Q. No. 1 – 5 Carry One Mark Each

1. Choose the most appropriate phrase from the options given below to complete the following sentence.

India is a post-colonial country because

(A) it was a former British colony

(B) Indian Information Technology professionals have colonized the world

(C) India does not follow any colonial practices

(D) India has helped other countries gain freedom

Answer: (A)

2. Who _____ was coming to see us this evening?

(A) you said (B) did you say (C) did you say that (D) had you said

Answer: (B)

3. Match the columns.

Column 1	Column 2
(1) eradicate	(P) misrepresent
(2) distort	(Q) soak completely
(3) saturate	(R) use
(4) utilize	(S) destroy utterly

(A) 1:S, 2:P, 3:Q, 4:R (B) 1:P, 2:Q, 3:R, 4:S

(C) 1:Q, 2:R, 3:S, 4:P (D) 1:S, 2:P, 3:R, 4:Q

Answer: (A)

4. What is the average of all multiples of 10 from 2 to 198?

(A) 90 (B) 100 (C) 110 (D) 120

Answer: (B)

Exp:

$$\left.\begin{array}{l} 10+190 \rightarrow \\ 20-180 \rightarrow \\ : \\ : \\ 90-110 \\ 100 \end{array}\right\} \begin{array}{l} 200 \\ \\ 9 \\ \\ \\ \end{array} \Rightarrow \frac{[(200)\times 9+100]}{19}=\frac{1900}{19}=100$$

5. The value of $\sqrt{12+\sqrt{12+\sqrt{12+....}}}$ is

(A) 3.464 (B) 3.932 (C) 4.000 (D) 4.444

Answer: (C)

Exp: $\text{let} = \sqrt{12+\sqrt{12+\sqrt{12+....}}} = y$

$\Rightarrow \sqrt{12+y} = y$

$\Rightarrow 12+y = y^2$

$\Rightarrow (y-4)(y+3) = 0$

$\Rightarrow y = 4,\ y = -3$

Q. No. 6 – 10 Carry Two Marks Each

6. The old city of Koenigsberg, which had a German majority population before World War 2, is now called Kaliningrad. After the events of the war, Kaliningrad is now a Russian territory and has a predominantly Russian population. It is bordered by the Baltic Sea on the north and the countries of Poland to the south and west and Lithuania to the east respectively. Which of the statements below can be inferred from this passage?

(A) Kaliningrad was historically Russian in its ethnic make up

(B) Kaliningrad is a part of Russia despite it not being contiguous with the rest of Russia

(C) Koenigsberg was renamed Kaliningrad, as that was its original Russian name

(D) Poland and Lithuania are on the route from Kaliningrad to the rest of Russia

Answer: (B)

7. The number of people diagnosed with dengue fever (contracted from the bite of a mosquito) in north India is twice the number diagnosed last year. Municipal authorities have concluded that measures to control the mosquito population have failed in this region.

Which one of the following statements, if true, does not contradict this conclusion?

(A) A high proportion of the affected population has returned from neighbouring countries where dengue is prevalent

(B) More cases of dengue are now reported because of an increase in the Municipal Office's administrative efficiency

(C) Many more cases of dengue are being diagnosed this year since the introduction of a new and effective diagnostic test

(D) The number of people with malarial fever (also contracted from mosquito bites) has increased this year

Answer: (D)

8. If x is real and $\left|x^2-2x+3\right| = 11$, then possible values of $\left|-x^3+x^2-x\right|$ include

(A) 2, 4 (B) 2, 14 (C) 4, 52 (D) 14, 52

Answer: (D)

Exp: $x^2 - 2x + 3 = 11$

$\Rightarrow (x-4)(x+2) = 0 \Rightarrow x = 4, x = -2$

Values of $\left|-x^3 + x^2 - x\right|$

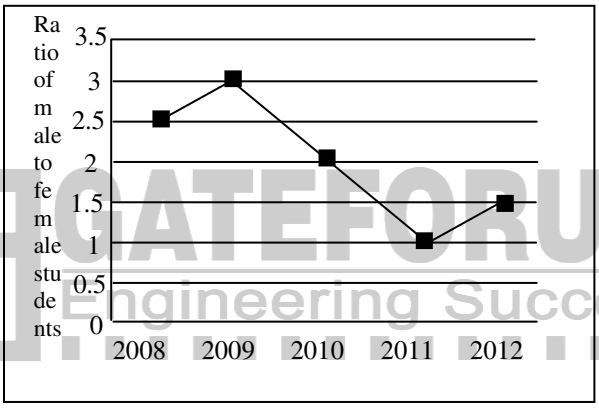
For $x = 4$

Value $= 52$

for $x = -2$

Value $= 14$

9. The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students doubled in 2009, by what percent did the number of male students increase in 2009?



