

GATE 2015 –CS on 8th February, 2015 – (Forenoon Session)**General Aptitude Questions****Q.No-1-5 Carry One Mark Each**

1. Extreme focus on syllabus and studying for tests has become such a dominant concern of Indian students that they close their minds to anything _____ to the requirements of the exam
(A) related (B) extraneous (C) outside (D) useful

Answer: (B)

Exp: extraneous -irrelevant or unrelated to the subject being dealt with.

2. A function $f(x)$ is linear and has a value of 29 at $x = -2$ and 39 at $x = 3$. Find its value at $x = 5$.
(A) 59 (B) 45 (C) 43 (D) 35

Answer: (C)

Exp: $f(x) = 2x + 33$

3. The Tamil version of _____ John Abraham-starrer Madras café _____ cleared by the Censor Board with no cuts last week but the film's distributors _____ no takers among the exhibitors for a release in Tamil Nadu _____ this Friday.
(A) Mr., was, found, on (B) a, was, found, at
(C) the, was, found, on (D) a, being, find at

Answer: (C)

Exp: John-Abraham starrer Madras Café talks about the movie not the person, so Mr. is ruled out. 'Find no takers' is not the correct phrase. At this Friday is incorrect. So, option C is correct.

4. If ROAD is written as URDG, then SWAN should be written as:
(A) VXDQ (B) VZDQ (C) VZDP (D) UXDQ

Answer: (B)

Exp: $R+3=U$, $O+3=R$, $A+3=D$, $D+3=G$;
 $S+3=V$, $W+3=Z$, $A+3=D$, $N+3=Q$

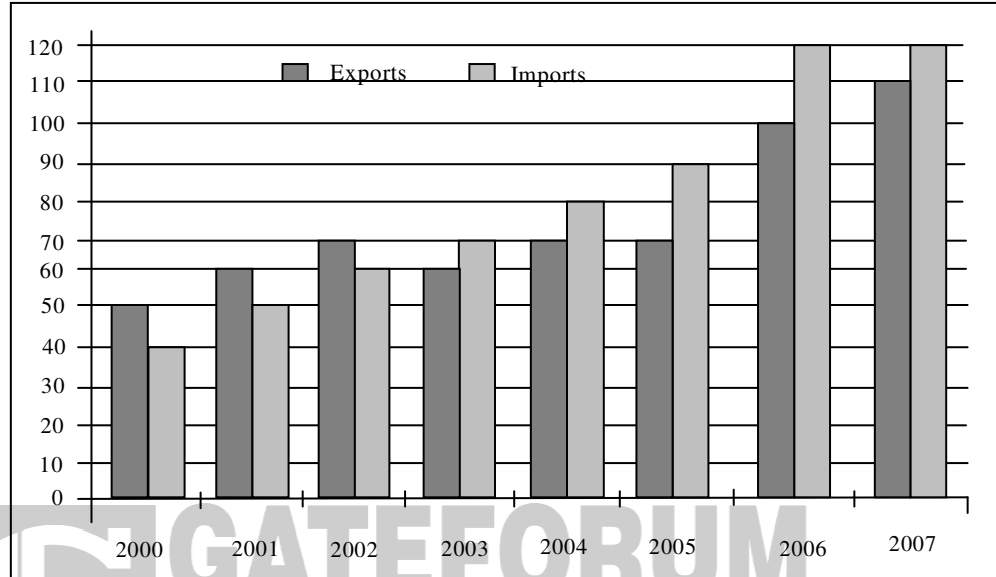
5. Select the pair that best expresses a relationship similar to that expressed in the pair:
Children: Pediatrician
(A) Adult: Orthopaedist (B) Females: Gynaecologist
(C) Kidney: Nephrologist (D) Skin: Dermatologist

Answer: (B)

Exp: Community of people: Doctor

Q.No-6-10 Carry Two Marks Each

6. The exports and imports (in crores of Rs.) of a country from the year 2000 to 2007 are given in the following bar chart. In which year is the combined percentage increase in imports and exports the highest?



Answer: 2006

Exp: Increase in exports in 2006 = $\frac{100 - 70}{70} = 42.8\%$

Increase in imports in 2006 = $\frac{120 - 90}{90} = 33.3\%$

which is more than any other year

7. The head of a newly formed government desires to appoint five of the six selected members P, Q, R, S, T and U to portfolios of Home, Power, Defense, Telecom, and Finance. U does not want any portfolio if S gets one of the five. R wants either Home or Finance or no portfolio. Q says that if S gets either Power or Telecom, then she must get the other one. T insists on a portfolio if P gets one.

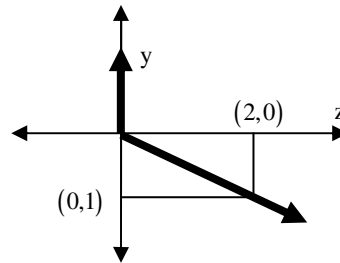
Which is the valid distribution of portfolios?

- (A) P-Home, Q-Power, R-Defense, S-Telecom, T-Finance
- (B) R-Home, S-Power, P-Defense, Q-Telecom, T-Finance
- (C) P-Home, Q-Power, T-Defense, S-Telecom, U-Finance
- (D) Q-Home, U-Power, T-Defense, R-Telecom, P-Finance

Answer: (B)

Exp: Since U does not want any portfolio, (C) and (D) are ruled out. R wants Home, or Finance or No portfolio, (A) is not valid. Hence option (B) is correct

8. Choose the most appropriate equation for the function drawn as a thick line, in the plot below.



- (A) $x = y - |y|$ (B) $x = -(y - |y|)$ (C) $x = y + |y|$ (D) $x = -(y + |y|)$

Answer: (B)

9. Most experts feel that in spite of possessing all the technical skills required to be a batsman of the highest order, he is unlikely to be so due to lack of requisite temperament. He was guilty of throwing away his wicket several times after working hard to lay a strong foundation. His critics pointed out that until he addressed this problem success at the highest level will continue to elude him.

Which of the statement (s) below is/are logically valid and can be inferred from the above passage?

- (i) He was already a successful batsman at the highest level
(ii) He has to improve his temperament in order to become a great batsman
(iii) He failed to make many of his good starts count
(iv) Improving his technical skills will guarantee success

- (A) (iii) and (iv) (B) (ii) and (iii) (C) (i), (ii) and (iii) (D) (ii) only

Answer: (B)

10. Alexander turned his attention towards India, since he had conquered Persia.

Which one of the statements below is logically valid and can be inferred from the above sentence?

- (A) Alexander would not have turned his attention towards India had he not conquered Persia.
(B) Alexander was not ready to rest on his laurels, and wanted to march to India
(C) Alexander was completely in control of his army and could command it to move towards India
(D) Since Alexander's kingdom extended to Indian borders after the conquest of Persia, he was keen to move further

Answer: (A)

Section Name: Computer Science and Information Technology**Q.No-1-25 Carry One Mark Each**

1. In a room there are only two types of people, namely Type 1 and Type 2. Type 1 people always tell the truth and Type 2 people always lie. You give a fair coin to a person in that room, without knowing which type he is from and tell him to toss it and hide the result from you till you ask for it. Upon asking, the person replies the following.
“The result of the toss is head if and only if I am telling the truth.”
Which of the following options are correct?
(A) The result is head
(B) The result is tail
(C) If the person is of Type 2, then the result is tail
(D) If the person is of Type 1, then the result is tail

Answer: (C)

2. Consider the relation $X(P, Q, R, S, T, U)$ with the following set of functional dependencies

$$F = \left\{ \begin{array}{l} \{P, R\} \rightarrow \{S, T\} \\ \{P, S, U\} \rightarrow \{Q, R\} \end{array} \right\}$$

Which of the following is the trivial functional dependency in F^+ , where F^+ is closure of F ?

