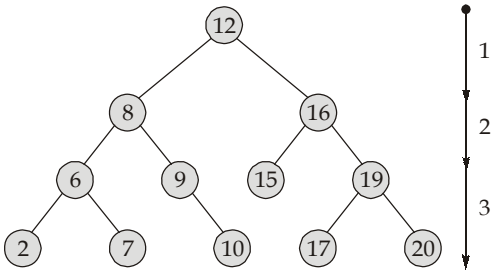
98. **(3)**

Post order: 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12

Inorder of BST must be sorted order:

2, 6, 7, 8, 9, 10, 12, 15, 16, 17, 19, 20

So, tree will be:



99. **(b)**

$$A_1 A_2 A_3 = A_1 \times (A_2 \times A_3)$$

$3 \times 100, 100 \times 2, 2 \times 2$

By **Person X applying Greedy:**

$A_1 \times (A_2 \times A_3)$

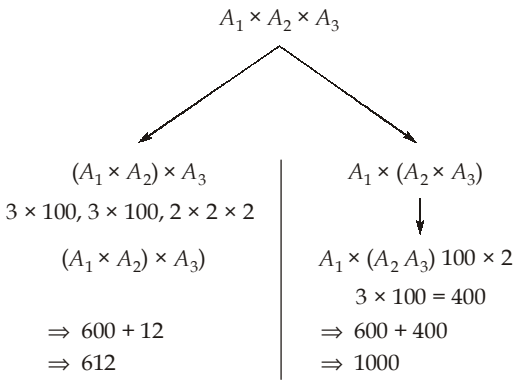
$3 \times 100, 100 \times 2, 2 \times 2$

$(A_2A_3) \rightarrow 100 \times 2, 2 \times 2 = 200 \times 2 = 400$

$A_1 \times (A_2A_3) \rightarrow 3 \times 100, 100 \times 2 = 300 \times 2 = 600$

Total number of multiplication required = 600 + 400 = 1000

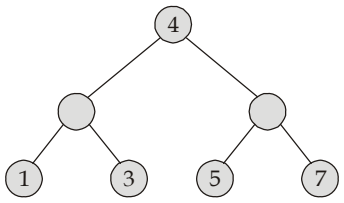
Person Y with Dynamic:



Number of multiplication saved by Person Y = 1000 – 612 = 388

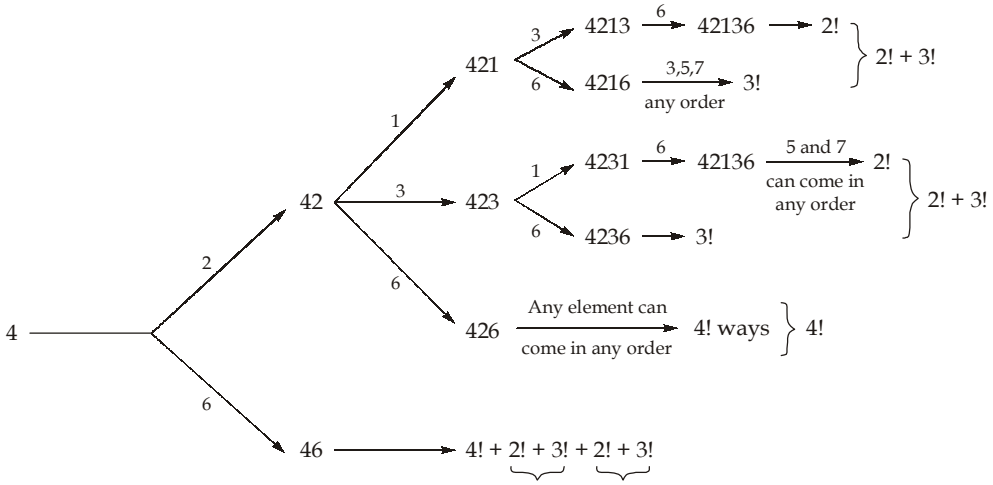
100. (80)

Since 4 is root element, so



(1, 3, 5, 7) can be inserted in any order since these are leaf nodes. However, 6 needs to be inserted before 5 and 7 and 2 needs to be inserted before 1 and 3.

4 being the root node, needs to be inserted first of all.



Total possibilities = 2(4! + 2(2! + 3!))
= 2(24 + 2(2 + 6))
= 2(24 + 16) = 2(40)
= 80 ways

❍❍❍❍

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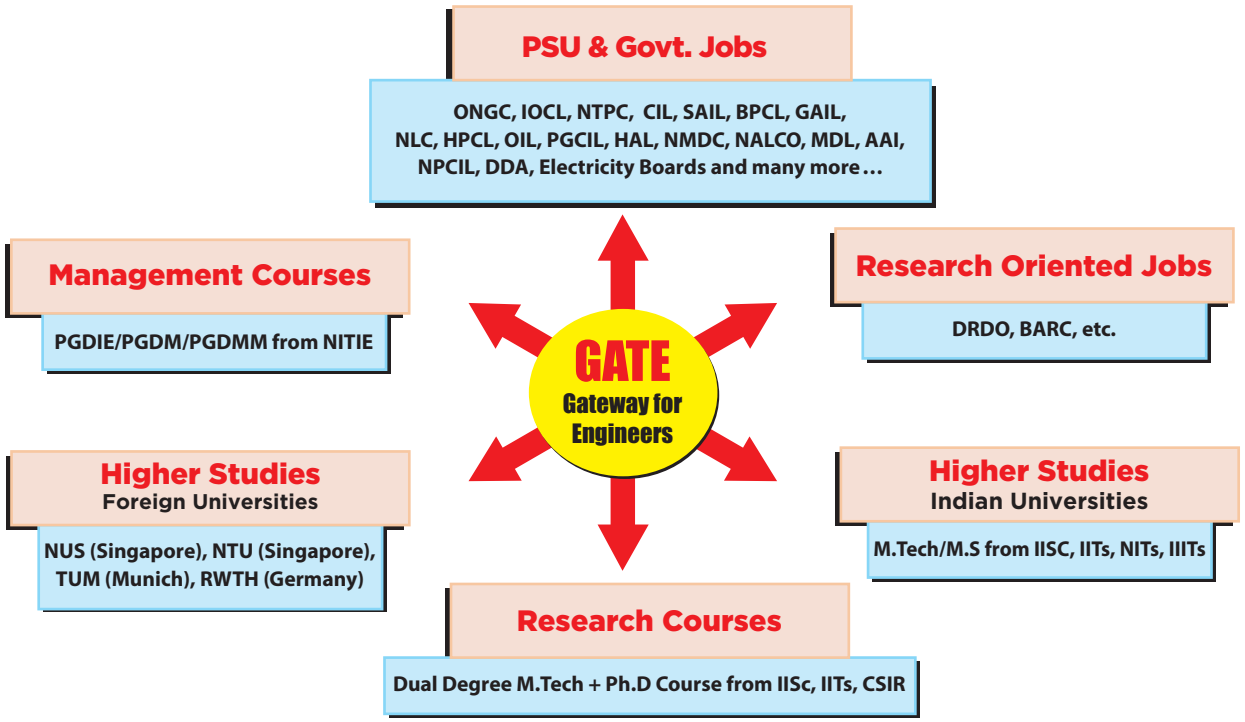
Revision through Questions for GATE 2020

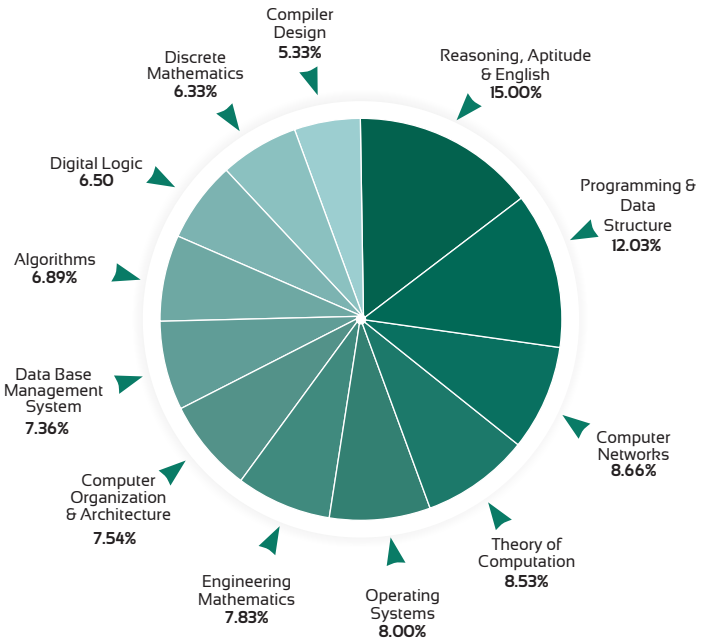
CS Computer Science

Q.101 - Q.125 out of 200 Questions

Day 5 of 8



SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	12.03%
Computer Networks	8.66%
Theory of Computation	8.53%
Operating Systems	8.00%
Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 5 : Q.101 to Q. 125 : Engineering and Discrete Mathematics

Q.101 Which of the following represents the solution to the system of equation?

$$\begin{bmatrix} 3 & 7.5 \\ -6 & 4.5 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 6 \\ -90 \end{bmatrix}$$

(a) 12, –4 (b) –12, –4
(c) –12, 4 (d) 12, 4

Q.102 The normal distribution $N(\mu, \sigma^2)$ with mean $\mu \in R$ and variance $\sigma^2 > 0$ has probability distribution function:

$$N(x \mid \mu, \sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{1}{2\sigma^2}(x-\mu)^2\right) \text{ for } x \in R$$

The difference of median and mean is _____.

(a) μ (b) σ
(c) $-\mu$ (d) 0

Q.103 A bag contains 15 defective items and 35 non defective items. If three items are selected at random without replacement, what will be the probability that all three items are defective?

(a) $\frac{1}{40}$ (b) $\frac{13}{560}$
(c) $\frac{15}{34}$ (d) $\frac{12}{499}$

Q.104 Which one of the following represents the eigen vectors of matrix $\begin{bmatrix} 4 & 6 \\ 2 & 8 \end{bmatrix}$?

(a) $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$ (b) $\begin{bmatrix} 3 \\ 1 \end{bmatrix}$
(c) $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 \\ 3 \end{bmatrix}$

Q.105 The determinant of a 2 × 2 matrix is 30. If one eigen value of the matrix is 5, then other eigen value is _____.

Q.106 The value of x for which equation satisfied is _____. [Upto 1 decimal place]

$$e^x e^2 = \frac{e^4}{e^{x+1}}$$

Q.107 Consider X be a random variable with E(X) = 10 and Var(X) = 25. What is the positive value of a and b such that $Y = aX - b$ has expectation 0 and variance 1?

(a) $a = 1, b = 2$ (b) $a = 0.2, b = 2$
(c) $a = 0.2, b = 1$ (d) $a = 0.2, b = 0.5$

Q.108 What is the standard deviation of a uniformly distributed variable between 0 and $\frac{1}{2}$?

(a) $\frac{1}{2\sqrt{12}}$ (b) $\frac{1}{\sqrt{12}}$

(c) $\frac{2}{\sqrt{12}}$ (d) $\frac{1}{\sqrt{6}}$

Q.109 Perform the following operations on the matrix $\begin{bmatrix} 1 & \frac{4}{3} & 15 \\ \frac{7}{3} & 3 & 35 \\ \frac{13}{3} & \frac{2}{3} & 65 \end{bmatrix}$

1. Add the third row to the second row.
2. Subtrace the third column from the first column.

The determined of the resultant matrix is _____.

Q.110 Consider the rank of matrix 'A' of size $(m \times n)$ is "$m - 1$". Then, which of the following is true?

(a) A A^T will be invertible.
(b) A have "$m - 1$" linearly independent rows and "$m - 1$" linearly independent column.
(c) A will have "m" linearly independent rows and "n" linearly independent columns.
(d) A will have "$m - 1$" linearly independent rows and "$n - 1$" independent columns.

Q.111 For function $f(x) = 4x^3 - 6x^2$, the maximum occurs in interval $[-1, 2]$ when x is equal to

(a) 0 (b) –1
(c) 1 (d) 2

Q.112 Find the limit?

$$\lim_{x\to\infty}\left[1+\frac{3}{2x}\right]^{5x}$$

(a) e^{15} (b) e^3
(c) $e^{15/2}$ (d) $e^{5/3}$

Q.113 Consider the following function:

$$f(x)=\begin{cases}-1.5x^2, & x \le -2\\ 6x-5, & x > -2\end{cases}$$

Which of the following is true at $x = -2$?

(a) Continuous but not differentiable
(b) Differentiable and continuous both
(c) Differentiable but not continuous
(d) Neither continuous nor differentiable

Q.114 Consider a man is known to speak truth 3 out of 5 times, he throw a die and reports the number obtained is 2. What is the probability that the number obtained is actually 2?

(a) $\frac{13}{30}$ (b) $\frac{3}{13}$

(c) $\frac{1}{10}$ (d) None of the above

Q.115 The value of

$$\int_0^2 \frac{1}{(3+2x)^2}\,dx = \_\_\_\_\_.$$ (Upto 3 decimal places)

Q.116 Consider

$$f(x)=\begin{cases}-x, & x\le 1\\ 1+x, & x\ge 1\end{cases} \text{ and } g(x)=\begin{cases}1-x, & x\le 0\\ x^2, & x>0\end{cases}$$

The composition of f and g i.e. $gof(x) = g(f(x))$. Then out of $f(x)$, $g(x)$ and $gof(x)$ in the interval $(-\infty, 0)$, how many are discontinuous _____.

Q.117 Consider two well formed formulas in propositional logic:

$F_1 : (p \leftrightarrow q) \wedge (\neg p \leftrightarrow q)$

$F_2 : (p \vee \neg q) \wedge (\neg p \vee q) \wedge (\neg p \vee \neg q)$

Which of the following is correct?

(a) F_1 is satisfiable, F_2 is valid (b) F_1 is unsatisfiable, F_2 is satisfiable

(c) F_1 is unsatisfiable, F_2 is valid (d) F_1 and F_2 both are unsatisfiable

Q.118 Consider R is real number and S and R are subsets of R × R define as:

S = $\{(x, y) : y = x + 1 \text{ and } 0 < x < 2\}$

T = $\{(x, y) : x - y \text{ is an integer}\}$

Which one of the following is true?

(a) T is an equivalence relation on R but S is not

(b) S is an equivalence relation on R but T is not

(c) Both S and T are an equivalence relation on R

(d) Neither S nor T is an equivalence relation on R

Q.119 Consider a mapping $f : n \to N$, where N is the set of natural numbers is defined as

$$f(n)=\begin{cases}n^2, & \text{for } n \text{ odd}\\ 2n+1, & \text{for } n \text{ even}\end{cases}$$

for $n \in N$. Which of the following is true about 'f'?

(a) Surjective but not injective (b) Injective but not surjective

(c) Bijective (d) Neither surjective nor injective

Q.120 Which of the formula is correct for given sentence:

"No students are allowed to carry smartphone"

(a) $\exists x(\neg$ student $(x) \rightarrow$ carry_smartphone $(x))$

(b) $\forall x($student $(x) \rightarrow \neg$ carry_smartphone $(x))$

(c) $\forall x(\neg$ student $(x) \rightarrow$ carry_smartphone $(x))$

(d) $\forall x(\neg$ student $(x) \rightarrow \neg$ carry_smartphone $(x))$

Q.121 The minimum number of ordered pair of integers (a, b) are needed to guarantee that there are two ordered pairs (a_1, b_1) and (a_2, b_2) such that $a_1 \bmod 4 = a_2 \bmod 4$ and $b_1 \bmod 6 = b_2 \bmod 6$ _____.