Answer: (140)

Exp: $\frac{m}{f} = 3$ $\frac{m}{f} = 2.5$ m=2.5f

$\frac{m'}{2f} = 3$

$m' = 6f$

$= \frac{m' - m}{m}$

$\% \uparrow = \frac{3.5f}{2.5f} \times 100$

$= \frac{7}{8} = 1.4$

$\boxed{\% \uparrow = 140\%}$

10. At what time between 6 *a.m.* and 7 *a.m* will the minute hand and hour hand of a clock make an angle closest to 60°?

(A) 6: 22 *a. m.* (B) 6:27 *a.m.* (C) 6: 38 *a.m.* (D) 6:45 *a.m.*

Answer: (A)

Exp: Angle by minute's hand

$60 \text{ min} \rightarrow 360^{\circ}$

$1 \text{ min} \rightarrow \frac{360}{60} = 6^{\circ}$

$8 \text{ min} \rightarrow 48^{\circ}$

Angle $\rightarrow 48^{\circ}$ with number '6'

Angle by hours hand

$60 \text{ min} = 30^{\circ}$

$22 \text{ min} \rightarrow \frac{30}{60} \times 22$

$= 11$

Total Angle=48+11=59°.

Q. No. 1 – 25 Carry One Mark Each

1. The security system at an IT office is composed of 10 computers of which exactly four are working. To check whether the system is functional, the officials inspect four of the computers picked at random (without replacement). The system is deemed functional if at least three of the four computers inspected are working. Let the probability that the system is deemed functional be denoted by p Then 100p= _____.

Answer: (11.85 - 11.95)

Exp: p= P [at least three computers are working]

= P (3 or 4 computers working)

$$=\frac{\left(4_{C_3}\right)\times\left(6_{C_1}\right)}{10_{C_4}}+\frac{4_{C_4}}{10_{C_4}}=\frac{5}{42}$$

$$\Rightarrow 100\,p=11.9.$$

2. Each of the nine words in the sentence "**The quick brown fox jumps over the lazy og**" is written on a separate piece of paper. These nine pieces of paper are kept in a box. One of the pieces is drawn at random from the box. The *expected* length of the word drawn is _____. (The answer should be rounded to one decimal place.

Answer: (3.8889)

Exp: Given words are

THE, QUICK, BROWN, FOX, JUMPS, OVER, THE, LAXY, DOG

LET X be the random variable such that X =length of the word

The Length of the words THE, FOX, THE, DOG is 3

The Length of the words OVER, LAXY is 4

The length of the words QUICK, BROWN, JUMPS, is 5

The corresponding probabilities are given below

x	3	4	5
P(X)	4/9	2/9	3/9

Expected length of the word= $\sum xp(x)=3\left(\frac{4}{9}\right)+4\left(\frac{2}{9}\right)+5\left(\frac{3}{9}\right)=3.8889$

3. The maximum number of edges in a bipartite graph on 12 vertices is

_____.

Answer: (36)

Exp: The number of edges in a bipartite graph on n-vertices is atmost $\frac{n^2}{4}$

The maximum number of edges in a bipartite graph on 12 –vertices is $\frac{n^2}{4}=\frac{12\times12}{4}=36$

4. If the matrix A is such that

$$A = \begin{bmatrix} 2 \\ -4 \\ 7 \end{bmatrix} \begin{bmatrix} 1 & 9 & 5 \end{bmatrix}$$

Then the determinant of A is equal to _____.

Answer: (0)

Exp: $A = \begin{bmatrix} 2 & 18 & 10 \\ -4 & -36 & 20 \\ 7 & 63 & 35 \end{bmatrix}$

$\Rightarrow |A| = 0 \quad (\because R_2 = -2R_1)$.

5. A non-zero polynomial f(x) of degree 3 has roots at x = 1,x = 2 and x = 3. Which one of the following must be TRUE?

(A) f(0) f(4) < 0 (B) f(0) f(4) > 0

(C) f(0) + f(4) > 0 (D) f(0) + f(4) < 0

Answer: (A)

Exp: Since, the roots of f(x) = 0 i.e., x = 1, 2, 3 lies between 0 and 4 and f(x) is of degree 3

$\therefore$ f(0) and f(4) are of opposite signs

$\Rightarrow$ f(0).f(4)<0.

6. The dual of a Boolean function $F(x_1, x_2, ..., x_n, +, ., ')$, written as F^D, is the same expression as that of F with + and swapped. F is said to be self-dual if $F = F^D$. The number of self-dual functions with n Boolean variables is

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

Answer: (D)

Exp: A function F is self dual if it has equal number of minterms and maxterms, also mutually exclusive terms should not be included.