- (A) $\{P, R\} \rightarrow \{S, T\}$ (B) $\{P, R\} \rightarrow \{R, T\}$ (C) $\{P, S\} \rightarrow \{S\}$ (D) $\{P, S, U\} \rightarrow \{Q\}$

Answer: (C)

Exp: $X \rightarrow Y$ is trivial if $Y \subseteq X$

3. Given a hash table T with 25 slots that stores 2000 elements, the load factor α for T is _____.

Answer: 80

Exp: Load factor (α) = $\frac{\text{no. of elements}}{\text{no. of slots}} = \frac{2000}{25} = 80$

4. Consider a software project with the following information domain characteristics for calculation of function point metric.
Number of external inputs (I) = 30
Number of external outputs (O) = 60
Number of external inquiries (E) = 23
Number of files (F) = 08
Number of external interfaces (N) = 02

It is given that the complexity weighting factors for I, O, E, F and N are 4,5,4,10 and 7, respectively. It is also given that, out of fourteen value adjustment factors that influence the development effort, four factors are not applicable, each of the other four factors have value 3, and each of the remaining factors have value 4. The computed value of function point metric is _____.

Answer: 612.06

5. Consider the following statements.

- I. TCP connections are full duplex
- II. TCP has no option for selective acknowledgment
- III. TCP connections are message streams

- (A) Only I is correct
- (B) Only I and III are correct
- (C) Only II and III are correct
- (D) All of I, II and III are correct

Answer: (A)

Exp: S1: TCP allows full – duplex communication. This is TRUE statement.

TCP is a full-duplex protocol; it allows both parties to send and receive data within the context of the single TCP connection..

S2: TCP has no option for selective acknowledgments. This is FALSE statement

TCP may experience poor performance when multiple packets are lost from one window of data. With the limited information available from cumulative acknowledgments, a TCP sender can only learn about a single lost packet per round trip time. An aggressive sender could choose to retransmit packets early, but such retransmitted segments may have already been successfully received. A Selective Acknowledgment (SACK) mechanism, combined with a selective repeat retransmission policy, can help to overcome these limitations. The receiving TCP sends back SACK packets to the sender informing the sender of data that has been received. The sender can then retransmit only the missing data segments.

S3: TCP work as a message stream. This is FALSE statement.

In TCP, Data is read as a byte stream, no distinguishing indications are transmitted to signal message (segment) boundaries.

6. Suppose U is the power set of the set $S = \{1,2,3,4,5,6\}$. For any $T \subseteq U$, let $|T|$ denote the number of element in T and T' denote the complement of T . For any $T, R \subseteq U$, let $T \setminus R$ be the set of all elements in T which are not in R . Which one of the following is true?

- (A) $\forall X \in U (|X| = |X'|)$
- (B) $\exists X \in U \exists Y \in U (|X| = 5, |Y| = 5 \text{ and } X \cap Y = \phi)$
- (C) $\forall X \in U \forall Y \in U (|X| = 2, |Y| = 3 \text{ and } X \setminus Y = \phi)$
- (D) $\forall X \in U \forall Y \in U (X \setminus Y = Y \setminus X')$

Answer: (D)

Exp: Counter example:

(A) Let $X = \{1\} \Rightarrow X' = S - X = \{2, 3, 4, 5, 6\} \Rightarrow |X| \neq |X'|$

(B) Since $|S| = 6$ and $|X| = 5 = |Y|$

\therefore Atleast 4 elements common in X and Y

$\Rightarrow X \cap Y = \phi$ is false

(C) Counter Example: Let $X = \{1, 2\}$ and $Y = \{2, 3, 4\}$ then $X/Y = \{1\} \neq \phi$

(D) $X \setminus Y = X - Y = X \cap Y'$ and $Y' \setminus X' = Y' - X' = Y' \cap (X')' = Y' \cap X = X \cap Y'$

$\therefore X \setminus Y = Y' \setminus X', \forall X, Y \in U$

7. Among simple LR (SLR), canonical LR, and look-ahead LR (LALR), which of the following pairs identify the method that is very easy to implement and the method that is the most powerful, in that order?

(A) SLR, LALR

(B) Canonical LR, LALR

(C) SLR, canonical LR

(D) LALR, canonical LR

Answer: (C)

Exp: In SLR method, we work with LR(0) items where as in CLR(1) we work with LR(1) items. LR(1) item is comprised of two parts-the LR(0) item and a look ahead associated with the item. If we work with LR(1) items instead of using LR(0) items, then every state of the parser corresponds to a set of LR(1) items. When the parser looks ahead in the input buffer to decide whether the reduction is to be done or not the information about the terminals is available in the state of the parser itself which is not in case of SLR parser state. Hence CLR(1) parser is more powerful than SLR.

8. Consider the following array of elements.

<89,19,50,17,12,15,2,5,7,11,6,9,100>

The minimum number of interchanges needed to convert it into a max-heap is

(A) 4

(B) 5

(C) 2

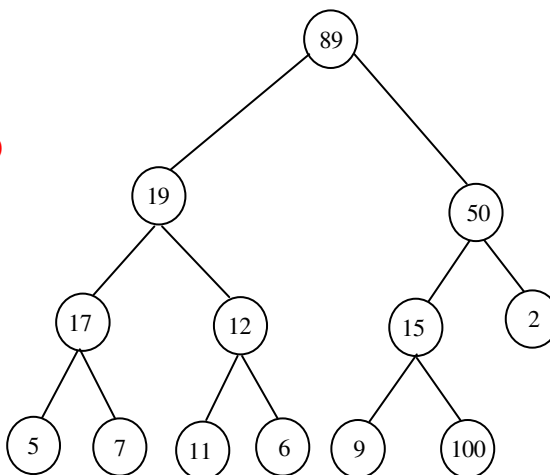
(D) 3

Answer: 3

Exp: 1st swap is : 100 and 15

2nd swap is : 100 and 50

3rd swap is : 100 and 89



9. The maximum number of processes that can be in Ready state for a computer system with n CPUs is
 (A) n (B) n^2 (C) 2^n (D) Independent of n

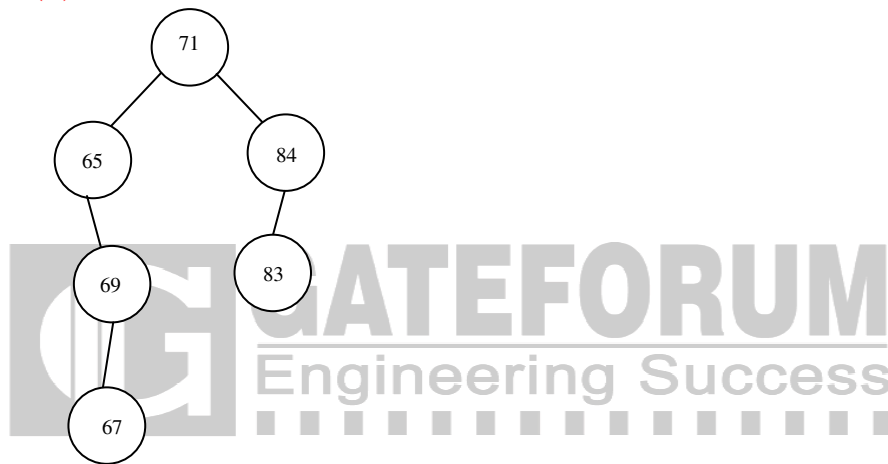
Answer: (D)

Exp: Number of processes which are in running processes will be atmost n as there are n processors. Maximum number of processes that will be in ready state is independent of number of processors.

10. While inserting the elements 71,65,84,69,67,83 in an empty binary search tree (BST) in the sequence shown, the element in the lowest level is
 (A) 65 (B) 67 (C) 69 (D) 83

Answer:: (B)

Exp:



11. Two processes X and Y need to access a critical section. Consider the following synchronization construct used by both the processes

Process X	Process Y
<pre> /*other code for process X*/ while(true) { var P = true; while(var Q == true) { /*criticalsection*/ varP= false; } } /*other code for process X*/ </pre>	<pre> /*other code for process Y*/ while(true) { varQ = true; while(var P == true) { /*Criticalsection*/ varQ=false; } } /*other code for process Y*/ </pre>

Here, varP and varQ are shared variables and both are initialized to false. Which one of the following statements is true?