Q.122 What is the maximum number of edges present in a disconnected graph on $n \geq 3$ vertices?

(a) $({}^{n}C_2 - 1)$ (b) $n - 2$

(c) ${}^{(n-1)}C_2$ (d) ${}^{(n-2)}C_2$

Q.123 What is the number of partition of X = $\{a, b, c, d, e, f\}$ where a and c are always in same block?

(a) 15 (b) 52

(c) 203 (d) None of these

Q.124 Consider the recurrence relation $a_k = -8a_{k-1} - 15a_{k-2}$ with initial conditions $a_0 = 0$ and $a_1 = 2$. Which of the following is an explicit solution to this recurrence relation?

(a) $(-3)^k - (-5)^k$ (b) $k(-3)^k - k(-5)^k$

(c) $(-5)^k - (-3)^k$ (d) $k(-3)^k - (-5)^k$

Q.125 Suppose tree 'T' has 10 vertices of degree 4, 20 vertices of degree 3 and 30 vertices of degree 2. If all of the rest of vertices are of degree 1, then the number of vertices 'T' have is _____.

❍❍❍❍

Detailed Explanations

101. (a)

$$\begin{bmatrix} 3 & 7.5 \\ -6 & 4.5 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 6 \\ -90 \end{bmatrix}$$

$$\begin{bmatrix} 3 & 7.5 & 6 \\ -6 & 4.5 & -90 \end{bmatrix}$$

$R_2 + 2R_1$

$$\begin{bmatrix} 3 & 7.5 & 6 \\ 0 & 19.5 & -78 \end{bmatrix}$$

$$19.5y = -78$$

or $$y = -4$$

$$3x + 7.5y = 6$$

$$3x + 7.5(-4) = 6$$

$$3x = 36$$

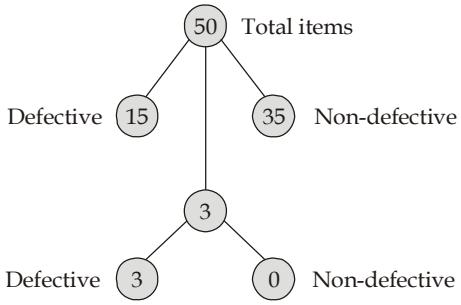
$\Rightarrow$ $$x = 12$$

$\therefore$ $$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 12 \\ -4 \end{bmatrix}$$

102. (d)

Mean, median and mode are all same (μ) for normal distribution.

103. (b)



$$\text{Required probability} = \frac{{}^{15}C_3 \times {}^{35}C_0}{{}^{50}C_3}$$

$$= \frac{15\times14\times13}{50\times49\times48} = \frac{13}{560}$$

104. **(c)**

The characteristic equation $|A - \lambda I| = 0$

i.e. $\begin{vmatrix} 4-\lambda & 6 \\ 2 & 8-\lambda \end{vmatrix} = 0$

or $(4 - \lambda)(8 - \lambda) - 12 = 0$

or $32 - 8\lambda - 4\lambda + \lambda^2 - 12 = 0$

$\Rightarrow \lambda^2 - 12\lambda + 20 = 0$

$\Rightarrow \lambda^2 - 10\lambda - 2\lambda + 20 = 0$

$\Rightarrow (\lambda - 10)(\lambda - 2) = 0$

$\Rightarrow \lambda = 10, 2$

Corresponding to $\lambda = 10$, we have

$$[A - \lambda I]x = \begin{bmatrix} -6 & 6 \\ 2 & -2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix}$$

Which gives, $-6x + 6y = 0$

$\Rightarrow x = y$

$2x - 2y = 0$

$\Rightarrow x = y$

i.e. eigen vector $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$

Corresponding to $\lambda = 2$, we have

$$[A - \lambda I]x = \begin{bmatrix} 2 & 6 \\ 2 & 6 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix}$$

Which gives, $2x + 6y = 0$ i.e. eigen vector $\begin{bmatrix} -3 \\ 1 \end{bmatrix}$

105. **(6)**

The product of eigen values is always equal to the determinant value of the matrix.

$\lambda_1 = 5$, λ_2 = Unknown

$|A| = 30$

$\lambda_1 \times \lambda_2 = 30$

$5 \times (\lambda_2) = 30$

$\Rightarrow \lambda_2 = 6$

106. **(0.5)**

Using the product and quotient properties of exponents we can rewrite the equation as

$$e^{x+2} = e^{4-(x+1)} = e^{4-x-1} = e^{3-x}$$

Since the exponential function e^x is one-to-one, we know the exponents are equal:

$x + 2 = 3 - x$

$\Rightarrow x = 0.5$

107. **(b)**

We know that, $E(X) = 10$

and $Var(X) = 25$

Now, $E(Y) = E(aX - b) = 0$

$aE(X) - b = 0$

$\Rightarrow \quad a(10) - b = 0$

$10a - b = 0 \quad \ldots(i)$

Given, $Var(Y) = 1$

$Var(aX - b) = a^2\, Var(X) = 1$

$\Rightarrow \quad 25a^2 = 1$

i.e $a = \pm\frac{1}{5}$

$a = \frac{1}{5}$ (taking positive values only)

By putting value of 'a' in equation (i)

We get $b = 2$

108. **(a)**

For rectangular distribution

$$\text{Variance} = \frac{(b-a)^2}{12}$$

Here, $a = 0, b = \frac{1}{2}$

$$\therefore \quad \text{Variance} = \frac{\left(\frac{1}{2}-0\right)^2}{12} = \frac{\frac{1}{4}}{12} = \frac{1}{4\times 12}$$

Then standard deviation $= \sqrt{\text{Variance}}$

$$= \sqrt{\frac{1}{4\times 12}} = \frac{1}{2\sqrt{12}}$$

109. **(0)**

Since operations 1 and 2 are elementary operations of the type of $R_i \pm kR_j$ and $C_i \pm kC_j$ respectively the determinant will be unchanged from the original determinant.

So the required determinant

$$= \begin{vmatrix} 1 & \frac{4}{3} & 15 \\ \frac{7}{3} & 3 & 35 \\ \frac{13}{3} & \frac{2}{3} & 65 \end{vmatrix} \xrightarrow{C_3 - 15C_1} \begin{vmatrix} 1 & \frac{4}{3} & 0 \\ \frac{7}{3} & 3 & 0 \\ \frac{13}{3} & \frac{2}{3} & 0 \end{vmatrix} = 0$$

110. **(b)**

Rank of matrix is "$m - 1$", so it must have "$m - 1$" linearly independent rows as well as "$m - 1$" independent columns.

111. **(d)**

$$f(x) = 4x^3 - 6x^2$$

$$\frac{df(x)}{dx} = 12x^2 - 12x$$

$$12x^2 - 12x = 0$$
$$12x\,[x - 1] = 0$$
$$x = 0, 1$$

$$\frac{df'(x)}{dx} = 24x - 12$$

At $x = 0$, $24 \times 0 - 12 = -12 < 0$ maxima

At $x = 1$, $24 \times 1 - 12 = 12 > 0$ minima

So, at

$$x = -1, f(-1) = 4(-1)^3 - 6(-1)^2 = -4 - 6 = -10$$
$$x = 0, f(0) = 4(0)^3 - 6(0)^2 = 0$$
$$x = 1, f(1) = 4(1)^3 - 6(1)^2 = 4 - 6 = -2$$
$$x = 2, f(2) = 4(2)^3 - 6(2)^2 = 32 - 24 = 8$$

So maximum value occurs at $x = 2$.

112. **(c)**

$$\lim_{x\to\infty}\left[1+\frac{3}{2x}\right]^{5x}$$

Put limit $x \to \infty$

1^∞ from create,

So, we know, for form 1^∞

$$\lim_{x\to\infty} f(x)^{g(x)} = e^{\left(\lim\limits_{x\to\infty}(f(x)-1)\cdot g(x)\right)}$$

Apply in given function:

$$= e^{\lim\limits_{x\to\infty}\left[1+\frac{3}{2x}-1\right]5x}$$

$$= e^{\lim\limits_{x\to\infty}\left[\frac{3}{2x}\right]5x} = e^{15/2}$$

113. **(d)**

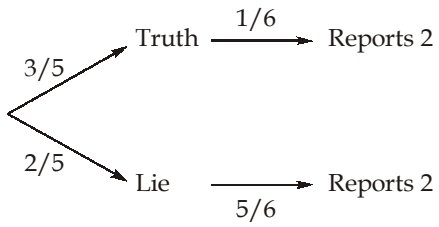
Check for continuous:

$$f(-2) = -1.5 \times (-2)^2 = -6$$
$$f(-2^+) = 6(-2) - 5 = -17$$
$$f(-2^-) = -1.5 \times (-2)^2 = -6$$
$$f(-2^-) \neq f(-2^+)$$

Function is not continuous, hence cannot be differentiable i.e. differentiable $\rightarrow$ continuous.

114. **(b)**

Applying Bayes Theorem:



So,

$$P(\text{spoke truth}/\text{reports 2}) = \frac{P(\text{spoke truth} \cap \text{reports 2})}{P(\text{reports 2})}$$

$$= \frac{\frac{3}{5}\times\frac{1}{6}}{\frac{3}{5}\times\frac{1}{6}+\frac{2}{5}\times\frac{5}{6}} = \frac{3}{13}$$

115. **(0.095) [0.095 to 0.096]**

Consider, $u = 3 + 2x$

$$\frac{du}{dx} = 2$$

$$dx = \frac{du}{2}$$

Calculate new limits:

$x = 0, u = 3 + 2 \cdot x = 3 + 0 = 3$

$x = 2, u = 3 + 2 \cdot x = 3 + 2 \times 2 = 7$

By substitution:

$$= \int_3^7 \frac{1}{u^2} \cdot \frac{1}{2} du$$

$$= \frac{1}{2}\left[-u^{-1}\right]_3^7 = \frac{1}{2}\left[\frac{1}{3} - \frac{1}{7}\right]$$

$$= \frac{1}{2}\left[\frac{4}{21}\right] = \frac{2}{21} = 0.095$$

116. **(0)**

For interval $(-\infty, 0)$

$$f(x) = -x;\ x < 0$$
$$g(x) = 1 - x;\ x \le 0$$

Both are continuous for $x < 0$ and we know composition of two continuous function is also continuous. So, $gof(x)$ is also continuous.

Hence no function is discontinuous.

117. **(b)**

F_1 : $(p \leftrightarrow q) \wedge (\neg p \leftrightarrow q)$

we know that $\neg (p \leftrightarrow q) \equiv (\neg p \leftrightarrow q)$

So, if $(p \leftrightarrow q)$ is assumed as A.

Then $A \wedge A' = 0$, means unsatisfiable.

F_2 : $(p \vee \neg q) \wedge (\neg p \vee q) \wedge (\neg p \vee \neg q)$

$= (p + q')\ (p' + q)\ (p' + q')$

$= (p + q')\ (p' + qq')$

$= (p + q')\ p'$

$\equiv p'q'$ which is not valid but satisfiable.

So, F_1 is unsatisfiable but F_2 is satisfiable.

118. **(a)**

1. $S = \{(x, y) : y = x + 1 \text{ and } 0 < x < 2\}$

- **Check for Reflexive Relation:**

  $(x , x) : x = x + 1$ but $x \neq x + 1$

  Hence cannot be reflexive S is not equivalence relation on R.

2. $T = \{(x, y) : x - y \text{ is an integer}\}$

- **Check for Reflexive Relation:**

  $(x, x) : x - x$ is integer $x - x = 0$ and $0 \in$ integer

  So, T is reflexive.

- **Check for Symmetric Relation:**

  $(x , y) : x - y$ is integer and $(y, x) : y - x$ also an integer.

  So, T is symmetric relation.

- **Check for Transitive Relation:**

  $(x , y) : x - y$ is integer and $(y, z) : y - z$ is integer then $(x , z) : x - z$ is also integer.

  So, T is transitive.

  Hence T is equivalence relation but S is not.

119. (d)

'N' is given as {1, 2, 3 .....}

$$f(n)=\begin{cases} n^2, & \text{for } n \text{ odd} \\ 2n+1, & \text{for } n \text{ even} \end{cases}$$

- **Check for Injective:**

  for $f(3) = n^2 = 9$

  for $f(4) = 2n + 1$

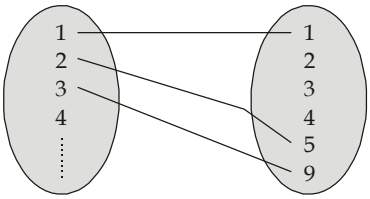
  $= 2 \times 4 + 1$

  $= 8 + 1 = 9$

  Since both $f(3)$, $f(4)$ maps to same element 9.

  Hence cannot be injective.

- **Check for Surjective:**



Hence for domain elements 2, 4 ..... are not mapped to any elements. Hence cannot be surjective.

120. (b)

"No students are allowed to carry smartphone"

Can be written as: Not a student are allowed to carry smartphone

$\equiv \neg[\exists x(\text{student}(x) \wedge \text{carry\_smartphone}(x))]$

$\equiv \forall x(\neg \text{ student}(x) \vee \neg \text{ carry\_smartphone}(x))$

$\equiv \forall x(\text{student}(x) \rightarrow \neg \text{ carry\_smartphone}(x))$

So, option (b) is correct representation only.

121. (25)

For a in (a, b), there are 4 different congruence classes possible for mod 4 i.e. 0, 1, 2 and 3 and 6 different congruence classes possible for mod 6 i.e. 0, 1, 2, 3, 4 and 5.

So number of different ordered pair where (a_1, b_1) and (a_2, b_2) such that $a_1 \bmod 4 = a_2 \bmod 4$ and $b_1 \bmod 6 = b_2 \bmod 6$ not possible are $4 \times 6 = 24$.

So to get two pair with given condition we need 24 + 1 = 25 ordered pairs.