The number of mutually exclusive terms (pair wise) is $\frac{2^n}{2} = 2^{n-1}$

Number of functions possible by taking any of the one term from the above mentioned mutually exclusive pair is $= 2^{2^{n-1}}$.

7. Let $k = 2^n$. A circuit is built by giving the output of an n-bit binary counter as input to an n-to-2^n bit decoder. This circuit is equivalent to a

(A) k-bit binary up counter. (B) k-bit binary down counter.

(C) k-bit ring counter. (D) k-bit Johnson counter.

Answer: (C)

Exp: In case of decoder output, single output will be 1 and remaining will be zero at a time. The output that is high will give the count of the ring counter at that time.

8. Consider the equation $(123)_5 = (x8)_y$ with x and y as unknown. The number of possible solutions is _____ .

Answer: (3)

Exp : $(123)_5 = (x8)_y$

Converting both sides to decimal:

$\Rightarrow 25+10+3 = xy+8$

$\Rightarrow xy+8 = 38 \Rightarrow xy = 30$

$\Rightarrow x = 1, y = 30$

or , $x = 2, y = 15$ or, $x = 3, y = 10$

$\therefore$ Total number of solutions: 3

9. A 4-way set-associative cache memory unit with a capacity of 16 KB is built using a block size of 8 words. The word length is 32 bits. The size of the physical address space is 4 GB. The number of bits for the TAG field is _____

Answer: (20)

Exp: Physical address size = 32 bits

Cache size $= 16\,k$ bytes $= 2^{14}$ Bytes

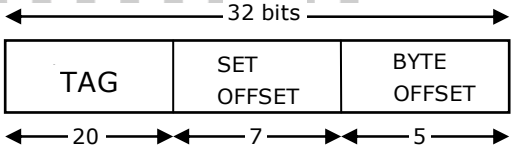
block size $= 8$ words $= 8 \times 4$ Byte $= 32$ Bytes

(where each word $= b$ Bytes)

No. of blocks $= \frac{2^{14}}{2^5} = 2^9$

block offset $= 9^{bits}$

No. of sets $= \frac{2^9}{4} = 2^7$



set ofset $= 7$ bits

Byte offset $= 8 \times 4$ Bytes $= 32$ Byte $= 2^5 = 5$ bits

TAG $= 32 - (7+5) = 20$ bits

10. Consider the function func shown below:

```
int func(int num) {
int count = 0;
    while (num) {
    count++;
     num>>= 1;
}
return (count);
}
```

The value returned by func(435)is _____.

Answer: (9)

Exp:
```
int func (int num)
{
int count = 0;
while (num)              //After each right shift, checks whether the num value is not zero//
    {
    count ++;
    num >>= 1;    //shifts all bits of num one slot to the right//
    }
return(count);
}
```

Initially num = 110110011, count = 0

count = 1; num = 101100110 after 1st right shift

count =2; num = 011001100 after 2nd right shift

:

:

Count = 9; num = 000000000 after 9th right shift.

After nine right shifts, num = 0; and while loop terminates count = 9 will be returned.

11. Suppose n and p are unsigned int variables in a C program. We wish to set p to ${}^{n}C_{3}$. If n is large, which one of the following statements is most likely to set p correctly?

(A) p = n * (n – 1) * (n-2) / 6; (B) p = n * (n – 1) / 2 * (n-2) / 3;

(C) p = n * (n – 1) / 3 * (n-2) / 2; (D) p = n * (n – 1) / 2 * (n-2) / 6.0;

Answer: (B)

Exp: $P = n_{C_3} = \frac{n(n-1)(n-2)}{6}$

It we multiply n, (n-1), (n-2) at once, it might go beyond the range of unsigned integer (resulting overflow). So options (A) and (D) are rested out. If n is even or odd n×(n-1)/2 will always result in integer value (no possibility of truncation, so more accuracy) where as incase of n*(n-1)/3, its not certain to get integer always (truncation possible, so less accuracy).

$$P = \underbrace{n*(n-1)/2}_{P_1} * \underbrace{(n-2)/3}_{P_2}$$

As P_1 will be having no error, resultant p will be more accurate.

$$P = \underbrace{n*(n-1)/3}_{P_1} * \underbrace{(n-2)/2}_{P_2}$$

As there is a possibility of truncation in P_1, there will be less accuracy in final result of P.