- (A) The proposed solution prevents deadlock but fails to guarantee mutual exclusion
- (B) The proposed solution guarantees mutual exclusion but fails to prevent deadlock
- (C) The proposed solution guarantees mutual exclusion and prevents deadlock
- (D) The proposed solution fails to prevent deadlock and fails to guarantee mutual exclusion

Answer: (A)

Exp: Var P = Var Q = FALSE Initially.

Assume that, process X is willing to enter into critical section. So it makes $V_{ar}P = \text{True}$, then if processor switches to process Y, then process Y can enter into critical section.

After entering into the critical section, then if processor switches to process X, then process X also can enter into the critical section.

It is clearly showing that both are in critical section at a time which leads to “failing to guarantee material exclusion”

To enter into the critical section process X is not waiting for process Y and vice versa. So we can “Prevent Deadlock” so, overall, option 1 is correct (or) TRUE.

12. Let # be a binary operator defined as

$X \# Y = X' + Y'$ where X and Y are Boolean variables.

Consider the following two statements.

(S1) $(P \# Q) \# R = P \# (Q \# R)$

(S2) $Q \# R = R \# Q$

Which of the following is/are true for the Boolean variables P, Q and R?

- (A) Only S1 is true
- (B) Only S2 is true
- (C) Both S1 and S2 are true
- (D) Neither S1 nor S2 are true

Answer:: (B)

Exp: $X \# Y = X' + Y'$

S1. L.H.S.

R.H.S.

$= (P \# Q) \# R$

$P \# (Q \# R)$

$(P \# Q)' + R'$

$P' + (Q \# R)'$

$= (P' + Q')' + R'$

$P' + (Q' + R')'$

$= PQ + R'$

$P' + QR$

$PQ + R' \neq P' + QR$

Hence S₁ is false

S2. $Q \# R = Q' + R'$ _____ (I)

$R \# Q' = R' + Q' = Q' + R'$ _____ (II)

I and II both are equal hence S₂ is true

13. Consider the following relation

Cinema (theater, address, capacity)

Which of the following options will be needed at the end of the SQL query

SELECT P1. address

FROM Cinema P1

Such that it always finds the addresses of theaters with maximum capacity?

- (A) WHERE P1. Capacity >= All (select P2. Capacity from Cinema P2)
(B) WHERE P1. Capacity >= Any (select P2. Capacity from Cinema P2)
(C) WHERE P1. Capacity >= All (select max(P2. Capacity) from Cinema P2)
(D) WHERE P1. Capacity >= Any (select max (P2. Capacity) from Cinema P2)

Answer:: (A)

Exp: Inner query collects capacities of all the theatres and in outer query we are filtering the tuples with the condition "capacity >= All". So the theatres which are having maximum capacity will be satisfy the conductivity and they will.

14. The value of $\lim_{x \rightarrow \infty} (1 + x^2)e^{-x}$ is

- (A) 0 (B) $\frac{1}{2}$ (C) -1 (D) ∞

Answer: (A)

Exp: $\lim_{x \rightarrow \infty} (1 + x^2)e^{-x} = \lim_{x \rightarrow \infty} \frac{1 + x^2}{e^x}$ is $\frac{\infty}{\infty}$ form

$$= \lim_{x \rightarrow \infty} \frac{2x}{e^x} \text{ (using L-Hospitals rule)}$$

$$\therefore \lim_{x \rightarrow \infty} (1 + x^2)e^{-x} = \lim_{x \rightarrow \infty} \frac{2}{e^x} = 0 \quad \text{and} \quad \lim_{x \rightarrow \infty} (1 + x^2)e^x = \infty$$

15. Consider the following C program segment.

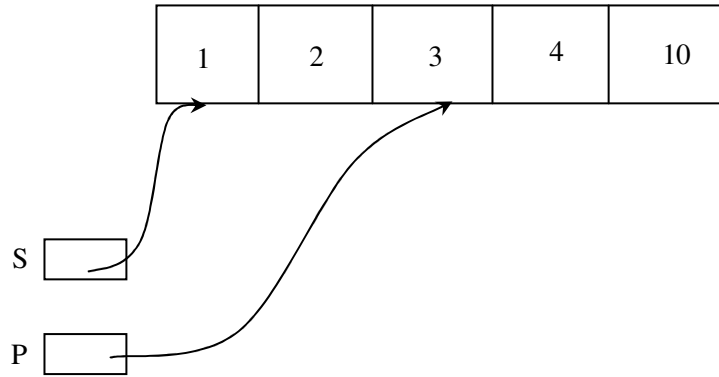
```
#include<stdio.h>
int main( )
{
    char s1[7] = "1234", *p;
    p = s1 + 2;
    *p = '0';
    printf ("%s", s1)
}
```

What will be printed by the program?

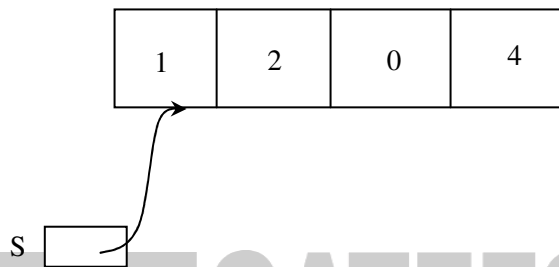
- (A) 12 (B) 120400 (C) 1204 (D) 1034

Answer: (C)

Exp:



After *P = '0' , array will become



and we are pointing string S which is 1204.

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

Answer: 15

Exp: 4-digit numbers with first digit '1'

1111, 1112, 1113, 1122, 1123, 1133, 1222, 1223, 1233, 1333 i.e., 10

4 digit numbers with first digit 2 : 2222, 2223, 2233, 2333 i.e., 4

4 digit numbers with first digit 3: 3333 i.e., 1

17. In the matrix $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$, one of the eigen values is 1. The eigenvectors corresponding to the eigen value 1 are

(A) $\{\alpha(4, 2, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

(B) $\{\alpha(4, 2, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

(C) $\{\alpha(\sqrt{2}, 0, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

(D) $\{\alpha(-\sqrt{2}, 0, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

Answer: (B)

Exp: X be an eigen vector corresponding to eigen value $\lambda = 1$, then

$$AX = \lambda X \Rightarrow (A - I)X = 0$$

$$\begin{bmatrix} 0 & -1 & 2 \\ 0 & 0 & 0 \\ 1 & 2 & 0 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = 0$$

$$\Rightarrow -y + 2z = 0 \text{ and } x + 2y = 0$$

$$\Rightarrow y = 2z \text{ and } \frac{x}{-2} = y$$

$$\therefore \frac{x}{-2} = y = 2z \Rightarrow \frac{x}{-4} = \frac{y}{2} = \frac{z}{1} = \alpha \text{ (say)} \Rightarrow X = \begin{pmatrix} -4 \\ 2 \\ 1 \end{pmatrix} \alpha; \alpha \neq 0$$

$$\therefore \text{Eigen vectors are } \{ \alpha(-4, 2, 1) | \alpha \neq 0, \alpha \in \mathbb{R} \}$$

18. Consider a machine with byte addressable main memory of 20^{20} bytes, block size of 16 bytes and a direct mapped cache having 2^{12} cache lines. Let the address of two consecutive bytes in main memory be $(E201F)_{16}$ and $(E2020)_{16}$. What are the tag and cache line address (in hex) for main memory address $(E201F)_{16}$?

- (A) E, 201 (B) F, 201 (C) E, E20 (D) 2, 01F

Answer: (A)

Exp:

4	12	4
TAG	cache block offset	word offset

\Rightarrow

E	201	F
TAG	cache block offset	word offset

19. Consider the equality $\sum_{i=0}^n i^3 = X$ and the following choices for X

- I. $\theta(n^4)$
II. $\theta(n^5)$
III. $O(n^5)$
IV. $\Omega(n^3)$

The equality above remains correct if X is replaced by

- (A) only I
(B) Only II
(C) I or III or IV but not II
(D) II or III or IV but not I

Answer: (C)

Exp: $X = \text{sum of the cubes of first } n \text{ natural numbers} = \frac{n^2(n+1)^2}{4}$ which is $\theta(n^4)$, $O(n^5)$ & $\Omega(n^3)$.