122. **(c)**

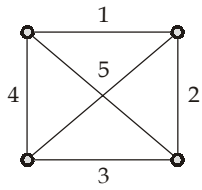
Maximum number of edges in connected graph:

$$^{n}C_2 = \frac{n(n-1)}{2}$$

So, by disconnected one vertex from it, we get:

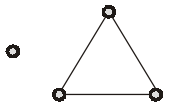
$$= {}^{n-1}C_2 = \frac{(n-1)(n-2)}{2}$$

Ex: connected graph on 4 vertices:



$= 6$ edges $= {}^{4}C_2$ edges

Disconnected graph on 4 vertices:



$= 3$

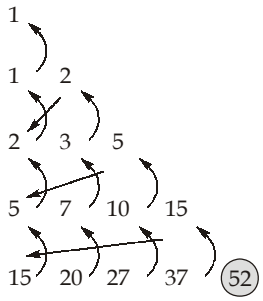
$= {}^{(4-1)}C_2 = {}^{3}C_2 = 3$

123. **(b)**

Since "a and c" are present in same block

So, $\{ac, b, d, e, f\}$

Using Bell number:



124. **(a)**

$$a_k = -8a_{k-1} - 15a_{k-2}$$

Consider, $k-2 = 1$, $k-1 = n$ and $k = n^2$

$$n^2 = -8n - 15 \quad \text{[Using characteristics equation method]}$$

$$n^2 + 8n + 15 = 0$$

$$n^2 + 5n + 3n + 15 = 0$$

$$n(n+5) + 3(n+5) = 0$$

$$(n+3)(n+5) = 0$$

$$n = -3 \text{ and } -5$$

So, $a_k = (-3)^k C_1 + (-5)^k C_2$

$$= (-3)^0 C_1 + (-5)^0 C_2 = 0$$

$\Rightarrow$ $C_1 + C_2 = 0$ ...(1)

$$a_1 = (-3)^1 C_1 + (-5)^1 C_2 = 2$$

$\Rightarrow$ $-3C_1 + -5C_2 = 2$ ...(2)

Solving equation (1) and (2), we get $C_1 = 1$ and $C_2 = -1$

So, $a_n = (-3)^k - (-5)^k$

125. **(102)**

Consider number of vertices of degree 1 = x

$$\text{Total number of edges} = \frac{10\times4 + 20\times3 + 30\times2 + x\times1}{2}$$

$$= \frac{(x+40+60+60)}{2} = \frac{x}{2} + \frac{160}{2}$$

$$= \frac{x}{2} + 80$$

$$\text{Total number of vertices} = 10 + 20 + 30 + x$$

$$= x + 60$$

Since is tree, so number of edges must be = (Number of vertices) – 1

$$= (x + 60) - 1 = x + 59$$

Thus, $x + 59 = \frac{x}{2} + 80$

$$2(x + 59 - 80) = x$$

$$2x - 2 \times 21 = x$$

$$x = 42$$

$$\text{Total number of vertices} = x + 60$$

$$= 42 + 60 = 102$$

❍❍❍❍

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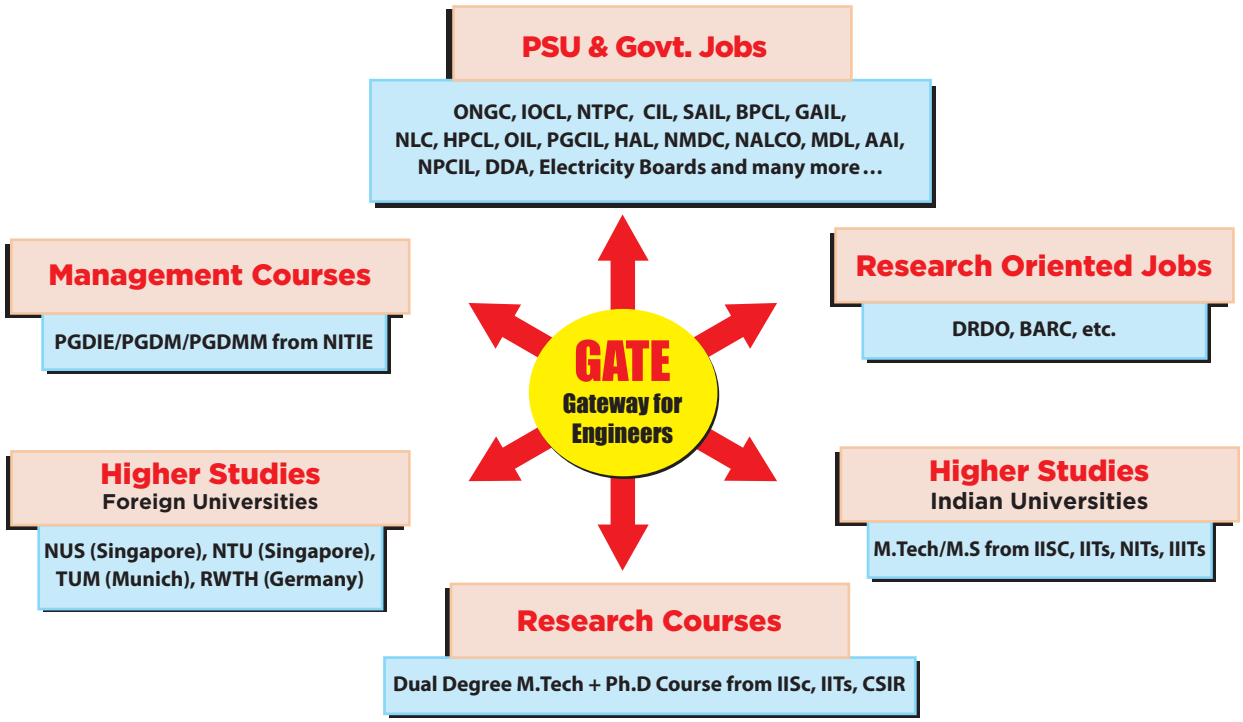
Revision through Questions for GATE 2020

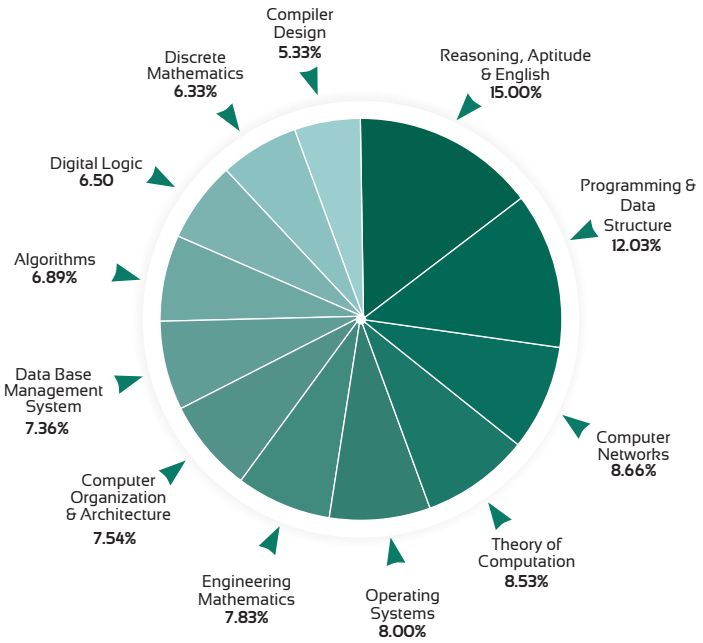
CS Computer Science

Q.126 - Q.150 out of 200 Questions

Day 6 of 8



SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	12.03%
Computer Networks	8.66%
Theory of Computation	8.53%
Operating Systems	8.00%
Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 6 : Q.126 to Q. 150 : Operating System + Databases

Q.126 Which of the following is deadlocks prevention scheme?

S_1 : Whenever a process requests a resource, it does not hold any other resources.

S_2 : If a process is holding some resources and requests another resource that can not be immediately allocated to it, all resources being hold are preempted.

S_3 : Each process requests resources either in only increasing order or in only decreasing order of enumeration.

(a) Only S_1 and S_3
(b) Only S_2 and S_3
(c) Only S_2 and S_3
(d) All S_1, S_3 and S_3

Q.127 Consider two processes P_1 and P_2, each needed 3 resources. The minimum number of resources needed to ensure deadlock free execution is _____.

Q.128 A computer uses 44 bit virtual address space, 1 GB of physical memory with page size of 16 KB. The page table entry size is 2 bytes and if each page table must fit in a single page then number of level of paging required is _____.

Q.129 Consider a paging scheme, in which average process size is 32 MB and each page table entry size is 4 B. The optimal size of page to minimize the total overload due to page table and internal fragmentation is _____ KB.

Q.130 Consider a system with following snapshot of allocation and remaining need of each process. Here allocation shows the current number of resources of each type allocated to each process and remaining need shows number of resources remains required to complete execution process.

Process	Allocation			Remaining need		
	A	B	C	A	B	C
P_1	2	3	0	1	1	0
P_2	3	1	2	0	1	0
P_3	0	3	1	2	2	2
P_4	1	1	3	1	3	1

If currently available resources in system as (A, B, C) = (1, 1, 1), then the number of possible safe sequence possible in system with 4 processes will be _____.

Q.131 Consider five memory partitions of size 100 KB, 500 KB, 200 KB, 450 KB and 600 KB in same order. If sequence of requests for blocks of size 212 KB, 417 KB, 112 KB, 426 KB and 280 KB in same order come and partitioning can be done in block, then which of the following algorithm satisfy all the block requests?

(a) Best fit algorithm
(b) First fit algorithm
(c) Both next fit and best fit results in same
(d) None of the above

Q.132 A student can take one or more courses and courses can be offered to any number of students. Which of the following represents given scenario in ER-model?

(a) 

(b) 

(c) 

(d) 

Q.133 Consider relation R(A, B, C, D, E, F, G) with the following functional dependencies AB → CD, D → B, AF → D, DE → F, C → G, F → E and G → A. What is the highest normal form?

(a) 1NF (b) 2NF
(c) 3NF (d) 4NF

Q.134 Let $R_1(\underline{P}, Q, R)$ and $R_2(\underline{S}, T)$ be two relation schema, where the primary keys are shown underlined, and let R be a foreign key in R_1 referring R_2. Which one of the following relational algebra expressions would necessary produce an empty relation?

(a) $\pi_R(R_1) - \pi_S(R_2)$ (b) $\pi_S(R_2) - \pi_R(R_1)$
(c) $\pi_S(R_1 \bowtie_{R \neq S} R_2)$ (d) $\pi_R(R_1 \bowtie_{R \neq S} R_2)$

Q.135 Which of the following statement is false?

(a) Relation with every attribute is prime always in 3NF.
(b) Relation with every candidate key simple always in 2NF.
(c) Relation with every attribute is prime always in BCNF.
(d) Relation R which satisfy 3NF and atmost one compound candidate key is also in BCNF.

Q.136 Consider R(A, B, C, D, E, F, G) be a relational schema with the following functional dependencies:

AC → G, D → EG, BC → D, CG → BD, ACD → B, CE → AG

The number of different minimal cover possible are _____.

Q.137 Consider a relation R (A, B, C, D, E) with the following functional dependencies:

$A \rightarrow BC$
$C \rightarrow E$
$B \rightarrow D$
$E \rightarrow A$

The total number of super keys present in the relation are _____.

Q.138 Consider relation 'R' and 'S' have 'n' and 'm' tuples, respectively. Choose the best matching between **List-I (Expression)** and **List-II (Maximum number of tuple):**

List-I	**List-II**
P. $R \cup S$	**1.** n
Q. $R \cap S$	**2.** $m \times n$
R. $\sigma_C(R) \times S$	**3.** min (m, n)
S. $\pi_L(R) - S$	**4.** $n + m$

Codes:

	P	Q	R	S
(a)	1	2	4	3
(b)	1	4	2	3
(c)	4	2	3	1
(d)	4	3	2	1

Q.139 Which of the following query transformations (i.e. replacing LHS expression by the RHS expression) is correct? (Assume R_1, R_2 and R_3 are relations, C_1 and C_2 are selection conditions and A_1 and A_2 are attributes of relations)?

(a) $\pi_{A1}(R_1 - R_2) \rightarrow \pi_{A1}(R_1) - \pi_{A1}(R_2)$ with condition $R_2 \subseteq R_1$

(b) $(R_1 \rtimes R_2) \bowtie R_3 \rightarrow R_1 \bowtie (R_2 \rtimes R_3)$

(c) $\pi_{A1}(\sigma_{C1}(R_1)) \rightarrow \sigma_{C1}(\pi_{A1}(R_1))$

(d) $\pi_{A1}(\pi_{A2}(\sigma_{C1}(\sigma_{C2}(R_1)))) \rightarrow \pi_{A1}(\sigma_{C2}(\sigma_{C1}(R_1)))$ with condition $A_1 \subset A_2$

Q.140 Consider A (P, Q, R, S, T, V, W) and the following FD's:

$W \rightarrow VS$

$T \rightarrow S$

$WS \rightarrow RT$

$QS \rightarrow P$

Which of the following is minimal cover of the given FD's?

(a) $\{W \rightarrow V, T \rightarrow S, W \rightarrow R, WS \rightarrow T, QS \rightarrow P\}$

(b) $\{W \rightarrow V, W \rightarrow S, T \rightarrow S, W \rightarrow R, QS \rightarrow P\}$

(c) $\{W \rightarrow V, T \rightarrow S, W \rightarrow R, WS \rightarrow R, QS \rightarrow P\}$

(d) $\{W \rightarrow V, T \rightarrow S, W \rightarrow R, W \rightarrow T, QS \rightarrow P\}$

Q.141 Consider a relation $r_1(\underline{A}, B, C)$, $r_2(\underline{C}, D, E)$ and $r_3(\underline{F}, G)$ with primary keys A, C and F respectively. Assume that r_1 has 150 tuples, r_2 has 100 tuples and r_3 has 75 tuples. The number of resultant tuple in $r_1 \bowtie r_2 \bowtie r_3$ are _____.

Q.142 Consider a B^+ tree in which search key is 15 bytes long, block size is 2048 bytes, record pointer is 12 bytes long and block pointer is 10 bytes long. The maximum number of keys that can be accommodated in each leaf node of the tree is _____. (Assume order of leaf node refers to number of keys present in the node)

Q.143 Consider the following transaction involving two bank accounts x and y:

read (x);
$x = x - 50$;
write (x);
read (y);
$y = y + 50$;
write (y);

Which of the following constraints fail if transaction is fail just after write (x); operation?

(a) Atomicity
(b) Durability
(c) Isolation
(d) None of these

Q.144 Which of the following is true?

(a) Secondary index over key must be dense
(b) Clustering index must be dense
(c) Primary index must be sparse
(d) Both (a) and (c)

Q.145 R

A	B	C
4	5	6
7	2	4
3	5	6

S

D	E	F
4	2	5
6	4	5
3	5	6

How many records in result of SQL query?

Select *
FROM R
Where EXISTS (Select count (*) FROM S Where R.C > S.D and S.F > 10)

(a) 0
(b) 1
(c) 2
(d) 3

Q.146 Consider a block of size such that it can hold:

- either 5 records of a relation R, or
- be used as a B^+ tree internal node with degree 11, or
- B^+ tree leaf node with degree 10.

If R has 1000 records, then the smallest number of blocks that could be used to store R and a sparse B^+ tree index on key of R is _____.

Q.147 S : $r_1(A)$, $r_2(A)$, $r_3(A)$, $r_4(A)$, $w_1(B)$, $w_2(B)$, $w_3(B)$, $w_4(B)$

How many serial schedules equal to schedule(S) but not conflict equal to schedule(S)?

(a) 1
(b) 2
(c) 5
(d) 6

Q.148 Consider the following schedule S of transactions T_1, T_2, T_3 and T_4:

T_1	T_2	T_3	T_4
		Write(x)	
	Write(x)		
	Commit		
			Read(x)
Write(x)			
		Read(x)	
Commit			
		Commit	
			Commit

Which one of the following statement is correct?

(a) Recoverable but not conflict serializable.

(b) Irrecoverable but conflict serializable.

(c) Irrecoverable and not conflict serializable.

(d) Both recoverable and conflict serializable.

Q.149 Consider the following statements:

S_1 : All strict schedules are serial.

S_2 : All recoverable schedules are conflict serializable.

S_3 : All strict schedules are conflict serializable.

S_4 : All conflict serializable schedules are free from cascading rollbacks.

Which of the following is true?

(a) Only S_1 and S_4

(b) Only S_2 and S_4

(c) Only S_2, S_3 and S_4

(d) None of these

Q.150 Consider the following relation schema Instructor (ID, Name, Dept_name, Salary) with table:

ID	Name	Dept_name	Salary
101	Crick	IN	72000
102	Katz	CS	75000
103	Srinivas	CS	32000
104	Brandt	CS	25000
105	Kim	EE	42000
106	Singh	EC	48000
107	Gold	EC	34000
108	Mozart	CE	70000
109	Gaurav	CE	20000
110	Kunal	CE	50000

Consider the following SQL query:

```
SELECT Dept_name, avg_salary
FROM  (SELECT Dept_name, avg (Salary) as avg_salary
       FROM Instructor
       GROUP by Dept_name)
WHERE avg_salary > 42000;
```

The number of tuple returned by above SQL query is _____.

❍❍❍❍

Detailed Explanations

126. (d)

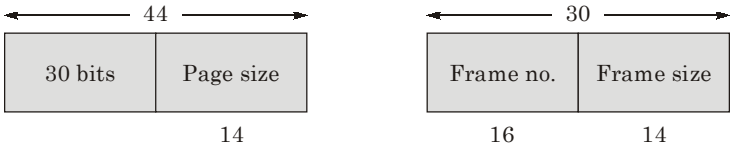
- Scheme 1 protocol ensures that hold and wait condition never occurs in the system.
- Scheme 2 ensures that there will be preemption of resources that have already been allocated.
- Scheme 3 ensures the circular wait condition.