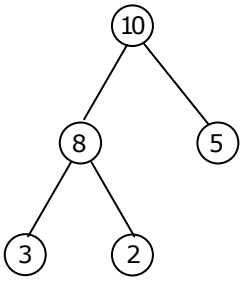
12. A priority queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted into the heap in that order. The level-order traversal of the heap after the insertion of the elements is:

(A) 10, 8, 7, 3, 2, 1, 5 (B) 10, 8, 7, 2, 3, 1, 5

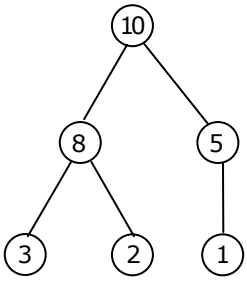
(C) 10, 8, 7, 1, 2, 3, 5 (D) 10, 8, 7, 5, 3, 2, 1

Answer: (A)

Exp: Initial max-heap is

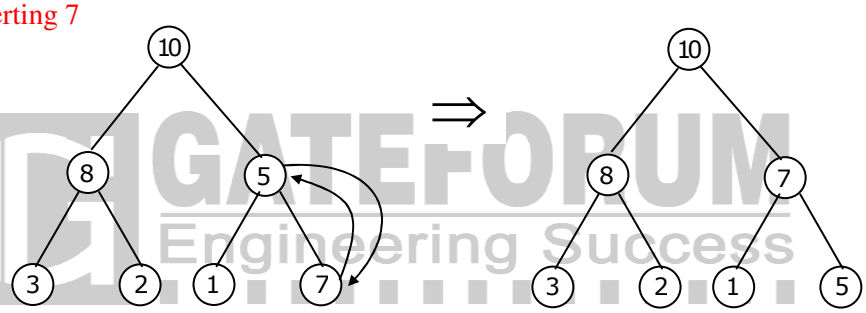


after inserting 1



Heapification is not required as it satisfies max-heap property

After inserting 7



Hence level order traversal is 10, 8, 7, 3, 2, 1, 5

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

$$T(n) = 2T\left(\frac{n}{2}\right) + \log n$$

(A) $\theta(n)$ (B) $\theta(n \log n)$ (C) $\theta(n^2)$ (D) $\theta(\log n)$

Answer: (A)

Exp: By Master's theorem case (i) $T(n)$ is $O(n)$

Here $a = 2,\ b = 2,\ f(n) = \log n$

$\log_b^a = \log_2^2 = 1$

we can choose $\epsilon > 0$, in such a way that

$f(n) = O\left(n \log_b^{a-\epsilon}\right)$; i.e., $\log n = O\left(n \log_b^{a-\epsilon}\right)$

By master theorem, If $f(n) = O\left(n \log_b^{a-\epsilon}\right)$ for some $\epsilon > 0$, then

$T(n) = \theta\left(n \log_b^a\right) = \theta(n)$

14. Consider the tree arcs of a BFS traversal from a source node **W** in an unweighted, connected, undirected graph. The tree **T** formed by the tree arcs is a data structure for computing

(A) the shortest path between every pair of vertices.

(B) the shortest path from **W** to every vertex in the graph.

(C) the shortest paths from **W** to only those nodes that are leaves of **T**.

(D) the longest path in the graph.

Answer: (B)

Exp: One of the application of BFS algorithm is to find the shortest path between nodes u and v.

But in the given question the BFS algorithm starts from the source vertex w and we can find the shortest path from w to every vertex of the graph

15. If $L_1 = \{a^n \mid n \geq 0\}$ and $L_2 = \{b^n \mid n \geq 0\}$, Consider

(I) $L_1.L_2$ is a regular language

(II) $L_1.L_2 = \{a^n b^n \mid n \geq 0\}$

Which one of the following is CORRECT?

(A) Only (I) (B) Only (II)

(C) Both (I) and (II) (D) Neither (I) nor (II)

Answer: (A)

Exp: L1.L2 is also regular since regular languages are closed under concatenation.

But L1.L2 is not $\{a^n b^n \mid n \geq 0\}$ because both the variable is independent in both languages.

16. Let $A \leq_m B$ denotes that language A is mapping reducible (also known as many-to-one reducible) to language B. Which one of the following is FALSE?

(A) If $A \leq_m B$ and B is recursive then A is recursive.

(B) If $A \leq_m B$ and A is undecidable then B is undecidable.

(C) If $A \leq_m B$ and B is recursively enumerable then A is recursively enumerable.

(D) If $A \leq_m B$ and B is not recursively enumerable then A is not recursively enumerable.

Answer: (D)

Exp: A language A is mapping reducible to a language B, if there is a computable function $f : \varepsilon^* \to \varepsilon^*$ where for every $w, w \in A \Leftrightarrow f(w) \in B$

If $A \leq mB$ and B is Turing recognizable then A is Turing recognizable.