20. The result evaluating the postfix expression $10\ 5 + 60\ 6 / * 8 -$ is

(A) 284

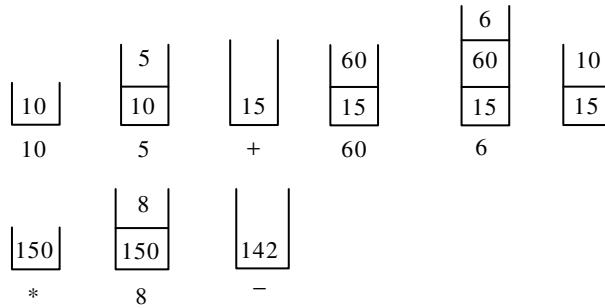
(B) 213

(C) 142

(D) 71

Answer: (C)

Exp:



21. Consider a CSMA/CD network that transmits data at a rate of 100 Mbps (10^8 bits second) over a 1 km(kilometer) cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

(A) 8000

(B) 10000

(C) 16000

(D) 20000

Answer: (D)

Exp: Given $L=1250$ Bytes

$B = 100$ mbps

$d = 1$ km

$V = ?$

In CSMA/CD, $L = 2 \times \frac{d}{v} \times B$

$$\Rightarrow V = \frac{2dB}{L} = \frac{2 \times 10^3 \times 10^8}{10^4} \Rightarrow V = 20,000 \text{ km/sec}$$

22. Consider a software program that is artificially seeded with 100 faults. While testing this program, 159 faults are detected, out of which 75 faults are from those artificially seeded faults. Assuming that both are and seeded faults are of same nature and have same distribution, the estimated number of undetected real fault is _____.

Answer: 175

23. Consider a binary tree T that has 200 leaf nodes. Then, the number of nodes in T that have exactly two children are _____.

Answer: 199

Exp: Let the number of leaf nodes of a binary tree with 'n' vertices be 'p' then the tree has

(i) 'p' vertices of degree '1'

(ii) one vertex (i.e. root of T) of degree '2'.

(iii) 'n - p - 1' vertices of degree '3'

(iv) 'n - 1' edges

\therefore By Handshaking theorem,

$$p \times 1 + 1 \times 2 + (n - p - 1) \times 3 = 2(n - 1)$$

$$\Rightarrow n = 2p - 1$$

$$= 399 \text{ as } p = 200$$

\therefore Number of nodes having exactly two children are $n - p$ i.e., 199

24. In a web server, ten Webpages are stores with the URLs of the form <http://www.yourname.com/var.html>; where, var is different number from 1 to 10 for each Webpage. Suppose, the client stores the Webpage with var = 1(say W1) in local machine ,edits and then tests. Rest of the Webpages remains on the web server. W1 contains several relative URLs of the form "var.html" referring to the other webpages. Which one of the following statements needs to be added in W1, so that all the relative URLs in W1 refers to the appropriate Webpages on the web server?

- (A) `<ahref : "http : // www.yourname.com / ", href : "... var .html" >`
 (B) `< base href : "http : // www.yourname.com / " >`
 (C) `< a href : "http : // www.yourname.com / " >`
 (D) `< base href : "http : // www.yourname.com / ", range : "... var .html" >`

Answer: (D)

25. Let L be the language represented by the regular expression $\Sigma^*0011\Sigma^*$ where $\Sigma = \{0,1\}$. What is the minimum number of states in a DFA that recognizes \bar{L} (complement of L)?

- (A) 4 (B) 5 (C) 6 (D) 8

Q.No-26-55 Carry Two Marks Each

26. In for non-zero x, $af(x) + bf\left(\frac{1}{x}\right) = \frac{1}{x} - 25$ where $a \neq b$ then $\int_1^2 f(x)dx$ is

- (A) $\frac{1}{a^2 - b^2} \left[a(\ln 2 - 25) + \frac{47b}{2} \right]$
 (B) $\frac{1}{a^2 - b^2} \left[a(2\ln 2 - 25) - \frac{47b}{2} \right]$
 (C) $\frac{1}{a^2 - b^2} \left[a(2\ln 2 - 25) + \frac{47b}{2} \right]$
 (D) $\frac{1}{a^2 - b^2} \left[a(\ln 2 - 25) + \frac{47b}{2} \right]$

Answer: (A)

Exp: $af(x) + b.f\left(\frac{1}{x}\right) = \frac{1}{x} - 25 \quad \dots (1)$

$$\Rightarrow af\left(\frac{1}{x}\right) + b.f(x) = x - 25 \quad \dots (2)$$

$$\text{Solving, we get } f(x) = \frac{1}{a^2 - b^2} \left[a\left(\frac{1}{x} - 25\right) - b(x - 25) \right]$$

$$\begin{aligned} \therefore \int_1^2 f(x) dx &= \frac{1}{a^2 - b^2} \left[a \{ \ln x - 25x \}_1^2 - b \left\{ \frac{x^2}{2} - 25x \right\}_1^2 \right] \\ &= \frac{1}{a^2 - b^2} \left[a \{ \ln 2 - 25 \} - b \left\{ \frac{3}{2} - 25 \right\} \right] \\ &= \frac{1}{a^2 - b^2} \left[a \{ \ln 2 - 25 \} + \frac{47}{2} b \right] \end{aligned}$$

27. Consider the following grammar G

$S \rightarrow F|H$

$S \rightarrow p|c$

$S \rightarrow d|c$

where S, F, and H are non-terminal symbols, p, d, and c are terminal symbols. Which of the following statements(s) is/are correct?