127. (5)

Minimum number of resources required = (Number of resources required by P_1 – 1) + (Number of resources required by P_2 – 1) + 1

$= (3 - 1) + (3 - 1) + 1 = 5$

128. (3)



$$\text{Size of page table at 1st level} = \frac{2^{44}}{2^{14}} \times 2 \text{ Bytes} = \frac{2^{45}}{2^{14}} = 2^{31} \text{ Bytes}$$

$$\text{Size of page table at 2nd level} = \frac{2^{31}}{2^{14}} \times 2 \text{ Bytes} = \frac{2^{32}}{2^{14}} = 2^{18} \text{ Bytes}$$

$$\text{Size of page table at 3rd level} = \frac{2^{18}}{2^{14}} \times 2 \text{ Bytes} = \frac{2^{19}}{2^{14}} = 2^{5} \text{ Bytes}$$

So, 3 levels of paging is required.

129. (16)

Suppose, page size = P Bytes

Process overhead = Page table overhead + Overhead due to internal fragmentation

Page table overhead = Number of pages per process × Page table entry size

$$= \left(\frac{\text{Process size}}{\text{Page size}}\right) \times 4\text{B} = \frac{32\text{MB}}{\text{P B}} \times 4\text{B}$$

Average overhead due to internal fragmentation $= \frac{0+P}{2} = \frac{P}{2}$

0 = Minimal internal fragmentation

P = Maximum internal fragmentation

$$\text{Overhead is paging} = \frac{32\text{ M} \times 4}{P} + \frac{P}{2}$$

To minimize overhead i.e. take differentiation with respect to 'P'.

$$\frac{-128\text{ M}}{P^2} + \frac{1}{2} = 0$$

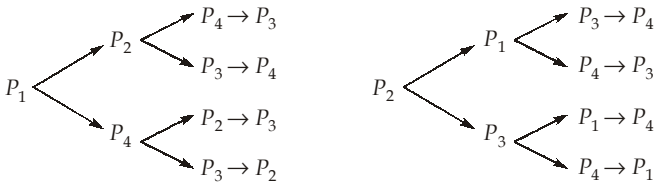
$$P^2 = 2 \times 128 \text{ MB}$$

$$P = \sqrt{256 \text{ MB}}$$

$$P = 16 \text{ KB}$$

130. **(8)**

With available resource (1, 1, 1):

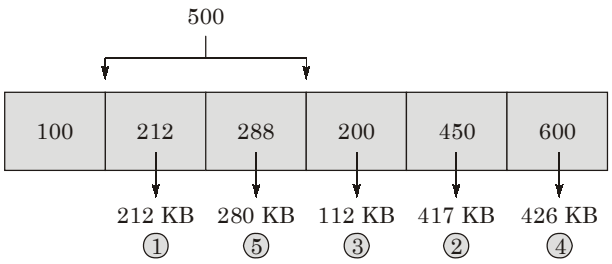


Number of ways = 4 Number of ways = 4

Total number of ways = 4 + 4 = 8

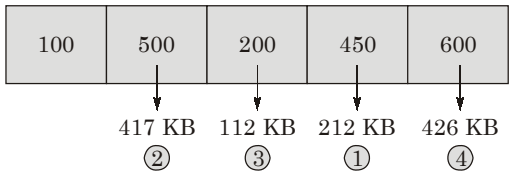
131. **(b)**

1. Using First Fit:



All request will be fit in memory.

2. Using Best Fit:



Request 280 KB will not fit in memory.

132. **(b)**

A student can enroll one or more course.

A course can be enrolled by one or more students.

Option (b) is correct. It is a many to many relation with total participation at one end.

133. **(c)**

Candidate keys: ABE, BEG, BCE, AF, FG, ADE etc. since all attribute are prime attribute. So, neither (prime → non-prime) nor (non-prime → non-prime) possible, so relation is always in 2NF as well as in 3NF. But since (candidate → anything), not present, so not in BCNF and highest normal form is 3NF.

134. **(a)**

As R_1 is referring to R_2 and S is primary key of R_2, $\pi_R(R_1) - \pi_S(R_2)$ will give empty relation or empty table as number of values in R column of table R_1 will always refer from respective values in S column of R_2.

135. **(c)**

- If every attribute is prime then (partial key → non key) and (non key → non key) is not possible. So, relation is always in 2NF as well as in 3NF.
- If every candidate key is simple (having exactly 1 attribute), then (partial key → non key) not possible. Hence, relation is in 2NF.
- Assume a relation R (ABC) with following functional dependencies:
  R (ABC)
  $\{AB \rightarrow C, C \rightarrow A\}$
  Candidate keys are AB and BC
  $AB \rightarrow C$ is in BCNF but $C \rightarrow A$ not in BCNF.

136. **(4)**

Given relation: R(A, B, C, D, E, F, G, H)

AC → G, D → EG, BC → D, CG → BD, ACD → B, CE → AG

Since, $(AC)^+ = ABCD$

So, ACD → B, here D is extraneous.

Minimal cover:

1. {AC → G, D → EG, BC → D, CG → B, CE → AF}
2. {AC → G, D → EG, BC → D, CG → D, CE → AF}
3. {AC → B, D → EG, BC → D, CG → D, CE → AF}
4. {AC → B, D → EG, BC → D, CG → B, CE → AF}

Total 4 minimal cover.

137. **(28)**

Candidate keys: $A^+ = \{A, B, C, D, E\}$

If A is a candidate key, then E will also be the candidate key, similarly C is also the candidate key.

A + {Any combination of B, C, D, E} = 2^4

+

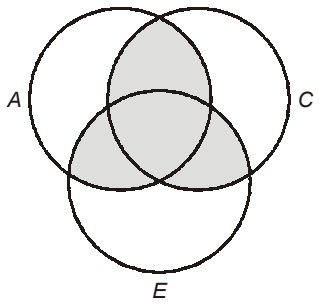
E + {Any combination of A, B, C, D} = 2^4

+

C + {Any combination of A, B, D, E} = 2^4

–

Common key



$2^4 + 2^4 + 2^4 - 3 \times 2^3 + 2^2$

$= 3[2^4 - 2^3] + 2^2$

$= 24 + 4 = 28$

138. **(d)**

- Maximum number of tuple for $R \cup S$ is $n + m$.
- Maximum number of tuple for $R \cap S$ is min (m, n).
- Maximum number of tuple for $\sigma_C(R) \times S$ is $m \times n$.
- Maximum number of tuple for $\sigma_L(R) - S$ is n.

139. **(d)**

(a) $\pi_{A1}(R_1 - R_2) \neq \pi_{A1}(R_1) - \pi_{A1}(R_2)$ because

R_1

A_1	A_2
2	4
3	4
2	5
3	5

R_2

A_1	A_2
2	4
2	5
3	5

LHS results:

A_1
3

RHS result:

A_1
Empty

(c) $\pi_{A1}(\sigma_{C1}(R_1)) \rightarrow \sigma_{C1}(\pi_{A1}(R_1))$ because LHS is always superset of RHS.

(d) $\pi_{A1}(\pi_{A2}(\sigma_{C1}(\sigma_{C2}(R_1)))) \rightarrow \pi_{A1}(\sigma_{C2}(\sigma_{C1}(R_1)))$ with condition $A_1 \subset A_2$ it gives the same results when LHS is replaced by RHS.

140. **(d)**

Checking $QS \rightarrow P$, $Q^+ = Q$, $S^+ = S$, Hence $QS \rightarrow P$ is essential.

Checking $WS \rightarrow R$, $WS \rightarrow T$

$W^+ \rightarrow WVSRT$, Hence it can be decomposed to $W \rightarrow R$, $W \rightarrow T$

So, the dependencies remained are

$W \rightarrow V$, $W \rightarrow S$, $T \rightarrow S$, $W \rightarrow R$, $W \rightarrow T$, $QS \rightarrow P$

Now, $\{W \rightarrow T, T \rightarrow S\}$ by transitive rule $W \rightarrow S$ can be obtained.

Hence minimal cover is: $W \rightarrow V$, $T \rightarrow S$, $W \rightarrow R$, $W \rightarrow T$, $QS \rightarrow P$.

141. **(11250)**

We know that natural join is associative i.e.

$$(r_1 \bowtie r_2) \bowtie r_3 = r_1 \bowtie (r_2 \bowtie r_3)$$

So, $\underset{150}{r_1} \bowtie \underset{100}{r_2}$ = Number of tuples in foreign key relation, so 150

Then, $(\underset{150}{r_1} \bowtie r_2) \underset{75}{\bowtie} r_3$ = Number of tuples is $m \times n$

$= 150 \times 75$

$= 11250$

142. **(75)**

Assume order of leaf node is P

Format of B^+ tree leaf node is 1

$B_p + P \times (\text{Key size}) + (P)\, R_p \leq \text{Block size}$

$P \times (15) + (P)\, 12 + 10 \leq 2048$

$27\, P \leq 2038$

$P \leq \lfloor 75.48 \rfloor$

$P \leq 75$

143. **(a)**

According to Atomicity either all operations of transaction are reflected properly in database, or none are. So, here transaction fails in middle so, Atomicity is fail.

144. **(a)**

- Secondary index over key build based on unordered field so that it is dense.
- Clustering index based on non key may be sparse also so, clustering index may be dense if each cluster one record.
- Primary index on key with ordering may be dense or sparse.

145. **(d)**

Result of inner query is non empty because even no record satisfy where condition of inner query count (*) produces one record.

So every record of R where condition true.

146. **(223)**

Number of block at database file = $\frac{1000R}{5R} = 200$

Number of block at leaf of B^+ tree = $\left\lceil \frac{200}{10} \right\rceil = 20$

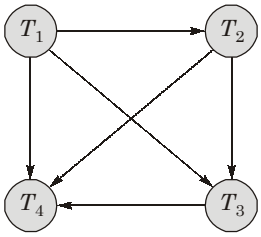
Number of block at internal nodes = $\left\lceil \frac{20}{11} \right\rceil = 2$

Number of block at last level = $\left\lceil \frac{2}{11} \right\rceil = 1$

Total number of blocks = 200 + 20 + 2 + 1 = 223

147. **(c)**

Number of conflict equal serial schedule.



1 topological order $T_1 : T_2 : T_3 : T_4$

[1 serial schedule equal to conflict equal to S]

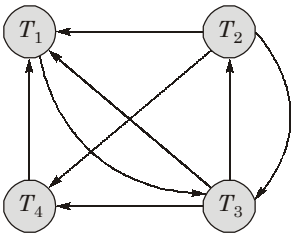
Number of view equal serial schedule

$$\underbrace{[T_1T_2T_3]}_{3! = 6} \rightarrow T_4$$

$$= 6 - 1 = 5$$

148. **(a)**

- **Checking conflict serializable:**



Since cycle exist in graph, so not conflict serializable.

- Checking recoverability:
  Since in given schedule, no write-read pair exist where commit of read(x), comes before commit after write(x). Hence recoverable.

149. (d)

S_1 : All strict schedule may or may not serial i.e.

T_1	T_2
W(A)	
	W(B)
W(C)	
	W(D)
C_1	
	C_2

Schedule is strict schedule but not serial.

S_2 : All recoverable schedule need not be conflict serializable.

T_1	T_2
R(A)	
	W(A)
	R(B)
W(B)	
C_1	
	C_2

Since cycle exist, so cannot be conflict serializable.

S_3 : All strict schedule need not be conflict serializable.

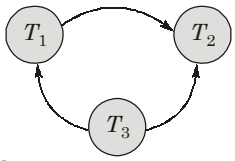
T_1	T_2
R(A)	
	W(A)
	W(B)
	C_2
R(B)	
C_1	

Schedule is strict schedule but not conflict serializable.

S_4 : All conflict serializable schedules may not free from cascading rollbacks i.e.

T_1	T_2	T_3
		W(A)
R(A)		
W(A)		
	R(A)	
	W(A)	
C_1		
	C_2	
		C_3

- Schedule is conflict serializable i.e.



no cycle exist.

- Schedule have cascading abort.

So, none of these statement is true.

150. (3)

1. Query: (SELECT Dept_name, avg (Salary) as avg_salary
   FROM Instructor
   GROUP by Dept_name)
   will return department name with their average salary.
2. Outside query return department name with average salary whose average salary more than 42000.
   i,e. IN, CS, CE.

❍❍❍❍

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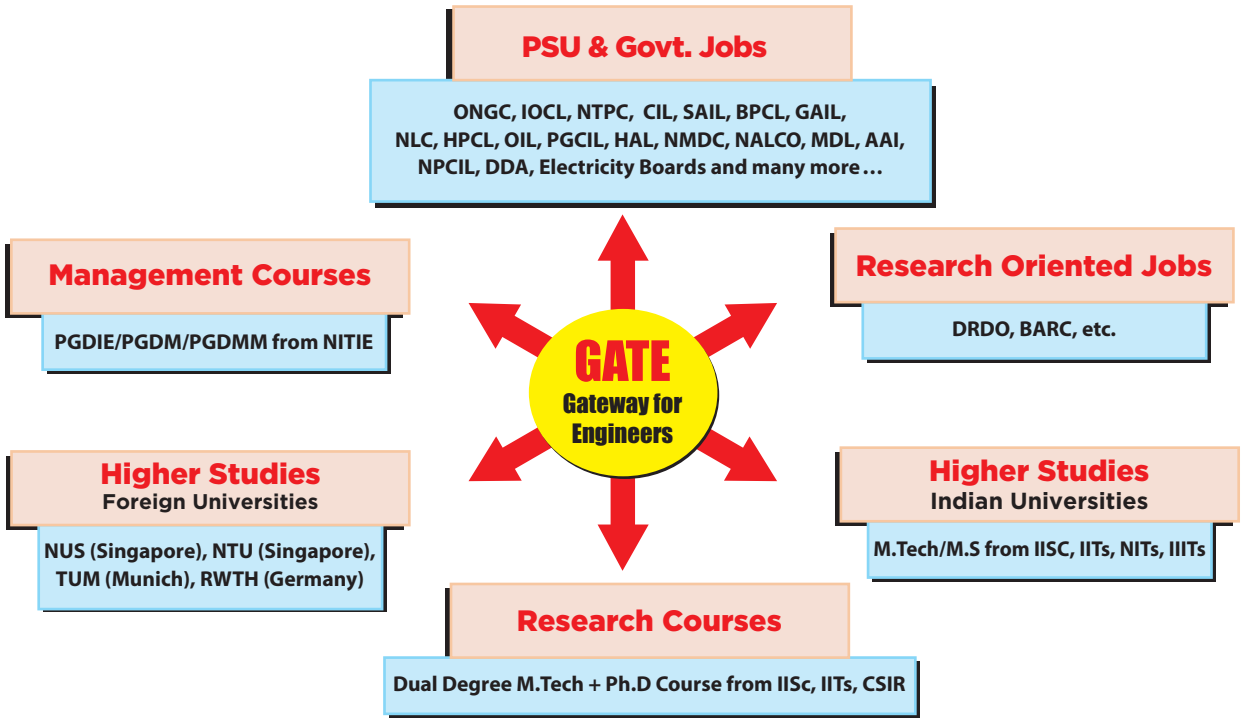
Revision through Questions for GATE 2020

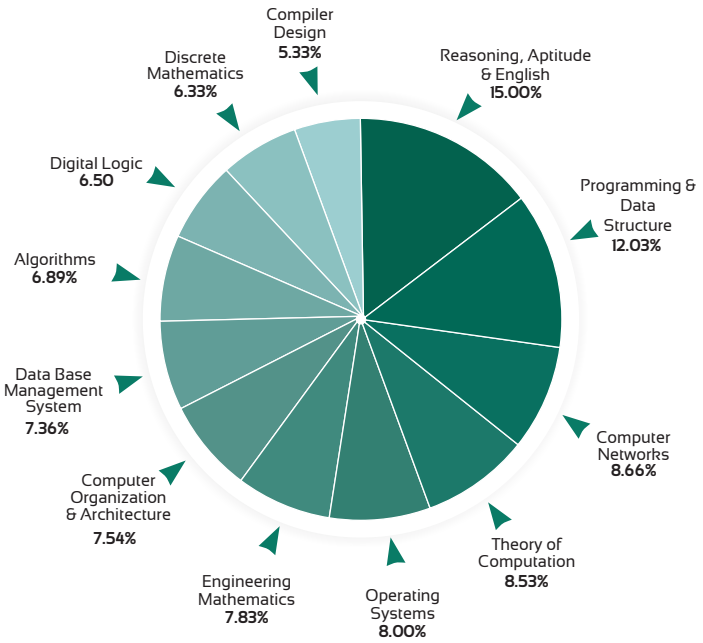
CS Computer Science

Q.151 - Q.175 out of 200 Questions

Day 7 of 8



SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
Reasoning, Aptitude & English	15.00%
Programming & Data Structure	12.03%
Computer Networks	8.66%
Theory of Computation	8.53%
Operating Systems	8.00%
Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 7 : Q.151 to Q. 175 : Computer Organization & Architecture. + Digital Logic

Q.151 In a register/memory type CPU, the instruction lengths are typically variable. This presents a problem when a "PC" of the CPU is incremented during the fetch-execute cycle. Which of the following statement is true with regard to PC incrementing?