If $A \leq mB$ and B is not recursively enumerable then A is not recursively enumerable

17. Consider the grammar defined by the following production rules, with two operators □ and +

$S \rightarrow T * P$

$T \rightarrow U \mid T * U$

$P \rightarrow Q + P \mid Q$

$Q \rightarrow Id$

$U \rightarrow Id$

Which one of the following is TRUE?

(A) + is left associative, while * is right associative

(B) + is right associative, while * is left associative

(C) Both + and * are right associative

(D) Both + and * are left associative

Answer: (B)

Exp: $S \rightarrow T \times P$

$T \rightarrow U \mid T \times U$

$P \rightarrow Q + P \mid Q$

$Q \rightarrow Id$

$U \rightarrow Id$

As the production rule $T \rightarrow T \times U$ is defined as left recursive rule, so * is left associate operator.

As the production rule $P \rightarrow Q + P$ is defined as right recursive rule, so + is right associative operator.

18. Which one of the following is **NOT** performed during compilation?

(A) Dynamic memory allocation (B) Type checking

(C) Symbol table management (D) Inline expansion

Answer: (A)

Exp: Symbol table management is done during compitation to store and retriew the information about tokens. Type checking is one of the check performed during semantic analysis of compitation.

Inline expansion is a compiler optimization that replaces a function call by the bodyof respective function.

Dynamic memory allocation is when an executing pregoram request the oprating system to give it a block of main memory, so ti is performed during sum time not during complete time.

Option (A) is answer

19. Which one of the following is TRUE?

(A) The requirements document also describes how the requirements that are listed in the document are implemented efficiently.

(B) Consistency and completeness of functional requirements are always achieved in practice.

(C) Prototyping is a method of requirements validation.

(D) Requirements review is carried out to find the errors in system design.

Answer: (C)

20. A FAT (file allocation table) based file system is being used and the total overhead of each entry in the FAT is 4 bytes in size. Given a 100 x 10^6 bytes disk on which the file system is stored and data block size is 10^3 bytes, the maximum size of a file that can be stored on this disk in units of 10^6 bytes is _____.

Answer: (99.55 to 99.65)

Exp: Number of entries in the FAT = Disk Capacity/Block size = $10^8/10^3 = 10^5$

⇨ Total space consumed by FAT = $10^5 * 4$ B = $0.4 * 10^6$ B
⇨ Maximum size of file that can be stored = $100 * 10^6 - 0.4 * 10^6 = 99.6 * 10^6$ B
⇨ Answer: 99.6

21. The maximum number of super keys for the relation schema R (E, F, G, H) with E as the key is _____.

Answer: (8)

Exp: The maximum number of super keys for the relation schema $R(E,F,G,H)$ with E as the key is $2^3 = 8$ as any subset of non key attributes along with key attribute will form the super key of R.

As we have 3 nonkey all (F, G and H) so subsets will be 2^3

22. Given an instance of the STUDENTS relation as shown below:

Student D	StudentName	Student Email	Student Age	CPI
2345	Shankar	Shankar@math	X	9.4
1287	Swati	swati@ee	19	9.5
7853	Shankar	Shankar@cse	19	9.4
9876	Swati	swati@mech	18	9.3
8765	Ganesh	ganesh@civil	19	8.7

For (StudentName, StudentAge) to be a key for this instance, the value X should NOT be equal to_____.

Answer: (19)

Exp: For (Student Name, student age) to be a key for given instance of STUDENTS relation, the pair value should not get repeated in any two tuples p and q (uniqueness in forced by the definition of key)

Tuple	Student Name	Student Age
P	Shankar	⊗ → should not be 19
Q	Shankar	19

23. Which one of the following is TRUE about the interior gateway routing protocols – Routing Information Protocol (RIP) and Open Shortest Path First (OSPF)?

(A) RILP uses distance vector routing and OSPF uses link state routing

(B) OSPF uses distance vector routing and RIP uses link state routing

(C) Both RIP and OSPF use link state routing

(D) Both RIP and OSPF use distance vector routing

Answer: (A)

Exp: RIP Uses Distance Vector Routing and OSPF uses Link State Routing.