S1: LL(1) can parse all strings that are generated using grammar G

S2: LR(1) can parse all strings that are generate using grammar G

(A) Only S1

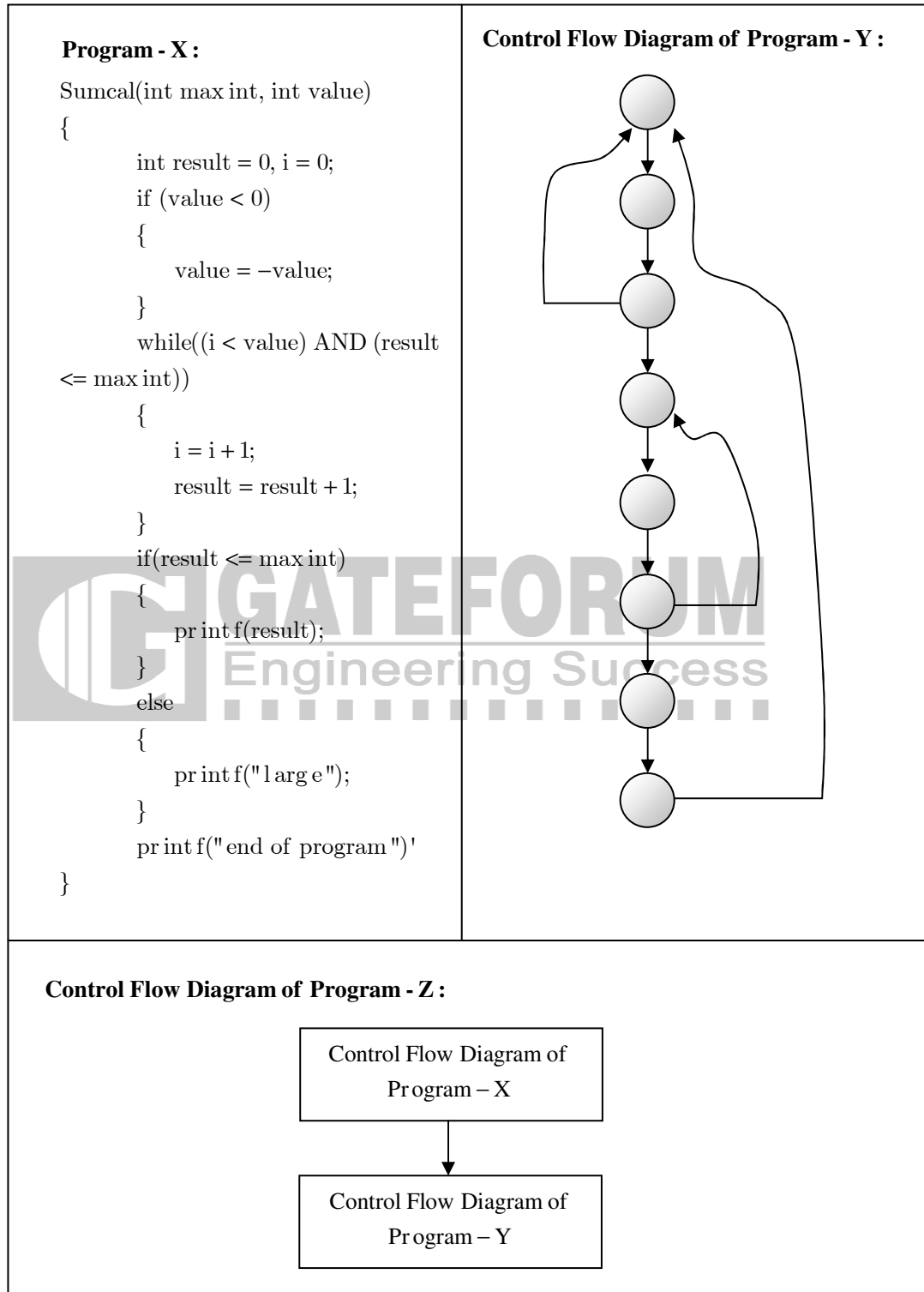
(B) Only S2

(C) Both S1 and S2

(D) Neither S1 nor S2

Answer: (D)

28. Consider three software items: Program –X, Control Flow Diagram of Program-Y and Control Flow Diagram of Program –Z as shown below

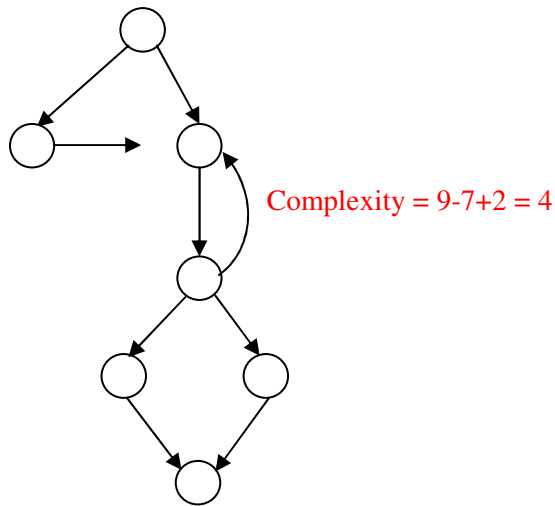


The values of McCabe's Cyclomatic complexity of Program –X, Program-Y, and Program-Z respectively are

- (A) 4,4,7 (B) 3,4,7 (C) 4,4,8 (D) 4,3,8

Answer: (A)

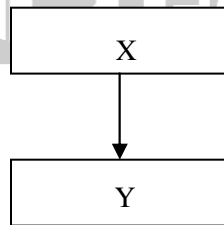
Exp: Program-X



Program-Y:

Cyclomatic complexity = $10 - 8 + 2 = 4$

Program Z:



Total number of edges = $X + Y + 1 \Rightarrow 20$

Total number of vertices = 15

Hence cyclomatic complexity = $20 - 15 + 2 = 7$

29. Consider the following partial Schedule S involving two transactions T1 and T2. Only the read and write operations have been shown. The read operation on data item P is denoted by read(P) and the write operation on data item P is denoted by write(P).

Time instance	Transaction-id	
	T1	T2
1	read(A)	
2	write(A)	

3		read(C)
4		write(C)
5		read (B)
6		write (B)
7		read (A)
8		commit
9	read (B)	

Schedule S

Suppose that the transaction T1 fails immediately after time instance 9. Which one of the following statements is correct?

- (A) T2 must be aborted and then both T1 and T2 must be re-started to ensure transaction atomicity
- (B) Schedule S is non-recoverable and cannot ensure transaction atomicity
- (C) Only T2 must be aborted and then re-started to ensure transaction atomicity
- (D) Schedule S is recoverable and can ensure atomicity and nothing else needs to be done

Answer: (B)

Exp: T₂ is reading the value written by T₁ and getting committed before T₁ commits. So it is non-recoverable schedule.

30. Consider a B+ tree in which the search Answer is 12 bytes long, block size is 1024 bytes, record pointer is 10 bytes long and block pointer is 8 bytes long. The maximum number of keys that can be accommodated in each non-leaf node of the tree is ____ .

Answer: 50

Exp: Suppose that 'k' is order of the non-leaf node

$$k(8) + (k-1)12 \leq 1024$$

$$20k \leq 1036$$

$$k \leq \left\lfloor \frac{1036}{20} \right\rfloor \Rightarrow k \leq 51$$

As the order is 51, maximum we can store 50 keys.

31. Suppose X_i for $i=1,2,3$ are independent and identically distributed random variables whose probability mass functions are $\Pr[X_i = 0] = \Pr[X_i = 1] = 1/2$ for $i=1,2,3$. Define another random variable $Y = X_1 X_2 \oplus X_3$, where \oplus denotes XOR. Then $\Pr[Y = 0 | X_3 = 0] = \underline{\hspace{2cm}}$.

Answer: 0.75

Exp: Given $X_3 = 0$

$$\therefore Y = X_1 X_2 \oplus X_3 = 0 \text{ gives } X_1 X_2 = 0$$

$$\Rightarrow X_1 = 1, X_2 = 0 \text{ or } X_1 = 0, X_2 = 1 \text{ or } X_1 = 0, X_2 = 0$$

$$\therefore \Pr[Y = 0 | X_3 = 0] = \frac{\Pr[(Y = 0) \cap (X_3 = 0)]}{\Pr(X_3 = 0)}$$

$$= \frac{\Pr[X_1 = 1, X_2 = 0, X_3 = 0] + \Pr[X_1 = 0, X_2 = 1, X_3 = 0] + \Pr[X_1 = 0, X_2 = 0, X_3 = 0]}{\Pr[X_3 = 0]}$$

$$= \frac{\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} + \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} + \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}}{\frac{1}{2}} (\because X_1, X_2, X_3 \text{ are independent})$$

$$= 3/4 = 0.75$$

32. Given the function $F = P' + QR$, where F is a function in three Boolean variables P, Q and R and $P' = !P$, consider the following statements

$$(S1) F = \sum(4, 5, 6)$$

$$(S2) F = \sum(0, 1, 2, 3, 7)$$

$$(S3) F = \Pi(4, 5, 6)$$

$$(S4) F = \Pi(0, 1, 2, 3, 7)$$

Which of the following is true?

- (A) (S1)-False, (S2)-True, (S3)-True, (S4)-False
 (B) (S1)-True, (S2)-False, (S3)-False, (S4)-True
 (C) (S1)-False, (S2)-False, (S3)-True, (S4) True
 (D) (S1)-False-True, (S2) True, (S3)-False, (S4)-False

33. The total number of prime implicants of the function $f(w, x, y, z) = \sum(0, 2, 4, 5, 6, 10)$ is ____ .

Answer: 3

Exp:

yz \ wx	00	01	11	10
00	*1	0	0	1
01	1	1*	0	1*
11	0	0	0	0
10	0	0	0	1*

There are three groups, and all the containing essential-1, so all are prime implicants as well as essential prime implicants also.

34. Consider the equation $(43)_x = (y3)_8$ where x and y are unknown. The number of possible solution is _____ .

Answer: 5

Exp: $(43)_x = (y3)_8$

$$\Rightarrow 3+4x = 3+8y \Rightarrow 4x = 8y$$

$$\Rightarrow x = 2y$$

$$\Rightarrow x \geq 5 \text{ and } y \leq 7$$

\therefore 5 solutions are possible which are (14,7), (12,6), (10,5), (8,4) and (6,3)

35. Let $f(n)=n$ and $g(n)=n^{(1+\sin n)}$, where n is a positive integer. Which of the following statement is/are correct?