(a) PC is incremented by the largest possible fixed value irrespective of the variability.
(b) Increment value is known when the current instruction is decoded within the IR.
(c) Increment value is known when the current instruction has completed execution.
(d) The binary loader overcomes the problem by positioning instructions at word boundaries so that PC can be incremented by a constant amount.

Q.152 Match **List-I (programming terms)** with **List-II (addressing modes)** and select the correct answer using the codes given below the lists:

List-I	**List-II**
A. Constant	**1.** Index addressing mode
B. Structure	**2.** Immediate addressing mode
C. Global variable	**3.** Register addressing mode

Codes:

	A	**B**	**C**
(a)	1	3	2
(b)	2	1	3
(c)	3	2	1
(d)	2	3	1

Q.153 A Program consists of four major types of instructions. The instruction mix and the CPI for each instruction type are given below:

	Instruction Type	CPI	Instruction Mix
1.	ALU	1	60%
2.	Load/Store with cache hit	2	18%
3.	Branch	4	12%
4.	Memory reference with cache miss	8	10%

If the clock frequency of the processor is 400 MHz. What is the avg CPI of the processor?

(a) 2.24 (b) 3.24
(c) 2.5 (d) 2.4

Q.154 A computer system that used memory mapped IO configuration, has a 32-bit address space. Address with 1's in the three MSB refer to devices. What is the maximum amount of memory address and I/O port address that can be referenced in such a system respectively?

(a) 7×2^{30} and 1×2^{30} (b) 1×2^{30} and 7×2^{30}
(c) 7×2^{29} and 1×2^{29} (d) 8×2^{32} and 1×2^{32}

Q.155 Consider the 2 GHz clock frequency processor used to execute the following program segment.

Instruction	Meaning	Size (in words)
I_1 : MOV r0, (3000)	$r0 \leftarrow m[[3000]]$	2
I_2 : MOV $r1$, [2000]	$r1 \leftarrow m[2000]$	1
I_3 : ADD $r0$, $r1$	$r0 \leftarrow r0 + r1$	1
I_4 : MUL $r0$, $r1$	$rD \leftarrow r0 \times r1$	1
I_5 : Mov (3000), $r0$	$m[[3000]] \leftarrow r0$	2
I_6 : Halt	Machine halts	1

Assume the 3 clock cycles required for Register to/from memory transfer, 1 clock cycle for ADD with both operands in register, 2 clock cycle MUL with both operands in register, 3 clock cycles per word for instruction fetch and decode and all other instruction take 0 clock cycles. What is the total time required to complete the program execution (in ns)?

(a) 12 (b) 15

(c) 18 (d) 25

Q.156 A system employs 10 stage instruction pipeline in which 5% instruction results in data dependency, 10% instruction results in control dependency, 2% instructions results in structural dependency. 10% instructions are exposed to data and control dependencies. If the penalty for structural dependency is 1 clock and the penalty for control dependency and data dependency are 3 clocks and 2 clocks respectively. The average instruction time is _____. [in cycles]

Q.157 The CPU supports the following instructions:

LOAD R_1, R_2 (100) ; $R_1 \leftarrow [R_2 + 100]$

ADD R_1, R_2 ; $R_1 \leftarrow R_1 + R_2$

SUB R_2, R_1 ; $R_2 \leftarrow R_2 - R_1$

STORE R_1 (100), R_2 ; $[R_1+100] \leftarrow R_2$

4 stage pipeline is used to execute the above instructions i.e., Fetch, Decode, Execute and Write Back. Let all instructions consume 1 clock each for fetch, decode and write operations. Execution require 3 clocks for memory related operation and 1 clock is for other instructions. The minimum number of clocks needed with operand forwarding is _____.

Q.158 To execute an instruction by a 32-bit machine the following steps are carried out: Fetch, Decode, Execution, Memory access and Store, each of which takes 1 clock period. In a pipelined execution of a 5-step task, a new instruction is read and it takes 1 ns. If there are 100 instructions in sequence, then the speedup ratio of pipe line processing system over an equivalent non pipeline processing system is _____.

Q.159 Which of the following is best characterize computers that use memory mapped I/O?

(a) The computer provides special instruction for manipulating I/O port.

(b) I/O ports are placed at address on bus and as accessed just like other memory location.

(c) To perform an I/O operation, it is sufficient to place the data in an address and call the channel to perform the operation.

(d) Ports are referenced only by memory mapped instruction of the computer and are located at hardwired memory location.

Q.160 Consider a direct mapped cache of size 64 KB with block size 32 bytes. The CPU generates 32 bit addresses, the size of tag memory is

(a) 2K × 16 byte (b) 2K × 32 bit
(c) 1K × 32 bit (d) 1K × 16 byte

Q.161 Suppose after analyzing a new cache design, you discover that the cache has too many conflict misses and this needs to be resolved. You know that you must increase associativity in order to decrease the number of cache misses. What are the implications of increasing associativity?

(a) Slower cache access time (b) Increase index bits
(c) Increase block size (d) All of these

Q.162 Consider a machine with a byte addressable main memory of 2^{24} bytes, block size is 32 bytes and 4-way set associative cache having 2^{15} cache blocks. What is the set and tag address of memory $(E4201F)_{16}$ in hexadecimal?

(a) 0100, 39 (b) 0010, 1F
(c) 0100, 27 (d) 0110, 37

Q.163 Consider a direct mapped cache with 16 blocks with block size of 16 bytes. Initially the cache is empty. The following sequence of access of memory blocks:

Ox80000, Ox80008, Ox80010, Ox80018, Ox30010

is repeated 10 times. Which of the following represents number of compulsory and conflict misses?

(a) Compulsory = 2 and conflict = 18 (b) Compulsory = 3 and conflict = 18
(c) Compulsory = 3 and conflict = 16 (d) None of these

Q.164 Consider a Direct cache with 32 blocks and each block of size 32 bytes. The byte address 1216 of main memory will mapped to line number _____ of cache.

Q.165 Consider a memory access to main memory takes 100 nsec and memory access to cache on cache hit takes 10 nsec. If 75% of processor's memory requests results in cache hit, then the average memory access time is _____ nsec.

Q.166 Suppose that a task makes extensive use of floating point operations with 40% of the time is consumed by floating point operations with a new hardware design. If the floating point module is speeded up by a factor of 4. What is the overall speedup?

(a) 0.7 (b) 1.42
(c) 1.6 (d) 2.5

Q.167 The total number of NAND gates required to implement a 4 × 1 multiplexer is (assuming a NAND gates of any number of inputs are available) _____.

Q.168 Consider, the Karnaugh map given below, where x represents "dont care" in function $f(w, x, y, z)$

yz \ wx	00	01	11	10
00	1			
01	1	1	x	
11		x	1	1
10				1

Total number of essential prime implicants are _____.

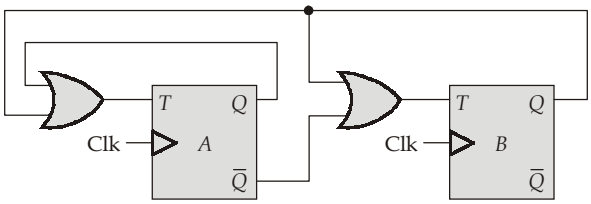
Q.169 Consider the following arithmetic equation:

$$\frac{302}{20} = 12.1$$

The minimum possible non-zero base for the given system is _____.

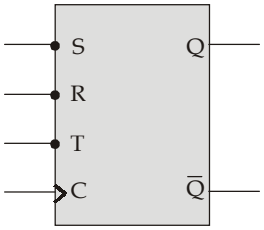
Q.170 Consider a 3-bit number A and 2 bit number B are given to a multiplier. The output of multiplier is realized using AND gate and one bit full adders. If minimum number of AND gates required are X and one bit full adders required are Y, then X + Y = _____.

Q.171 The circuit shown in figure below is:



(a) a MOD-2 counter
(b) a MOD-3 counter
(c) Generate sequence 00, 10, 01, 00 .....
(d) Generate sequence 00, 10, 00, 10, 00 .....

Q.172 A company announces a new flip flop named Set-Reset-Toggle due to shortage elements to the electronics and computer industries. The device symbol and function table for this flip flop are shown below:



S	R	T	Function
X	X	1	Toggle
1	0	0	Set
0	1	0	Reset
0	0	0	Hold
1	1	0	Hold

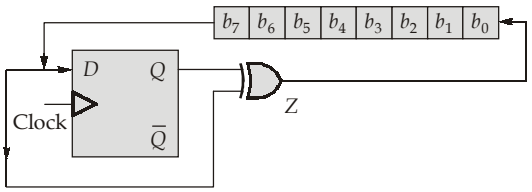
Which of the following is the characteristic equation?

(a) $Q^+ = TQ' + T'[Q(S \oplus R) + SR']$ (b) $Q^+ = (T \oplus Q) + S + R'Q$

(c) $Q^+ = T'Q + T[Q'(S + R) + SR']$ (d) $Q^+ = TQ' + T'[Q(S + R') + SR']$

Q.173 The difference between 201 and next larger double precision number is 2^P, if IEEE double precision format is used then the value of P is _____.

Q.174 Consider 8-bit left shift register and D flip-flop shown in figure below is synchronized with same clock. The D flip-flop is initially cleared.



Which of the following represents the behaviour of above circuit?

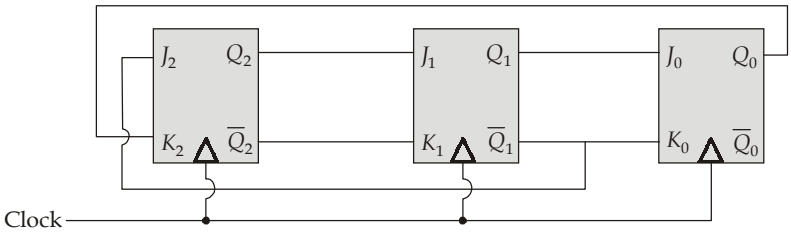
(a) Binary to 2's complement converter

(b) Binary to 1's complement converter

(c) Binary to Excess–3 code converter

(d) Binary to Gray code converter

Q.175 Consider the circuit shown in the figure below:



Then the value of $(Q_2 Q_1 Q_0)$ after the first clock pulse is equal to _____. (Assume all the outputs to be '0' initially)

❍❍❍❍

Detailed Explanations

151. (b)

Increment value is known when the current instruction is decoded within the IR.

152. (b)

- Immediate addressing mode is used for Constant.
- Index addressing mode is used for Structure.
- Register addressing mode is used for Global variable.

153. (a)

$$\begin{aligned}\text{Avg CPI} &= \Sigma(IC_i \times CPI_i)\\ &= (0.6 \times 1) + (0.18 \times 2) + (0.12 \times 4) + (0.1 \times 8)\\ &= 2.24\end{aligned}$$

154. (c)

The given address space is of 32 bits. Also, it is given that "111" as the MSB in those 29 bits, refer to IO devices. That means out of 32 '3'-bits are fixed, so total IO address space can be 1×2^{29}.

Similarly, since "111" are reserved hence rest of 7 combinations represent memory location (000 to 110). So, the total memory address space will be 7×2^{29}.

155. (c)

Instruction	Size (in words)	Number of Clock Cycles
I_1: MOV r 0, (3000)	2	3 × 2 + 3 = 9
I_2: MOV r 1, [2000]	1	3 × 1 + 3 = 6
I_3: ADD r 0, r 1	1	3 × 1 + 1 = 4
I_4: MUL r 0, r 1	1	3 × 1 + 2 = 5
I_5: Mov (3000), r 0	2	3 × 2 + 3 = 9
I_6: Halt	1	3 × 1 + 0 = 3
		Total = 36

$$\begin{aligned}\text{Total time} &= 36 \text{ cycles} \times 0.5 \text{ ns}\\ &= 18 \text{ ns}\end{aligned}$$

156. (1.92)

$$\begin{aligned}T_{avg} &= (1 + \text{number of stalls/instruction}) \text{ cycle time}\\ T_{avg} &= 1 + (5\% \times 2) + (10\% \times 3) + (2\% \times 1) + (10\% \times 5)\\ &= 1 + 0.92\\ &= 1.92 \text{ cycles}\end{aligned}$$

157. (11)

	CC_1	CC_2	CC_3	CC_4	CC_5	CC_6	CC_7	CC_8	CC_9	CC_{10}	CC_{11}
I_1	F	D	E	E	E	W					
I_2		F	D	///	///	E	W				
I_3			F	///	///	D	E	W			
I_4				///	///	F	D	E	E	E	W

Minimum clock cycles = 11[CC = Clock cycle]

158. (4.8)

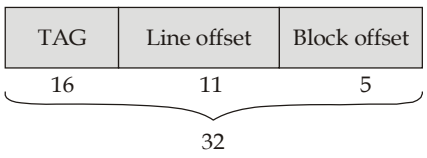
$$t_n = 5 \text{ ns}$$
$$t_p = 1 \text{ ns}$$
$$K = 5,\ n = 100$$
$$S = \frac{n.t_n}{(K+n-1)t_p}$$
$$S = \frac{100 \times 5\ ns}{(5+100-1)1\ ns}$$
$$S = \frac{500}{104}$$
$$S = 4.8$$

159. (b)

Memory mapped I/O uses the same address bus to address both memory and I/O devices the memory and registers of the I/O devices are mapped to address values.
So, when an address is accessed by the CPU, it can depict whether the address range belongs to some I/O device or a memory location.

160. (c)

$$\text{Size of cache} = 64 \text{ KB} = 2^{16} \text{ byte} = 16 \text{ bits}$$
$$\text{Number of cache line} = \frac{\text{Cache size}}{\text{Line size}} = \frac{2^{16}}{2^5} = 2^{11}$$



$$\text{Tag memory size} = \text{Number of cache lines} \times (\text{Number of tag bits in each line})$$
$$= 2^{11} \times 16$$
$$= 1K \times 32 \text{ bit}$$

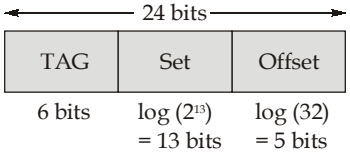
161. (a)

Increase in the associativity leads to increase in the number of tag comparisons. Hence it leads to increase in cache access time.