24. Which one of the following socket API functions converts an unconnected active TCP socket into a passive socket?

(A) connect (B) bind (C) listen (D) accept

Answer: (C)

Exp:

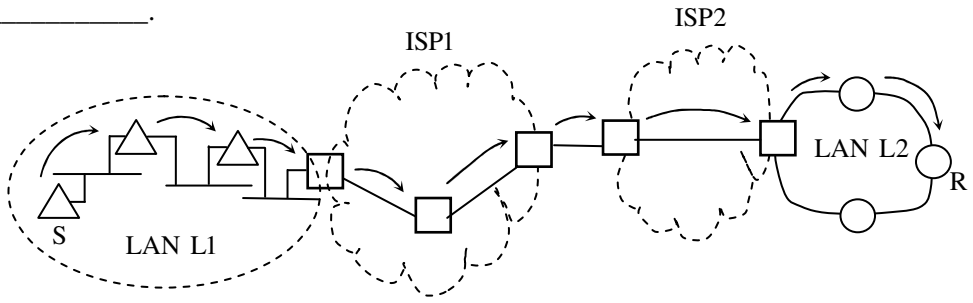
(a) The **connect function** is used by a TCP client to establish a connection with a TCP server.

(b) The **bind function** assigns a local protocol address to a socket. With the Internet protocols, the protocol address is the combination of either a 32-bit IPv4 address or a 128-bit IPv6 address, along with a 16-bit TCP or UDP port number.

(c) The **listen function** converts an unconnected socket into a passive socket, indicating that the kernel should accept incoming connection requests directed to this socket.

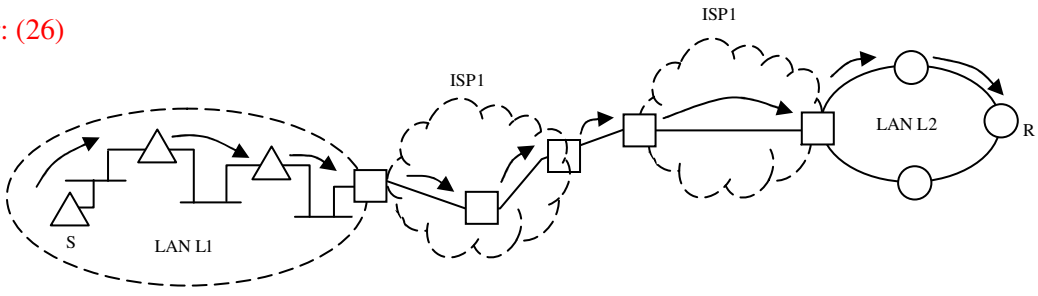
(d) The **accept function** is called by a TCP server to return the next completed connection from the front of the completed connection queue. If the completed connection queue is empty, the process is put to sleep (assuming the default of a blocking socket).

25. In the diagram shown below, L1 is an Ethernet LAN and L2 is a Token-Ring LAN. An IP packet originates from sender S and traverses to R, as shown. The links within each ISP and across the two ISPs, are all point-to-point' optical links. The initial value of the TTL field is 32. The maximum possible value of the TTL field when R receives the datagram is _____.



Answer: (26)

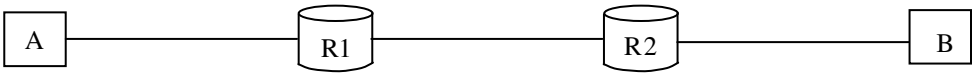
Exp:



The TTL field is set by the sender of the datagram, and reduced by every router on the route to its destination. So, there are 5visits at 5 routers and one visit at receiver R in above figure which leads 32 – 6 = 26.

Q. No. 26 – 55 Carry Two Marks Each

26. Consider the store and forward packet switched network given below. Assume that the bandwidth of each link is 10^6 bytes / sec. A user on host A sends a file of size 10^3 bytes to host B through routers R1 and R2 in three different ways. In the first case a single packet containing the complete file is transmitted from A to B. In the second case, the file is split into 10 equal parts, and these packets are transmitted from A to B. In the third case, the file is split into 20 equal parts and these packets are sent from A to B. Each packet contains 100 bytes of header information along with the user data. Consider only transmission time and ignore processing, queuing and propagation delays. Also assume that there are no errors during transmission. Let T1, T2 and T3 be the times taken to transmit the file in the first, second and third case respectively. Which one of the following is CORRECT?



(A) T1 < T2 < T3 (B) T1 > T2 > T3

(C) T2 = T3, T3 < T1 (D) T1 = T3, T3 > T2

Answer: (D)