I. $f(n) = O(g(n))$

II. $f(n) = \Omega(g(n))$

(A) Only I

(B) Only II

(C) Both I and II

(D) Neither I nor II

Answer: (D)

Exp: As $-1 \leq \sin x \leq 1$, neither of them is true

36. Suppose $c = \langle c[0], \dots, c[k-1] \rangle$ is an array of length k , where all the entries are from the set $\{0, 1\}$. For any positive integers a and n , consider the following pseudo code.

DOSOMETHING (c, a, n)

$z \leftarrow 1$

for $i \leftarrow 0$ to $k-1$

do $z \leftarrow z^2 \bmod n$

if $c[i] = 1$

then $z \leftarrow (z \times a) \bmod n$

return z

If $k = 4$, $c = \langle 1, 0, 1, 1 \rangle$, $a = 2$ and $n = 8$, then the output of DOSOMETHING (c, a, n) is _____.

Answer: 0

Exp:

C	i	0	1	1
---	---	---	---	---

20something

{ z = 1	k = 0			
for i = 0 to 0.3	z = 1			
do				
z ← z ² mod	z = 1	z = 4	z = 0	z = 0
if c[i] = 1	c[0] = 1	c[1] = 0	c[1] = 1	c[1] = 1
z ← 2 × z mod 8	z = 2		z = 0	z = 0
end				
return 2				
}				

37. Consider the following recursive C function.

Void get (int n)

```
{
    if (n < 1) return;
    get(n-1)
    get(n-3);
    printf("%d",n);
}
```

If get (6) function is being called in main () then how many times will the get () function be invoked before returning to the main () ?

(A) 15

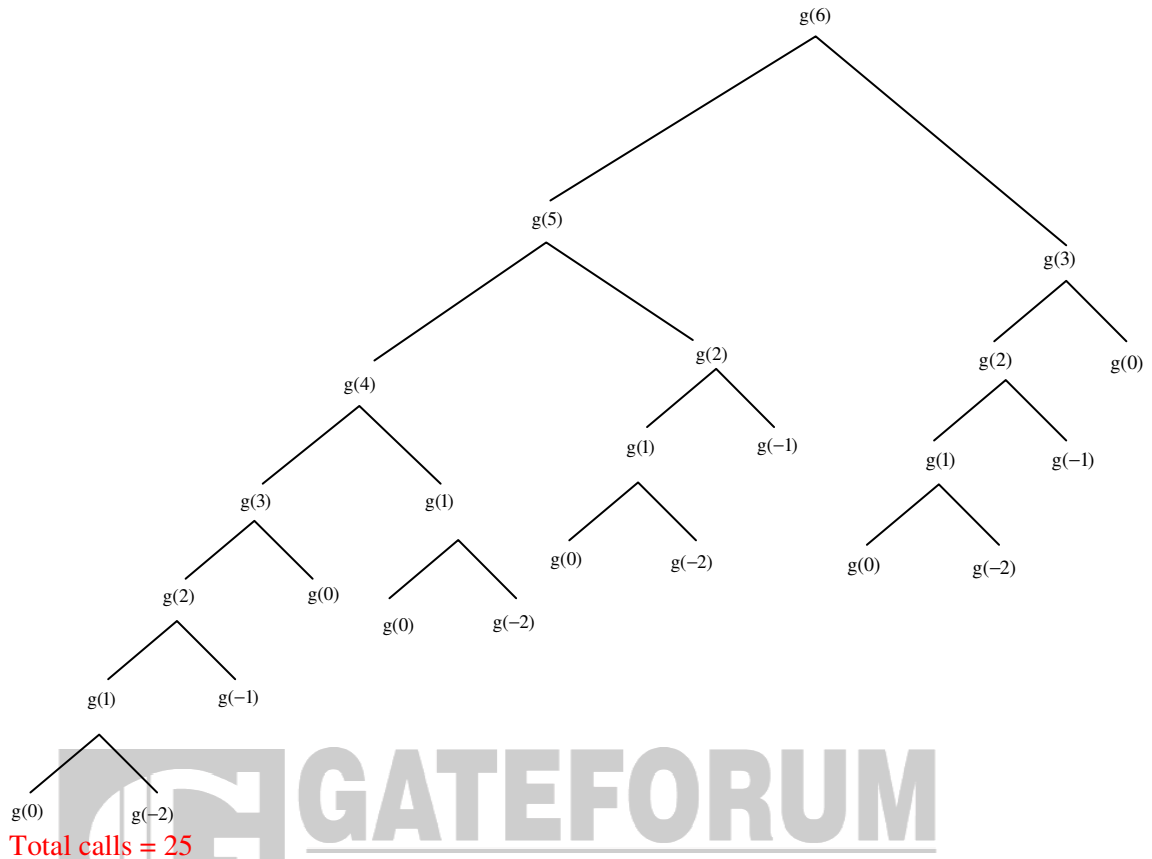
(B) 25

(C) 35

(D) 45

Answer: (B)

Exp:



38. Assume that a mergesort algorithm in the worst case takes 30 second for an input of size 64. Which of the following most closely approximates the maximum input size of a problem that can be solved in 6 minutes?

(A) 256 (B) 512 (C) 1024 (D) 2048

Answer: (B)

Exp: $O(n \log n) = 30s$

$$n = 64$$

$$O(64 \log 64) = 30$$

Hence will get factor of 12.8 for 6 min = $6 \times 60 = 360s$

$$O(256 \log 256) = 360$$

$$O(512 \log 512) = 360$$

$$O(1024 \log 1024) = 360$$

$$O(2048 \log 2048) = 360$$

So for 512 will get 12.8 as a factor

39. Consider the following two C code segments. Y and X are one and two dimensional arrays of size n and $n \times n$ respectively, where $2 \leq n \leq 10$. Assume that in both code segments, elements of Y are initialized to 0 and each element $X[i][j]$ of array X is initialized to $i + j$. Further assume that when stored in main memory all elements of X are in same main memory page frame.

Code segment 1:

```
//initialize element of Y to 0
//initialize elements X[i] [j] of X to 1+j
For (i = 0; i < n; i++)
    Y[i] += x[0] [i];
```

Code segment 2:

```
//initialize elements of Y to 0
//initialize elements X[i] [j] of X to 1+j
For (I = 0; i < n; i++)
    Y[i] += x[i] [0];
```

Which of the following statements is/are correct?

S1: Final contents of array Y will be same in both code segments

S2: Elements of array X accessed inside the for loop shown in code segment 1 are contiguous in main memory

S3: Elements of array X accessed inside the for loop shown in code segment 2 are contiguous in main memory.

(A) Only S2 is correct

(B) Only S3 is correct

(C) Only S1 and S2 are correct

(D) Only S1 and S3 are correct

Answer: (C)

40. The velocity v (in kilometer/minute) of a motorbike which start from rest, is given at fixed intervals of time t (in minutes as follows.

t	2	4	6	8	10	12	14	16	18	20
v	10	18	25	29	32	20	11	5	2	0

The approximate distance (in kilometers) rounded to two places of decimals covered in 20 minutes using Simpson's $1/3^{\text{rd}}$ rule is _____.