162. **(a)**

Number of lines in cache = 2^{15}

Number of sets = $\frac{2^{15}}{2^2} = 2^{13}$



Tag size = 24 – (13 + 5) = 6 bits

So, $(E4201F)_{16}$ = 111001 000010 000000 011111

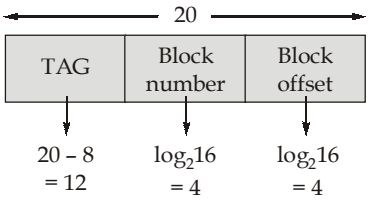
Set = 0100

TAG = 0011 1001 = 39

163. **(b)**

Main memory address size = 5 × 4 = 20 bits

Direct mapped cache:



1st pass:

1. Ox800 0 0 = Compulsory misses
2. Ox800 0 8 = Hit
3. Ox800 1 0 = Compulsory misses
4. Ox800 1 8 = Hit
5. Ox300 1 0 = Compulsory misses

2nd pass:

1. Ox800 0 0 = Hit
2. Ox800 0 8 = Hit
3. Ox800 1 0 = Conflict misses
4. Ox800 1 8 = Hit
5. Ox300 1 0 = Conflict misses

So for 10 passes:

Compulsory misses = 3

Conflict misses = 2 × 9 = 18

164. **(6)**

We know that,

$$\text{Block number in main memory} = \frac{\text{Byte address}}{\text{Bytes per block}}$$

$$= \left\lfloor \frac{1216}{32} \right\rfloor = \lfloor 38 \rfloor = 38$$

Now, block number 38 will mapped to line number 38 mod 32 = 6

165. **(35)**

$$\begin{aligned} T_{avg} &= H_C T_C + (1 - H_C)(T_M + T_C) \\ &= 0.75\ (10) + (1 - 0.75)(100 + 10) \\ &= 7.5 + 0.25\ (110) \\ &= 7.5 + 27.5 = 35 \text{ nsec} \end{aligned}$$

166. **(b)**

By using Amdhal's law:

$$s = 4;\ f = 40\%$$

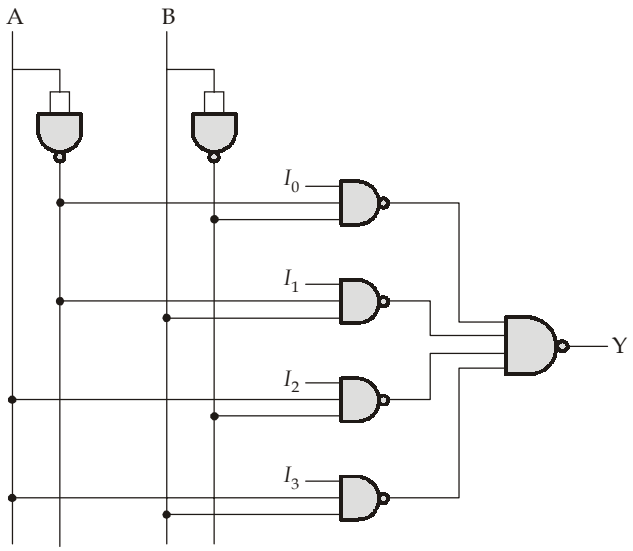
$$s_{overall} = \left[(1 - f) + \frac{f}{s} \right]^{-1}$$

Here f is most frequency used operation frequency and s is speed up factor.

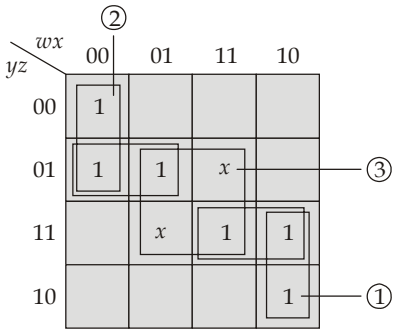
$$s_{overall} = \left[(1 - 0.4) + \frac{0.4}{4} \right]^{-1}$$

$$= [0.6 + 0.1]^{-1} = 1.42$$

167. **(7)**



168. (3)



Here 3 essential prime implicants are presents, while 5 prime implicants are presents.

169. (4)

Let the base be 'x'. Thus the decimal equivalent can be written as,

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

$$3x^2 + 2 = 2x^2 + 4x + 2$$

$$x^2 - 4x = 0$$

$$x(x-4) = 0$$

$\therefore \quad x = 0$ and $x = 4$

Since, we require non-zero number, thus $x = 4$.

170. (9)

Let,

A =		a_2	a_1	a_0
B =			b_1	b_0
A × B =		a_2b_0	a_1b_0	a_0b_0
	b_1a_2	b_1a_1	b_1a_0	↓
	b_1a_2	$(a_2b_0 + a_1b_1)$	$(a_1b_0 + b_1a_0)$	a_0b_0
	C_3	C_2	C_1	C_0

Number of AND gates required X = 6

Number of one bit full adders required Y = 3

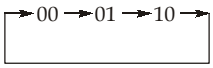
$$X + Y = 6 + 3 = 9$$

171. (b)

The truth table for the circuit is obtained below:

Present state		FF input		Next state	
Q_A	Q_B	T_A $(Q_A + Q_B)$	T_B $(\bar{Q}_A + Q_B)$	Q_A^+	Q_B^+
0	0	0	1	0	1
0	1	1	1	1	0
1	0	1	0	0	0
0	0	0	1	0	1

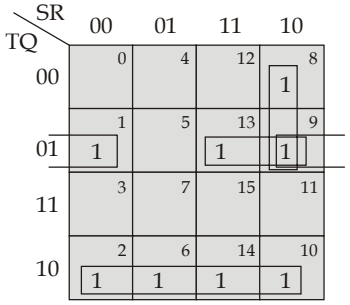
So, the counter counts the sequence of 3 states as



Hence, the circuit is of a MOD-3 counter.

172. (d)

S	R	T	Q	Q^+
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0



$$Q^+ = TQ' + T'QS + T'QR' + T'SR'$$
$$= TQ' + T'[Q(S + R') + SR']$$

173. (–45)

Format of IEEE double Precision:

Sign	Exponant	Mantissa
1 bit	11 bits	52 bits

Representation of 201 = $(1.1001001)_2 \times 2^7$

Next largest number = $(1.1001001)_2 \times 2^{-52}$

So, Difference = $2^{-52} \times 2^7$

$= 2^{(-52 + 7)}$

$= 2^{-45}$

Comparing with 2^P will gives P = –45.

174. **(d)**

Output of ExOR Gate = $b_i \oplus b_{i+1}$

Initially $Q = 0$ assume

So, After 1 clock, $Z = b_7 \oplus b_0$

After 2 clock, $Z = b_7 \oplus b_6$

After 3 clock, $Z = b_6 \oplus b_5$

After 4 clock, $Z = b_5 \oplus b_4$

After 5 clock, $Z = b_4 \oplus b_3$

After 6 clock, $Z = b_3 \oplus b_2$

After 7 clock, $Z = b_2 \oplus b_1$

After 8 clock, $Z = b_1 \oplus b_0$

Which is same as Binary to gray code converter.

175. **(100)**

At first cycle, the inputs of flip-flop are

$J_2K_2 = 1\ 0$ (Set)

$J_1K_1 = 0\ 1$ (Reset)

$J_0K_0 = 0\ 1$ (Reset)

$\therefore$ $Q_2 = 1$

$Q_1 = 0$

$Q_0 = 0$

$\therefore$ Output $(Q_2Q_1Q_0) = (100)_2$

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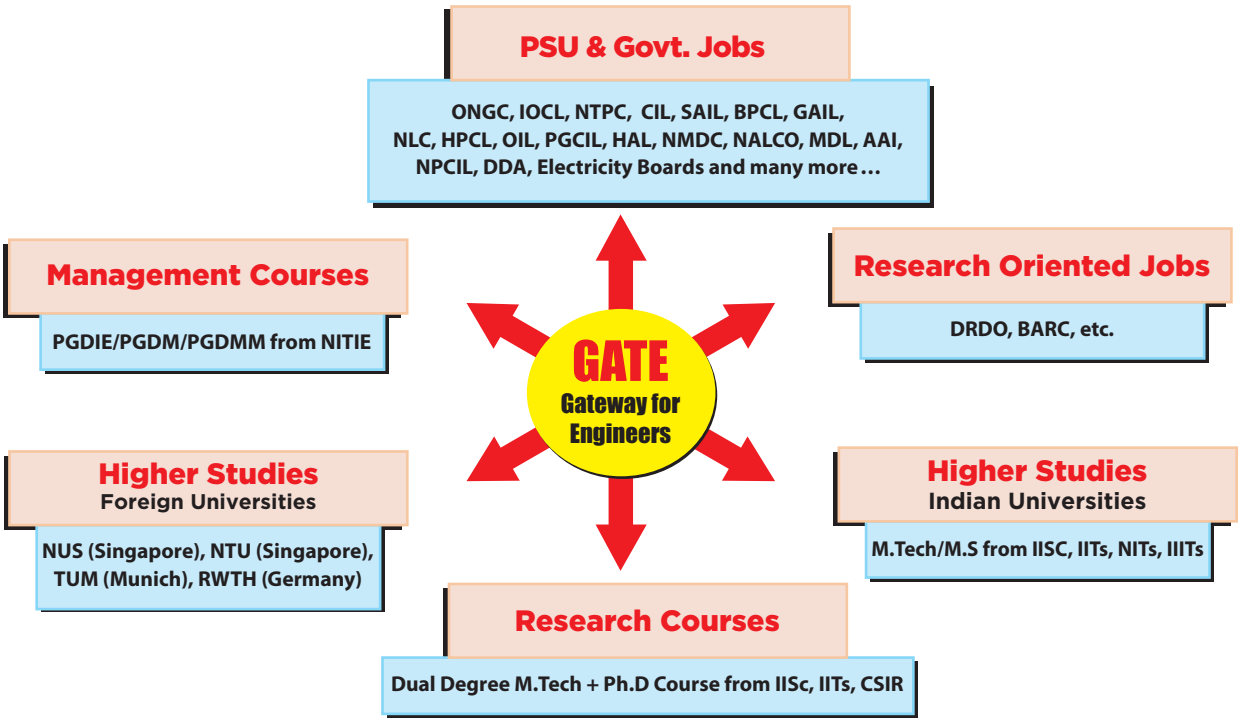
Revision through Questions for GATE 2020

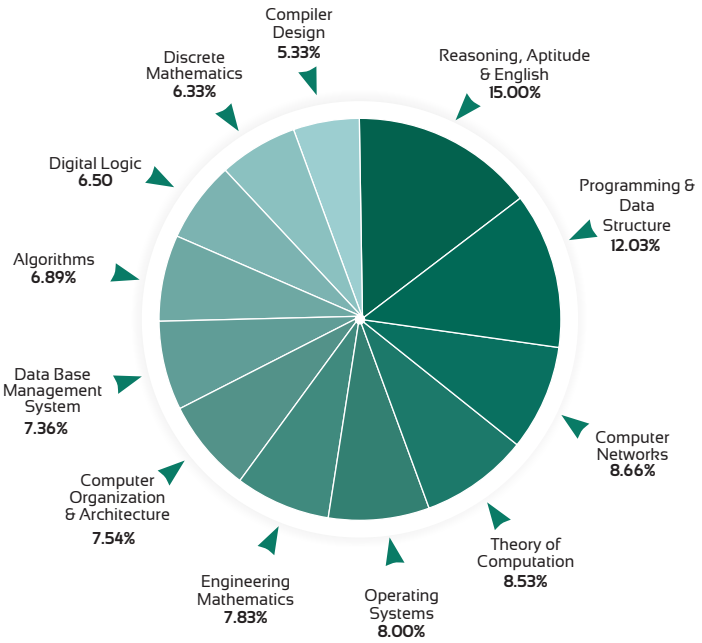
CS Computer Science

Q.176 - Q.200 out of 200 Questions

Day 8 of 8



SUBJECTWISE WEIGHTAGE ANALYSIS OF GATE SYLLABUS



Subject	Average % (last 5 yrs)
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Engineering Mathematics	7.83%
Computer Organization & Architecture	7.54%
Data Base Management System	7.36%
Algorithms	6.89%
Digital Logic	6.50%
Discrete Mathematics	6.33%
Compiler Design	5.33%
Total	**100%**

Day 8 : Q.176 to Q. 200 : Compiler Design + Data Structure

Q.176 In a compiler the module that checks the token arrangement against the source code grammar is called _____.

(a) Lexical analyzer
(b) Syntax analyzer
(c) Semantic analyzer
(d) Code optimizer

Q.177 Consider the following grammar:

$S \rightarrow S \times E \mid E$
$E \rightarrow F + E \mid F$
$F \rightarrow id$

Which of the following is true?

(a) '×' is right associative but '+' is left associative
(b) '+' is right associative but '×' is left associative
(c) Both '+' and '×' are right associative
(d) Both '+' and '×' re left associative

Q.178 Which of the following is false?

(a) Live variable analysis used in control flow graph for register allocation.
(b) Basic block does not contain jump into the middle of the block.
(c) Three address code is linear representation of syntax tree.
(d) With triples representation optimization can change the execution order.

Q.179 Consider the following grammar:

$S \rightarrow ZZ$
$Z \rightarrow xZ \mid y$

Which of the following is represent "handle" in the generation of string "$xxxyxy$"?

(a) ZxZ
(b) Zxy
(c) $xZxy$
(d) xZ

Q.180 The number of tokens in the following C-code _____.

```
int main()
{
    int m = 10;
    int n, n1;
    n = ++m;
    n1 = m++;
    n --;
    -- n1;
    n - = n1;
    printf("%d", n);
    return 0;
}
```

Q.181 Consider the following grammar:

C → PF class id XY
P → public | ∈
F → final | ∈
X → extends id | ∈
Y → implements I | ∈
I → id J
J → , I | ∈

Which of the following is true?

(a) FIRST (C) = {public, final}
FOLLOW (X) = {implements}

(b) FIRST (Y) = {implements, ∈}
FOLLOW (P) = {final}

(c) FIRST (C) = {public, final, class}
FOLLOW (X) = {implements, $}

(d) FIRST (Y) = {implements}
FOLLOW (P) = {final, class}

Q.182 Consider the following grammar to generate binary fractions:

$F \rightarrow 0.B \quad \{F.\text{val} = B.\text{val}\}$
$B_0 \rightarrow 0B_1 \quad \{\mathbf{S_1}\}$
$B_0 \rightarrow 1B_1 \quad \{\mathbf{S_2}\}$
$B \rightarrow 0 \quad \{B.\text{val} = 0\}$
$B \rightarrow 1 \quad \{\mathbf{S_3}\}$

If the above grammar with semantic rules calculate $\sum_{i=1}^{n} bi2^{-i}$ and each non-terminal has synthesized attribute 'val' to store its value. Then the missing semantic rules will be _____.