Exp: Given Bandwidth = 10^6 bytes/sec

$L=10^3$ bytes

Case: 1

L = 1000 bytes

Header size = 100 bytes

Total Frame size = 1000 + 100 = 1100 bytes

$\therefore T_x = \frac{1100\times 8}{10^6\times 8} = 1100\ \mu s$

So, $T_1 = 3300\ \mu s$

Case: 2

L = 100 bytes

Header size = 100 bytes

Total Frame size = 100 + 100 = 200 bytes

$\therefore T_x = \frac{200\times 8}{10^6\times 8} = 200\ \mu s$ for 1 packet

For 10 packets $\Rightarrow$ Tx = 2000 μs

So, $T_2 = 2000 + 200 + 200 = 2400\ \mu s$

Case: 3

$L = 50$ bytes

Header size $= 100$ bytes

Total Frame size $= 50 + 100 = 150$ bytes

$\therefore T_x = \frac{150 \times 8}{10^6 \times 8} = 150\,\mu s$ for 1 packet

For 20 packets $\Rightarrow Tx = 3000\mu s$

So, $T_3 = 3000 + 150 + 150 = 3300\,\mu s$

$\therefore\ T_1 = T_3$

$T_3 > T_2$

27. An IP machine Q has a path to another IP machine H via three IP routers R1, R2, and R3.

Q—R1—R2—R3—H

H acts as an HTTP server, and Q connects to H via HTTP and downloads a file. Session layer encryption is used, with DES as the shared key encryption protocol. Consider the following four pieces of information:

[I1] The URL of the file downloaded by Q

[I2] The TCP port numbers at Q and H

[I3] The IP addresses of Q and H

[I4] The link layer addresses of Q and H

Which of I1, I2, I3, and I4 can an intruder learn through sniffing at R2 alone?

(A) Only I1 and I2 (B) Only I1 (C) Only I2 and I3 (D) Only I3 and I4

Answer: (C)

Exp: An Intruder can't learn [I1] through sniffing at R2 because URLs and Download are functioned at Application layer of OSI Model.

An Intruder can learn [I2] through sniffing at R2 because Port Numbers are encapsulated in the payload field of IP Datagram.

An Intruder can learn [I3] through sniffing at R2 because IP Addresses and Routers are functioned at network layer of OSI Model.

An Intruder can't learn [I4] through sniffing at R2 because it is related to Data Link Layer of OSI Model.

28. A graphical HTML browser resident at a network client machine *Q* accesses a static HTML webpage from a HTTP server *S*. The static HTML page has exactly one static embedded image which is also at *S*. Assuming no caching, which one of the following is correct about the HTML webpage loading (including the embedded image)?

(A) *Q* needs to send at least 2 HTTP requests to *S*, each necessarily in a separate TCP connection to server *S*

(B) *Q* needs to send at least 2 HTTP requests to *S*, but a single TCP connection to server *S* is sufficient

(C) A single HTTP request from *Q* to *S* is sufficient, and a single TCP connection between *Q* and *S* is necessary for this

(D) A single HTTP request from *Q* to *S* is sufficient, and this is possible without any TCP connection between *Q* and *S*

Answer: (B)

29. Consider the following schedule S of transactions T1, T2, T3, T4:

T1	T2	T3	T4
Writes [x] Commit	Reads[X]		
		Writes[X] Commit	
	Writes[Y] Reads [Z] Commit		
			Reads[X] Reads[Y] Commit

Which one of the following statements is CORRECT?

(A) S is conflict-serializable but not recoverable

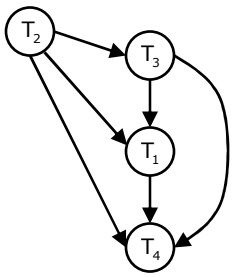
(B) S is conflict-serializable but is recoverable

(C) S is both conflict-serializable and recoverable

(D) S is neither conflict-serializable nor is it recoverable

Answer: (C)

Exp: The precedence graph of schedule s is a follows.



⇒ No cycle, so S is conflict serializable

In the schedule S of transactions T_1, T_2, T_3 and T_4 for each pair of transaction T_i and T_j, such that T_j reads a data item previously written by T_i the commit operation of T_j appears after the commit operation of T_i hence the schedule is recoverable schedule.

30. Consider a join (relation algebra) between relations r(R)and s(S) using the nested loop method. There are 3 buffers each of size equal to disk block size, out of which one buffer is reserved for intermediate results. Assuming size(r(R))<size(s(S)), the join will have fewer number of disk block accesses if

(A) relation r(R) is in the outer loop.

(B) relation s(S) is in the outer loop.

(C) join selection factor between r(R) and s(S) is more than 0.5.

(D) join selection factor between r(R) and s(S) is less than 0.5.

Answer: (A)

Exp: A join between r(R) and s (S) using nested loop method will be as follows.

For each tuple r in R do

For each tuple s in S do

If r and s satisfy the join condition then output the tuple <r,s>

This algorithm will involve $n_r*b_s+b_r$ block transfers and n_r+b_r seeks, where b_r and b_s are number of blocks in relations R and S respectively and n_r is number of tuple in relation R. Now to have less block accesses, n_r should be less and it is already given that |R|<|S|. Relation r(R) should be in the outer loop to have fewer number of disk block accesses.