Answer: 309.33

Exp: Let 'S' be the distance covered in 20 minutes, then by simpson's $\frac{1}{3^{\text{rd}}}$ rule,

$$S = \int_0^{20} V dt \quad \because v = \text{velocity}$$

$$= \frac{2}{3} [(0+0) + 4(10+25+32+11+2) + 2(18+29+20+5)]$$

$$= 309.33 \text{ km}$$

(Here length of each of the subinterval is $h = 2$)

41. Consider the following C program

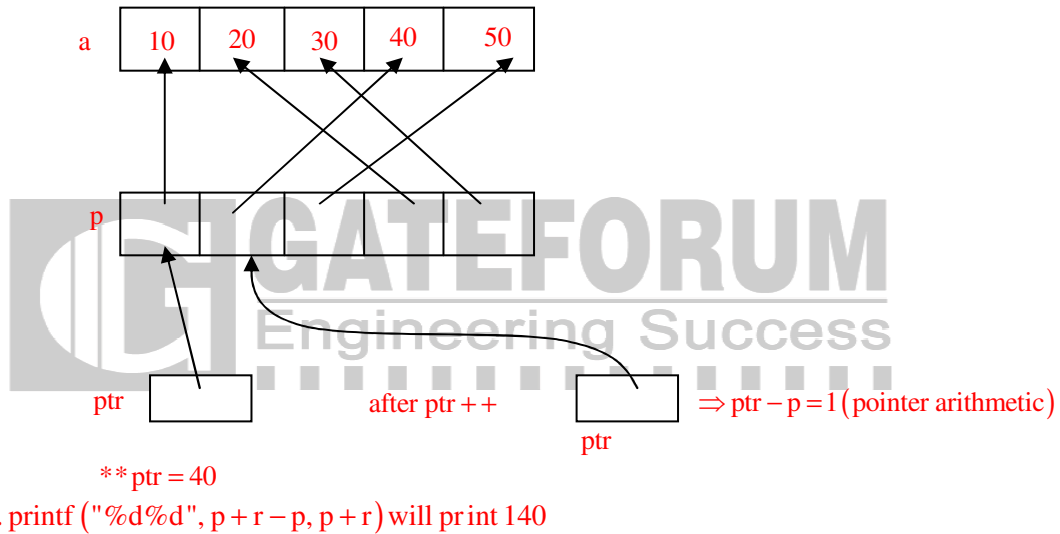
```
#include <stdio.h>

int main( )
{
    static int a[ ] = {10, 20, 30, 40, 50};
    static int *p[ ] = {a, a + 3, a + 4, a + 1, a + 2};
    int **ptr = p;
    ptr ++;
    printf ("%d %d", ptr - p, **ptr);
}
```

The output of the program is _____.

Answer: (140)

Exp:



42. Consider the following policies for preventing deadlock in a system with mutually exclusive resources.

- I. Processes should acquire all their resources at the beginning of execution. If any resources acquired so far are released.
- II. The resources are numbered uniquely, and processes are allowed to request for resources only in increasing resource numbers.
- III. The resources are numbered uniquely, and processes are allowed to request for resources only in decreasing resource numbers.
- IV. The resources are numbered uniquely. A process is allowed to request only for a resource with resource number larger than its currently held resources.

When of the above policies can be used for preventing deadlock?

- (A) Any one of I and III but not II or IV
- (B) Any one of I, III, and IV but not II
- (C) Any one of II and III but not I or IV
- (D) Any one of I, II, III, and IV

Answer: 4

Exp: For deadlock prevention we need to dissatisfy any of the necessary condition for deadlock

1. For hold and wait if we r dissatisfy it can be hold or wait for hold ...before process start os assign all resources. While executing if process making new resource request it has to release all its assign resources that is waiting for release resources
2. If we r dissatisfy circular wait condition suppose there r five resources uniquely numbered r1 to r5 and there five processes p1 to p5 suppose p2 hold r1 ,and requesting for r2,and r2 hold by p3 and wait for r3,r3 hold by p4 wait for r4which is hold by p5and wait for r5 which is held by p1 (this is happening in circular manner)(condition to come out from circular wait is a process can hold the resource and request for new resource only when holding resource id is lesser then requesting resource id) in above p1 is violating condition.
3. If we dissatisfy preemption if a process hold some resources requesting for new resources and that requesting resources are busy with some other process requesting process voluntarily release its held resources
4. Answer,,, according to 1 and 3 above statements first option is correct
According to above second statement second option is correct
According to above second statement if we implement the logic in reverse order third option is also correct
According to second statement condition fourth option is also correct

43. Let G be a connected undirected graph of 100 vertices and 300 edges. The weight of a minimum spanning tree of G is 500. When the weight of each edge of G is increased by five, the weight of a minimum spanning tree becomes _____.

Answer: 995

Exp: G has 100 vertices \Rightarrow spanning tree contain 99 edges given, weight of a minimum spanning tree of G is 500 since, each edge of G is increased by five

\therefore Weight of a minimum spanning tree becomes $500 + 5 \times 99 = 995$

44. If the following system has non-trivial solution.

$$px + qy + rz = 0$$

$$qx + ry + pz = 0$$

$$rx + py + qz = 0,$$

Then which one of the following options is TRUE?

(A) $p - q + r = 0$ or $p = q = -r$

(B) $p + q - r = 0$ or $p = -q = r$

(C) $p + q + r = 0$ or $p = q = r$

(D) $p - q + r = 0$ or $p = -q = -r$

Answer: (C)

Exp: For non-trivial solution, we have $|A| = 0$

$$\text{i.e., } \begin{vmatrix} p & q & r \\ q & r & p \\ r & p & q \end{vmatrix} = 0$$

$$(C_1 \rightarrow C_1 + C_2 + C_3)$$

$$(p+q+r) \begin{vmatrix} 1 & q & r \\ 1 & r & p \\ 1 & p & q \end{vmatrix} = 0$$

$$[R_2 \rightarrow R_2 - R_1; R_3 \rightarrow R_3 - R_1]$$

$$p+q+r=0 \text{ (or)} \begin{vmatrix} 1 & q & r \\ 0 & r-q & p-r \\ 0 & p-q & q-r \end{vmatrix} = 0$$

$$\Rightarrow (r-q)^2 - (p-q)(p-r) = 0$$

$$\Rightarrow p^2 + q^2 + r^2 - pq - qr - pr = 0$$

$$\Rightarrow (p-q)^2 + (q-r)^2 + (r-p)^2 = 0$$

$$\Rightarrow p-q=0; q-r=0, r-p=0$$

$$\Rightarrow p=q=r \dots (2)$$

45. Consider a network connected two systems located 8000 kilometers apart. The bandwidth of the network is 500×10^6 bits per second. The propagation speed of the media is 4×10^6 meters per second. It is needed to design a Go-Back-N sliding window protocol for this network. The average packet size is 10^7 bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then the minimum size in bits of the sequence number field has to be _____.

Answer: 8

$$\text{Exp: Given } \left. \begin{array}{l} L = 10^7 \text{ bits} \\ B = 500 \times 10^6 \text{ bps} \end{array} \right\} T_x \Rightarrow \frac{L}{B} = \frac{10 \times 10^6}{500 \times 10^6} = 0.02 \text{ sec}$$

$$\left. \begin{array}{l} d = 8000 \text{ km} \\ v = 4 \times 10^6 \text{ m/s} \end{array} \right\} \Rightarrow T_p = \frac{d}{v} = \frac{8 \times 10^6}{4 \times 10^6} = 2 \text{ sec}$$

$$\eta = 100\%$$

$$n = ?$$

$$\therefore a = \frac{T_p}{T_n} = \frac{2}{0.02} = 100$$

$$\text{Given Protocol, Go back N protocol. So } \eta = \frac{w}{1+2a} \text{ where } w = 2^n - 1$$

$$\frac{100}{100} = \frac{w}{1+2a} \Rightarrow w = 1+2a$$

$$\begin{aligned}\Rightarrow 2^{n-1} &= 1 + 2(100) \\ \Rightarrow 2^n - 1 &= 201 \\ \Rightarrow 2^n &= 202 \Rightarrow 2^n = 2^8 \\ \Rightarrow n &= 8\end{aligned}$$

46. Language L_1 is polynomial time reducible to language L_2 . Language L_3 is polynomial time reducible to L_2 , which in turn is polynomial time reducible to language L_4 . Which of the following is/are true?