(a) $S_1 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val}/2\}$
$S_2 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val}/2^{\,B_1 \cdot \text{val}}\}$
$S_3 : \{B \cdot \text{val} = 1\}$

(b) $S_1 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val}/2\}$
$S_2 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val} + 1/2\}$
$S_3 : \{B \cdot \text{val} = 1/2\}$

(c) $S_1 : \{B_0 \cdot \text{val} = B \cdot \text{val}\}$
$S_2 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val}/2 + 1/2\}$
$S_3 : \{B \cdot \text{val} = 1/2\}$

(d) $S_1 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val}/2\}$
$S_2 : \{B_0 \cdot \text{val} = B_1 \cdot \text{val}/2 + 1/2\}$
$S_3 : \{B \cdot \text{val} = 1/2\}$

Q.183 Consider the regular expression-token mapping given below:

Regex	Token
ca*b	1
(a|b)*b	2
c*	3

Choose the correct output when lexical analyzer scans the following input: "aaabccabbb"

(a) 232
(b) 132
(c) 231
(d) 123

Q.184 Choose the correct sequence of occurrence during compilation process

(a) Character stream → parse tree → optimized code

(b) Parse tree → token stream → intermediate code

(c) SDT tree → parse tree → optimized code

(d) Parse tree → 3 address code → character stream

Q.185 Consider the following statements:

S_1 : Analysis phase of compiler includes code optimization stage.

S_2 : Synthesis phase of compiler is followed by analysis phase.

(a) S_1 is correct, S_2 is not

(b) S_2 is correct, S_1 is not

(c) S_1 and S_2 are correct

(d) S_1 and S_2 are incorrect

Q.186 Given the 3-address code for a basic block:

Num	Instruction	Meaning
1	Ld a, T_1	$T_1 \leftarrow a$
2	Ld b, T_2	$T_2 \leftarrow b$
3	Ld c, T_3	$T_3 \leftarrow c$
4	Ld d, T_4	$T_4 \leftarrow d$
5	Add T_1, T_2, T_5	$T_5 \leftarrow T_1 + T_2$
6	Add T_5, T_3, T_6	$T_6 \leftarrow T_3 + T_5$
7	Add T_6, T_4, T_7	$T_7 \leftarrow T_6 + T_4$
8	ST T_7, a	$a \leftarrow T_7$

The number of registers that are needed to allocate this basic block with no spills are _____.

Q.187 Consider the following statements:

S_1 : During a program execution, stack is used for dynamic memory allocation and heap is used for static memory allocation.

S_2 : During a program execution, heap is stored in main memory and stack is present in secondary memory.

S_3 : During a program execution, access to heap memory variables is slower as compared to accessing variables allocated on stack.

S_4 : During a program execution, in a multithreaded situation, each thread has its own stack and share a common heap memory.

Which of the following are true?

(a) S_1 and S_3 only

(b) S_1 and S_4 only

(c) S_3 and S_4 only

(d) S_2 and S_3 only

Q.188 What would be the output of following program for static and dynamic scoping respectively?

```
int x;
int main( ) {x = 23; f( ); g( );}
void f( ) {int x = 22; int y = 99; h( );}
void g( ) {int x = 45; int z = 23; h( );}
void h( ) {printf("%d\n", x);}
```

(a) 23, 23; 23, 23 (b) 22, 45; 22, 45
(c) 23, 23; 22, 45 (d) 23, 23; 99, 45

Q.189 Which of the following data structure is efficient to implement priority queue with basic operation such as insertion, deletion and searching?

(a) Linked list (b) Heap
(c) Sorted array (d) Unsorted array

Q.190 The minimum size of stack required to evaluate given postfix expression is _____.

$$25 \times 6 + 42 \times -$$

Q.191 Consider a stack implementation supports, in addition to PUSH and POP, an operation REVERSE, which reverses the order of the elements on the stack. Which of the following represents the minimum stack operations required to implement ENQUEUE and DEQUEUE operations of queue data structure respectively?

(a) 1 and 3 (b) 3 and 1
(c) 2 and 2 (d) Either (a) or (b)

Q.192 An implementation of a queue Q, using two stacks S_1 and S_2, is given below:

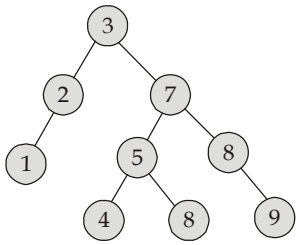
```
void enqueue(Q, x) {
    push(S1, x);
}
void dequeue(Q, x) {
    if (stack-empty(S2)) then
        if (stack-empty(S1)) then {
            print("Q is empty");
            return;
        }
    else while (! stack-empty(S1)) {
        x = pop(S1);
        push(S2, x);
    }
    x = pop(S2);
}
```

The number Push and Pop operation needed is represented by X and Y, then the value of X + Y for following operation are _____.

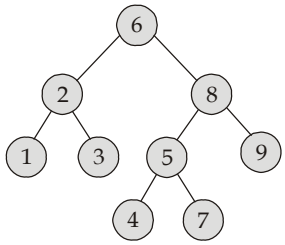
Enqueue (4), Enqueue (3), Enqueue (2), Dequeue,
Enqueue (6), Dequeue, Dequeue, Dequeue, Enqueue (5)

Q.193 Which of the following represents the final AVL tree if 8, 1, 9, 3, 2, 6, 5, 4, 7 elements are inserted into an empty tree?

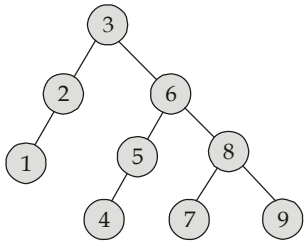
(a)



(b)



(c)

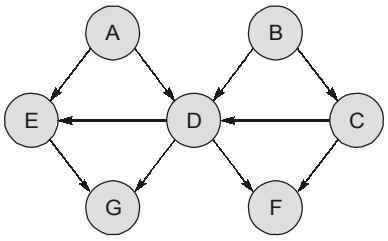


(d) None of these

Q.194 Consider a binary tree where for every node $|P - Q| \leq 2$. P represents number of nodes in left sub tree for node S and Q represents the number of nodes in right sub tree for node S for $h > 0$. The minimum number of nodes present in such binary tree of height $h = 4$ _____. (Assume root is at height 0)

Q.195 The maximum number of edges possible in an undirected graph with 5 nodes, when Depth First Search (DFS) call made on any random node in the graph results in stack size '5' i.e. 5 function calls present in stack simultaneously are _____.

Q.196 Consider the following graph:



The number of topological orders for the given graph are _____.

Q.197 Consider the following statements:

S_1 : Rotation operation in AVL always preserves the inorder numbering.

S_2 : The median of all element in the AVL trees is always at root or one of its two children.

S_3 : If every node in binary search tree has either 0 or 2 child, then searching time is O(log$n$).

S_4 : A 3-array tree is a tree in which every internal node has exactly 3 children. The number of leaf nodes in such a tree with 20 internal will be 41.

Which of above statements are true?

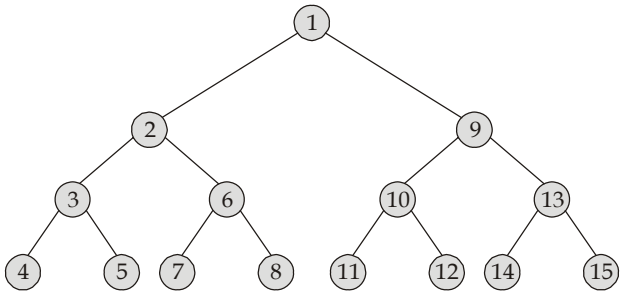
(a) S_1, S_2 only
(b) S_2, S_3 only
(c) S_3, S_4 only
(d) S_1, S_4 only

Q.198 A d-ary heap is like a binary heap, but instead of two children, nodes have 'd' children. A d-ary heap can be represented in a 1-dimensional array as follows. The root is kept in A[1], its d children are kept in order in A[2] through A[d + 1] their children are kept in order in A[d + 2] through A[$d^2 + d + 1$] and so on. What index does maps the j^{th} child for ($1 \le j \le d$) of i^{th} index node?

(a) $d(i - 1) + 1$
(b) $d(i - 1) + j + 1$
(c) $d(i - 1) + j$
(d) $(d \times i) + j + 1$

Q.199 A 3-array tree is a tree in which every internal node has exactly 3 children. The number of leaf nodes in such a tree with 20 internal nodes will be _____.

Q.200 Consider a binary min heap given below containing integer in [1, 15]. The maximum number of node movement on 5 successive removal of element are _____.



❍❍❍❍

Detailed Explanations

176. (b)

- **Lexical analyzer** scan the source code as a stream of characters and counts it into meaning full lexemes.
- **Syntax analyzer** checks the token arrangement against the source code grammar.
- **Semantic analyzer** check whether the parse tree constructed follows the rules of language.
- **Code optimizer** do code optimization of the intermediate code.

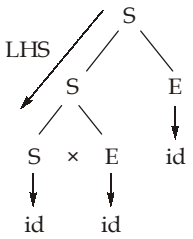
177. (b)

$S \rightarrow S \times E \mid E$

$E \rightarrow F + E \mid F$

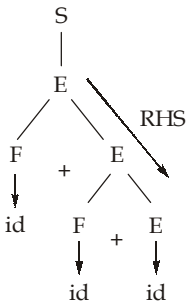
$F \rightarrow id$

1. For expression "id × id × id".



So, '×' is left associative.

2. For expression "id + id + id".



So, '+' is left associative.

178. (d)

- With triple, optimization cannot change the execution order but with indirect triple we can.
- Live variable analysis needed in register allocation and deallocation.
- Basic block does not contain jump into middle of the block i.e. sequence of instruction where control enter the sequence at begin and exist at end.
- Three address code is linear representation of syntax tree.

179. (d)

String given: "$xxxyxy$"

$$S \rightarrow ZZ \rightarrow \overbrace{Zx}^{\text{Handle } \{Z \rightarrow xZ\}}Z \rightarrow Zxy \rightarrow xZxy \rightarrow xxZxy \rightarrow xxxZxy \rightarrow xxxyxy$$

- ZxZ is not handle i.e. cannot reduce to any variable.
- Zxy is not handle i.e. cannot reduce to any variable.
- $xZxy$ is not handle i.e. cannot reduce to any variable.
- xZ is handle since xZ reduce to Z in next step.

180. (46)

```
int main ( )
①  ②  ③④
{
⑤
    int m = 10 ;
    ⑥ ⑦⑧⑨⑩
    int n , n1 ;
    ⑪⑫⑬⑭⑮
    n = ++m ;
    ⑯⑰⑱⑲⑳
    n1 = m ++ ;
    ㉑㉒㉓㉔㉕
    n -- ;
    ㉖㉗㉘
    -- n1 ;
    ㉙㉚㉛
    n -= n1 ;
    ㉜㉝㉞㉟
    printf ( "%d" , n ) ;
      ㊱  ㊲  ㊳ ㊴㊵㊶㊷
    return 0 ;
      ㊸  ㊹㊺
}
㊻
```

Number of tokens are 46.

181. (c)

$$\begin{aligned}
\text{FIRST (C)} &= \text{FIRST (PF class id XY)} \\
&= \{\text{public}\} \cup \text{FIRST (F class id XY)} \\
&= \{\text{public}\} \cup \{\text{final}\} \cup \text{FIRST (class id XY)} \\
&= \{\text{public}\} \cup \{\text{final}\} \cup \{\text{class}\} \\
&= \{\text{public, final, class}\} \\
\text{FIRST (X)} &= \text{FIRST (Y)} \\
&= \{\text{implements}\} \cup \text{FOLLOW (C)} \\
&= \{\text{implements}\} \cup \{\$\} \\
&= \{\text{implements}, \$\} \\
\text{FIRST (Y)} &= \text{FIRST (implements I)} \cup \text{FIRST } (\in) \\
&= \{\text{implements}, \in\} \\
\text{FOLLOW (P)} &= \text{FIRST (F)} \\
&= \{\text{final}\} \cup \text{FIRST (class)} = \{\text{final, class}\}
\end{aligned}$$

182. **(d)**

Since for every 1 after fractional point represented by $1/2^i$. So, $\{B.\text{val} = 1/2\}$, then, for B_0=1B_1 lower bit from fractional side added to B.val i.e., $\{B_0.\text{val} = B_1.\text{val}/2+1/2\}$.

Finally $B_0 \rightarrow 0B_1$, old value divide by 2 i.e., $\{B_0.\text{val} = B_1.\text{val}/2\}$

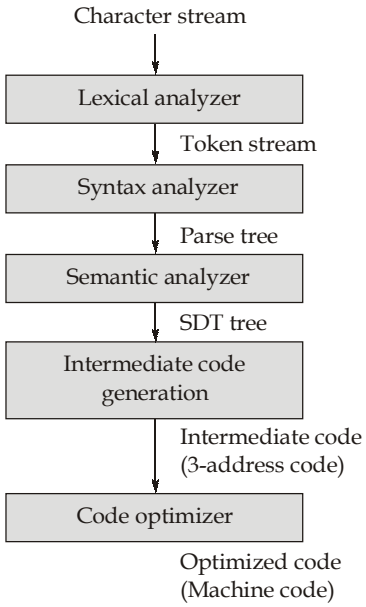
183. **(a)**

aaab $\rightarrow$ 2

cc $\rightarrow$ 3

abbb $\rightarrow$ 2

184. **(a)**



185. **(d)**

Analysis phase {lexical analysis, syntax analysis, semantic analysis} is followed by synthesis phase {intermediate code generation, code optimizer, machine code generation}.

186. **(4)**

$$R_1 \leftarrow a$$
$$R_2 \leftarrow b$$
$$R_3 \leftarrow c$$
$$R_4 \leftarrow d$$
$$R_2 \leftarrow R_1 + R_2$$
$$R_3 \leftarrow R_3 + R_2$$
$$R_4 \leftarrow R_3 + R_4$$
$$a \leftarrow R_4$$

So, 4 registers are needed.

187. **(c)**

S_1 : Stack and heap is used for dynamic memory allocation.

S_2 : Heap and stack both are present in main memory.

S_3 : Access to heap memory variables is slower as compared to accessing variables allocated on stack. Because to access a heap memory variable we need access pointer variable first.

S_4 : In a multithreaded situation, each thread has its own stack and share a common heap memory.

188. **(c)**

Static scoping means that x refers to the x declared innermost scope of declaration. Since 'h' is declared inside the global scope, the innermost x is the one in the global scope (it has no access to the x's in 'f' and 'g', since it was not declared inside them), so the program prints 23 twice. Dynamic scoping means that x refers to the x declared in the most recent frame of the call stack. 'h' will use the x from either 'f' or 'g', whichever one that called it so the program would print 22 and 45.

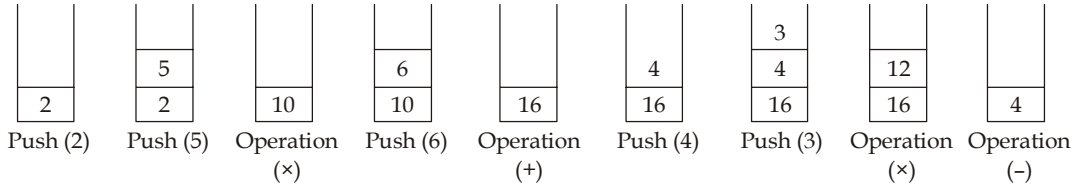
189. **(c)**

Priority queue:

1. **Via Linked list:** Insertion = O(n), Deletion = O(1), Search = O(n)
2. **Via Sorted array:** Insertion = O(n), Deletion = O(1), Search = O(log$n$)
3. **Via Unsorted array:** Insertion = O(1), Deletion = O(n), Search = O(n)
4. **Via Heap list:** Insertion = O(log$n$), Deletion = O(log$n$), Search = O(n)

190. **(3)**

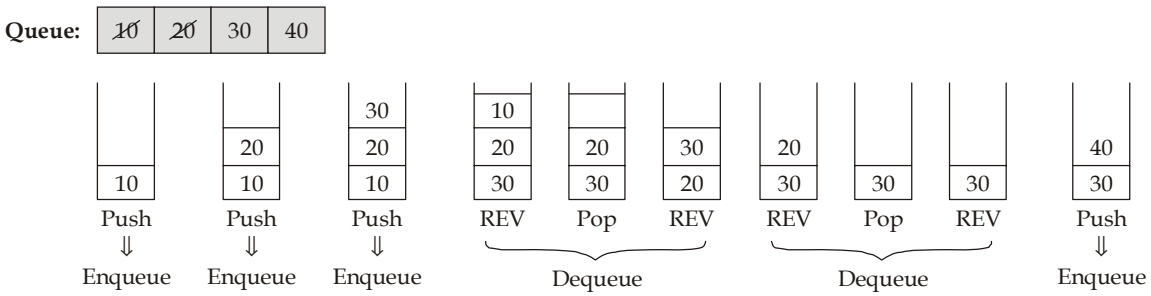
To evaluate an expression we need an operand stack as given in question.



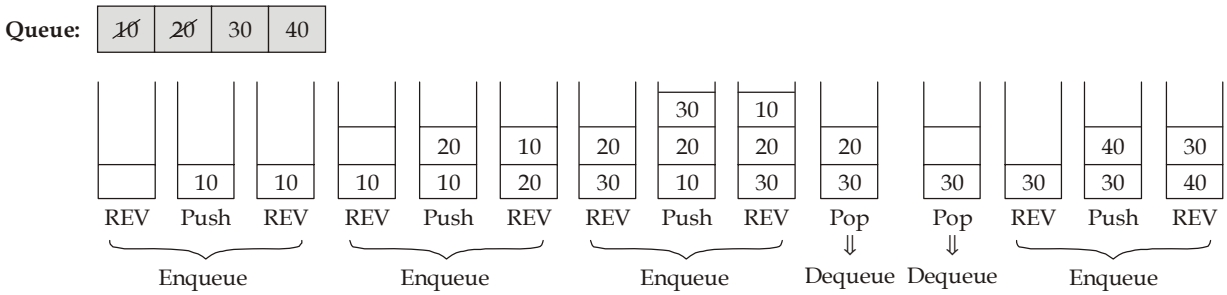
So, minimum stack size needed is 3.

191. **(d)**

Enqueue: PUSH ⇒ 1 operation
Dequeue: REVERSE, POP, REVERSE ⇒ 3 operation
Example: Enqueue (10), Enqueue (20), Enqueue (30)
Dequeue, Dequeue, Enqueue (40)

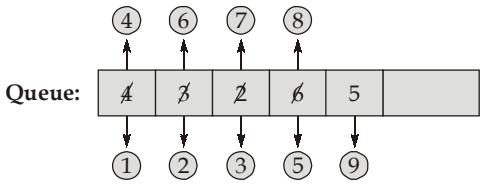


Enqueue: REV, PUSH, REV
Dequeue: POP
Example: Enqueue (10), Enqueue (20), Enqueue (30)
Dequeue, Dequeue, Enqueue (40)



So, either 1 Enqueue and 3 Dequeue or 3 Enqueue and 1 dequeue operation possible.

192. **(17)**

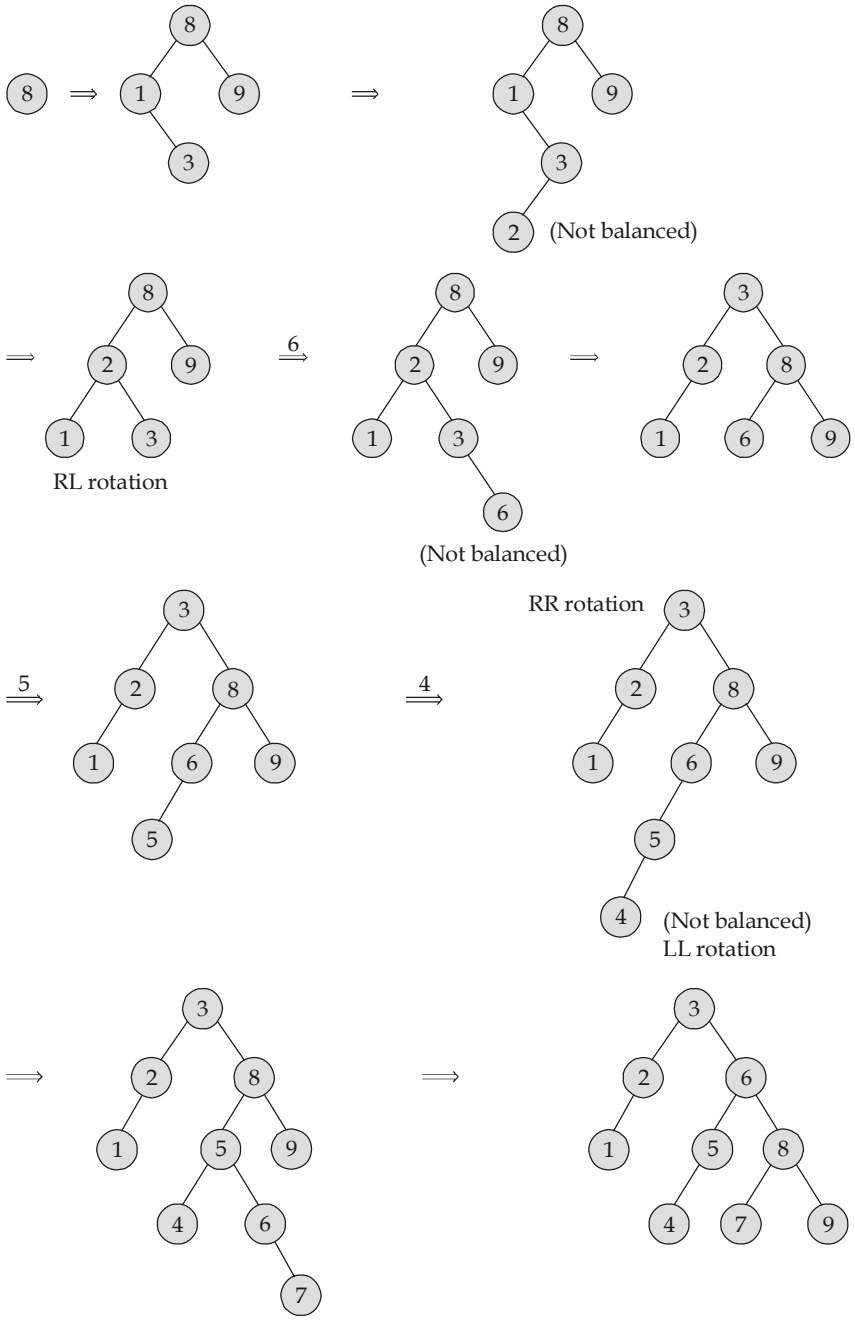


1. Enqueue (4) = Push (S_1, 4)
2. Enqueue (3) = Push (S_1, 3)
3. Enqueue (2) = Push (S_1, 2)
4. Dequeue = Push (S_2, Pop (S_1)), Push (S_2, Pop (S_1)), Push (S_2, Pop (S_1)), Pop (S_2)
5. Enqueue (6) = Push (S_1, 6)
6. Dequeue (3) = Pop (S_2)
7. Dequeue (2) = Pop (S_2)
8. Dequeue (6) = Push (S_2, Pop (S_1)), Pop (S_2)
9. Enqueue (5) = Push (S_1, 5)

So, X = Push = 9
Y = Pop = 8
So, X + Y = 17

193. (c)

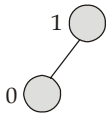
8, 1, 9, 3, 2, 6, 5, 4, 7



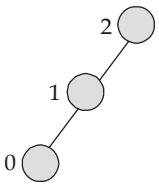
∴ Option (c) is correct.

194. (9)

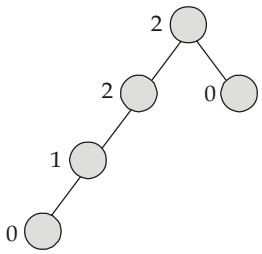
For height ($h = 1$) minimum number of node is 2 by using formula $2^{h-1} + 1$ i.e.



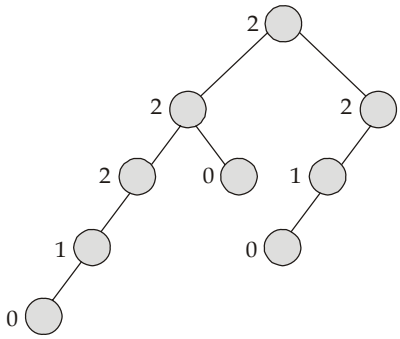
For height ($h = 2$) minimum number of node is 3 by using formula $2^{h-1} + 1$ i.e.



For height ($h = 3$) minimum number of node is 5 by using formula $2^{h-1} + 1$ i.e.

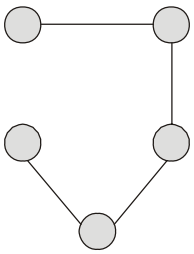


So for height ($h = 4$) minimum number of node will be 9 by using formula $2^{h-1} + 1$.



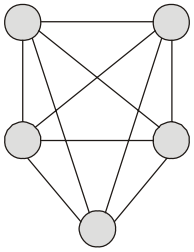
195. **(10)**

Since number of function calls simultaneously present in stack is '5'.



Since maximum edges asked, so, it must be complete graph i.e.

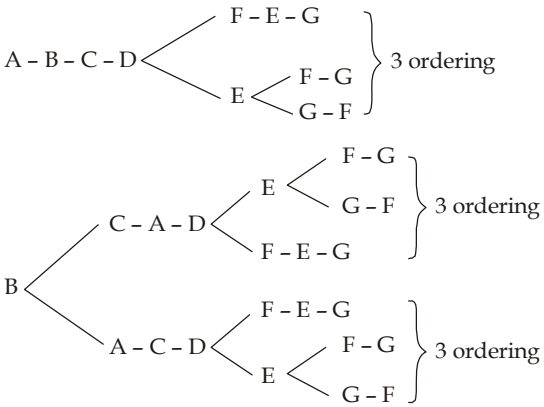
$$\frac{5\times(5-1)}{2} = \frac{20}{2} = 10$$



So, 10 edges are present in such graph.

196. **(9)**

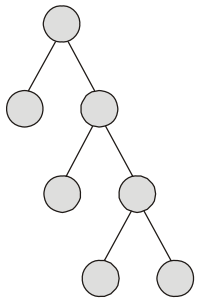
Applying topological sorts:



Total 9 ordering are possible.

197. **(d)**

- Rotation operation in always preserves the inorder numbering so 1st is true.
- AVL tree does not guarantee that both left and right subtree has equal number of nodes, so statement is false.
- Consider



satisfying the property of statement 3, in this tree if element present is at last level the time complexity will be $c \times n/2 \simeq O(n)$. So S_3 is false.

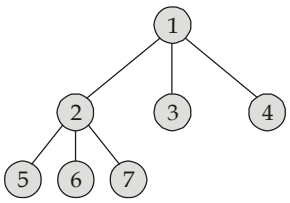
- Total nodes = 3 × internal nodes + 1
  = 3 × 20 + 1 = 61

  and $20 + 41 = 61$

  (Leaf + internal = total) so S_4 is true.

198. **(b)**

Consider 3 array heap:



Array = A	1	2	3	4	5	6	7	.....	
	1	2	3	4	5	6	7	.....	n

So, root at A[1] i.e. $d(i-1)+j+1$

$= 3(1-1)+j+1$

$= 0+0+1=1$

1st child of root $= d(i-1)+j+1$

$= 3(1-1)+1+1=2$

3rd child of root $= d(i-1)+j+1$

$= 3(1-1)+3+1$

$= 0+4=4$

Index for node 7 $= d(i-1)+j+1$

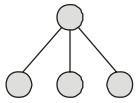
$= 3(2-1)+3+1$

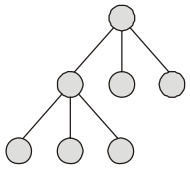
$= 3+3+1=7$

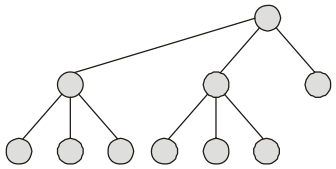
So, index maps to $d(i-1)+j+1$.

199. **(41)**

$n \rightarrow$ number of internal nodes:

Let $n = 1$  $\Rightarrow$ 3 $\Rightarrow$ 2 (1 – 1) + 3

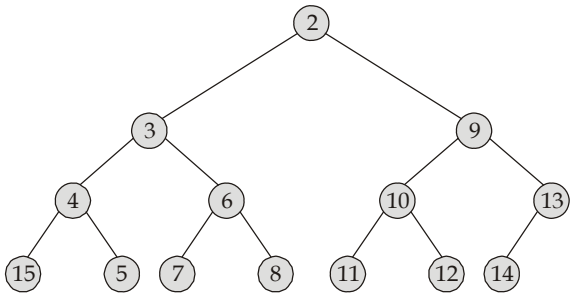
Let $n = 2$  $\Rightarrow$ 5 $\Rightarrow$ 2 (2 – 1) + 3

Let $n = 3$  $\Rightarrow$ 7 $\Rightarrow$ 2 (3 – 1) + 3

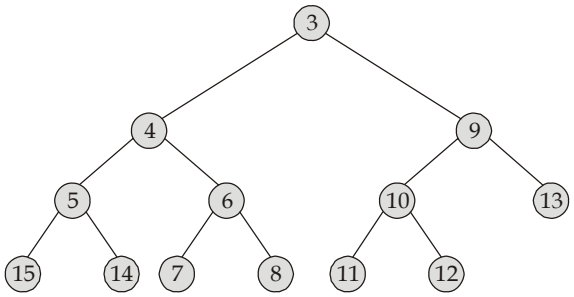
Number of internal nodes = 2 (n – 1) + 3 = 2 (20 – 1) + 3 = 41

For every internal node accept root node, 2 leaf nodes are added.

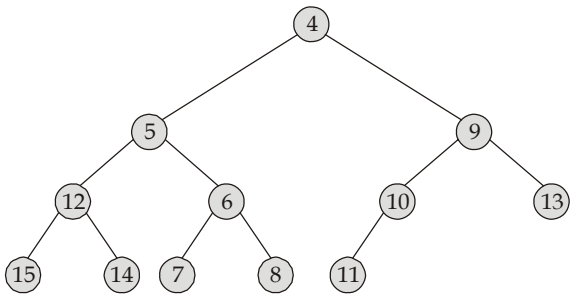
200. **(18)**



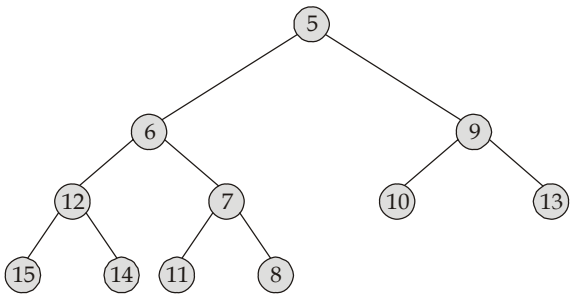
First deletion takes 4 node movement



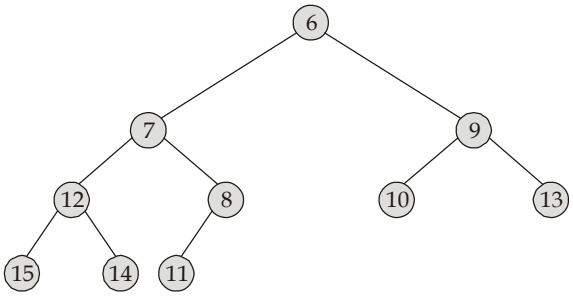
Second deletion takes 4 node movement



Third deletion takes 3 node movement



Fourth deletion takes 4 node movement



Fifth deletion takes 3 node movement

Total number of head movement = 4 + 4 + 3 + 4 + 3 = 18

❍❍❍❍