- I. if $L_4 \in P$, then $L_2 \in P$
- II. if $L_1 \in P$ or $L_3 \in P$, then $L_2 \in P$
- III. $L_1 \in P$, if and only if $L_3 \in P$
- IV. if $L_4 \in P$, then $L_1 \in P$ and $L_3 \in P$

- (A) II only
- (B) III only
- (C) I and IV only
- (D) I only

Answer: (C)

Exp: $L_2 \leq_p L_4$

$$L_1 \leq_p L_2$$

If $L_4 \in P$ then $L_2 \in P$ hence $L_1 \in P$, hence option C.

47. Consider the following reservation table for a pipeline having three stages S_1 , S_2 , and S_3 .

	Time →				
	1	2	3	4	5
S_1	X				X
S_2		X		X	
S_3			X		

The minimum average latency (MAL) is _____.

48. In the network 200.20.11.144/27, the fourth octet (in decimal) of the last IP address of the network which can be assigned to a host is _____.

Answer: 158

Exp: Given IP address 200.20.11.144/27

To find out the last address in a block, we have to set (32-n) no. of right most bits to 1.

$$n=27$$

$$32 - n = 32 - 27 = 5$$

$$200.20.11.10010000$$

$$200.20.11.10011111$$

$$200.20.11.159$$

∴ CIDR Address range is 200.20.11.128/27-200.20.11.159/27

But w.r.t the question, the value of the last octet of last host in this network is 200.10.11.158.

49. Which of the following languages are context-free?

$$L_1 = \{a^m b^n a^n b^m \mid m, n \geq 1\}$$

$$L_2 = \{a^m b^n a^m b^n \mid m, n \geq 1\}$$

$$L_3 = \{a^m b^n \mid m = 2n + 1\}$$

(A) L_1 and L_2 only (B) L_1 and L_3 only (C) L_2 and L_3 only (D) L_3 only

Answer: (C)

Exp: $a^m b^n a^n b^m \Rightarrow$ This one is CFL

$a^m b^n a^m b^n \Rightarrow$ by pumping lemma this one is not CFL.

$\{a^m b^n \mid m = 2n + 1\}$ This is CFL.

50. Consider the following C program

```
#include <stdio.h>
int main( )
{
    int i, j, k = 0;
    j = 2 * 3 / 4 + 2.0 / 5 + 8 / 5;
    k = --j;
    for (i = 0; i < 5; i++)
    {
        Switch (i + k)
        {
            case 1:
            case 2: printf ("\n %d", i + k)
            case 3: printf ("\n %d", i + k);
            default: printf ("\n %d", i + k);
        }
    }
    Return 0;
}
```

The number of times printf statement is executed is _____.

Answer: 10

Exp: j and k will be evaluated to 2 and -1 respectively.

In for loop:

When i = 0; 1 time printed (-1)

When i = 1; 1 time printed (0)

When i = 2; 3 times printed (1,1,1)

When i = 3; 3 times printed (2,2,2)

When i = 4; 2 times printed (3,3)

∴ on the whole printf is executed 10 times

51. Consider the following C program.

```
#include <stdio.h>

int f1(void);
int f2(void);
int x = 10;

int main( )
{
    int x = 1;
    x += f1( ) + f2( ) + f3( ) + f2( );
    printf ("%d", x);
    return 0;
}

int f1( ) {int x = 25; x ++; return x;}
int f2( ) {static int x = 50; x ++; return x;}
int f3( ) {x* = 10; return x};
```

The output of the program is_____.

Answer: 230

Exp: In function main x will be updated as follows

$$x = \underset{\substack{\downarrow \\ 1}}{x} + \underset{\substack{\downarrow \\ 26}}{f_1()} + \underset{\substack{\downarrow \\ 51}}{f_2()} + \underset{\substack{\downarrow \\ 100}}{f_3()} + \underset{\substack{\downarrow \\ 52}}{f_2()} \quad x$$

Note: static variable in $f_2()$ will be initialized only once & it retains value in between function calls.

52. Consider the following code sequence having five instructions I_1 to I_5 . Each of these instructions has the following format.

OP Ri, Rj, Rk

Where operation OP is performed on contents of registers Rj and Rk and the results is stored in register Ri.

I_1 : ADD R1, R2, R₃

I_2 : MUL R7, R1, R3

I_3 : SUB R4, R1, R5

I_4 : ADD R3, R2, R4

I_5 : MUL R7, R8, R9

Consider the following three statements.

S1: There is an anti-dependence between instructions I_2 and I_5

S2: There is an anti-dependence between instructions I_2 and I_4

S3: Within an instruction pipeline an anti-dependence always creates one or more stalls

Which one of above statements is/are correct?

(A) Only S1 is true

(B) Only S2 is true

(C) Only S1 and S3 are true

(D) Only S2 and S3 are true

Answer: (D)

Exp: I_1 $R_1 \leftarrow R_2 + R_3$

I_2 $R_7 \leftarrow R_1 \times R_3$

I_3 $R_4 \leftarrow R_1 - R_5$

I_4 $R_3 \leftarrow R_2 + R_4$

I_5 $R_7 \leftarrow R_8 \times R_9$

Anti dependence

(i) ----- = x

(j) X: -----

then i and j are anti-dependence

Hence I_2 and I_4 are anti-dependence

⇒ Anti-dependence create stall in pipeline

53. Two hosts are connected via a packet switch with 10^7 bits per second links. Each link has a propagation delay of 20 microseconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 1000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last of the data in microsecond is _____.

54. Let R be a relation on the set of ordered pairs of positive integers such that $((p, q), (r, s)) \in R$ if and only if $p - s = q - r$. Which one of the following is true about R ?

(A) Both reflexive and symmetric (B) Reflexive but not symmetric
(C) Not reflexive but symmetric (D) Neither reflexive nor symmetric

Answer: (C)

Exp: Since $p - q \neq q - p$

$$\therefore (p, q) R (p, q)$$

$\Rightarrow R$ is not reflexive

Let $(p, q) R (r, s)$ then $p - s = q - r$

$$\Rightarrow r - q = s - p$$

$$\Rightarrow (r, s) R (p, q)$$

$\Rightarrow R$ is symmetric

55. For the processes listed in the following table, which of the following scheduling schemes will the lowest average turnaround time?

Process	Arrival Time	Processing Time
A	0	3
B	1	6
C	4	4
D	6	2

- (A) First Come First Serve
(B) Non-preemptive Shortest Job First
(C) Shortest Remaining Time
(D) Round Robin with Quantum value two

Answer: (C)

Exp:

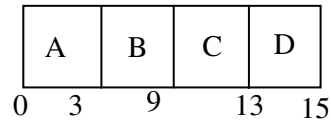
Process	AT	BT
A	0	3
B	1	6
C	4	4
D	6	2

} Given Snapshot

- (i) FCFS

Process	AT	BT	LT	TAT
A	0	3	3	3
B	1	6	9	8
C	4	4	13	9
D	6	2	15	9
				<hr/> 29 4 = 7.25

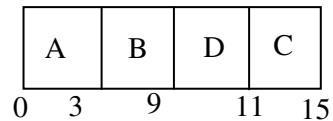
Gantt chart



(ii) SJF

Process	AT	BT	LT	TAT
A	0	3	3	3
B	1	6	9	8
C	4	4	15	11
D	6	2	11	5
				$\frac{27}{4} = 6.75$

Gantt chart



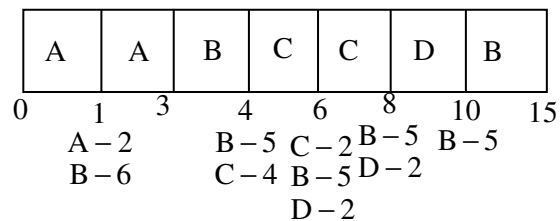
B-6 C-9

D-2

(iii) SRTF

Process	AT	BT	CT	TAT
A	0	3	3	3
B	1	6	15	14
C	4	4	8	4
D	6	2	10	4
				$\frac{25}{4} = 6.25$

Gantt chart



(iv) R.Q (Q = 2)

Process	AT	BT	CT	TAT
A	0	3	5	5
B	1	6	15	14
C	4	4	13	9
D	6	2	11	5
				$\frac{33}{4} = 8.25$

Gantt Chart

R. Q