31. Consider the procedure below for the *Producer-Consumer* problem which uses semaphores:

```
Semaphore n = 0;
Semaphore s = 1;
Void producer ( )                    Void consumer( )
{                                    {
    while (true)                         while(true)
    {                                    {
    Produce ( );                         semWait (s) ;
    SemWait (s);                         semWait (n) ;
    addToBuffer ( );                removeFromBuffer ( ) ;
    semSignal (s);                       semsignal (s);
    semSignal (n);                       consume ( ) ;
    }                                    }
}                                         }
```

Which one of the following is TRUE?

(A) The producer will be able to add an item to the buffer, but the consumer can never consume it.

(B) The consumer will remove no more than one item from the buffer.

(C) Deadlock occurs if the consumer succeeds in acquiring semaphore **s** when the buffer is empty.

(D) The starting value for the semaphore **n** must be 1 and not 0 for deadlock-free operation.

Answer: (C)

Exp: (A) The producer will be able to add an item to the buffer, but the consumer can never consume if given statement is false, because once producer produces an item and places in buffer, the next turn to execute can be given to consumer ( ). [The value of s = 1 and n=1]. So consumer will be definitely able to consume it by performing successful down operations on s and n.

(B) The consumer will remove no more than one item from the buffer.

Given statement is false as if p( ) produces and adds to buffer, (c) will consume the added item, this sequence of alteration (p and c) will always make consumer to remove items from buffer.

This statement would have been true if it was said that the consumer will remove no more than one item from the buffer one after the other. (at a time).

(C) Dead lock occurs if the consumer succeeds in acquiring semaphore's' when the buffer is empty. Given statement is true as when buffer is empty initially if consumer gets the turn to execute as follows:-

```
S = 1,   n = 0;
consumer( )
{
  while (True)
  {
   p(s);[s = \0]
   p(s); [m = 0; it blocks consumer]
   }
}
producer( )
{
  while (True)
  {
   producer( );
   p(s);[s = 0; it blocks p( )]
   }
}
```


So from the above execution both producer and consumer goes in block state waiting for each other to wake them up and hence dead lock occurs.

(D) Even if the starting value for the semaphore 'n' becomes 1, there will be invalid execution of consumer on buffer empty condition, which should not happen. So statement is false.

32. Three processes A, B and C each execute a loop of 100 iterations. In each iteration of the loop, a process performs a single computation that requires t_c CPU milliseconds and then initiates a single I/O operation that lasts for t_{io} milliseconds. It is assumed that the computer where the processes execute has sufficient number of I/O devices and the OS of the computer assigns different I/O devices to each process. Also, the scheduling overhead of the OS is negligible. The processes have the following characteristics:

Process id	t_c	t_{io}
A	100ms	500ms
B	350ms	500ms
C	200ms	500ms

The processes A, B, and C are started at times 0, 5 and 10 milliseconds respectively, in a pure time sharing system (round robin scheduling) that uses a time slice of 50 milliseconds. The time in milliseconds at which process C would ***complete*** its first I/O operation is _____.

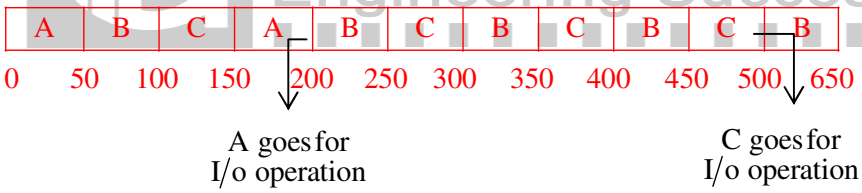
Answer: (1000)

Exp:

Process id	t_c	t_{io}	A.T	TQ = 50ms
A	100 ms	500 ms	0 ms	
B	350 ms	500 ms	5 ms	
C	200 ms	500 ms	10 ms	

The Gantt chart for Round robin algorithm for the first iteration execution for each of the 3 processes is as follows:

R .Q ~~A~~ ~~B~~ ~~C~~ A



After finishing t_c CPU ms at time 500ms, C goes for I/O operation, that needs 500ms more, so the time at which process C would complete its first I/O operations is 500+500 = 1000ms

33. A computer has twenty physical page frames which contain pages numbered 101 through 120. Now a program accesses the pages numbered 1, 2, …, 100 in that order, and repeats the access sequence THRICE. Which one of the following page replacement policies experiences the same number of page faults as the optimal page replacement policy for this program?

(A) Least-recently-used (B) First-in-first-out

(C) Last-in-first-out (D) Most-recently-used

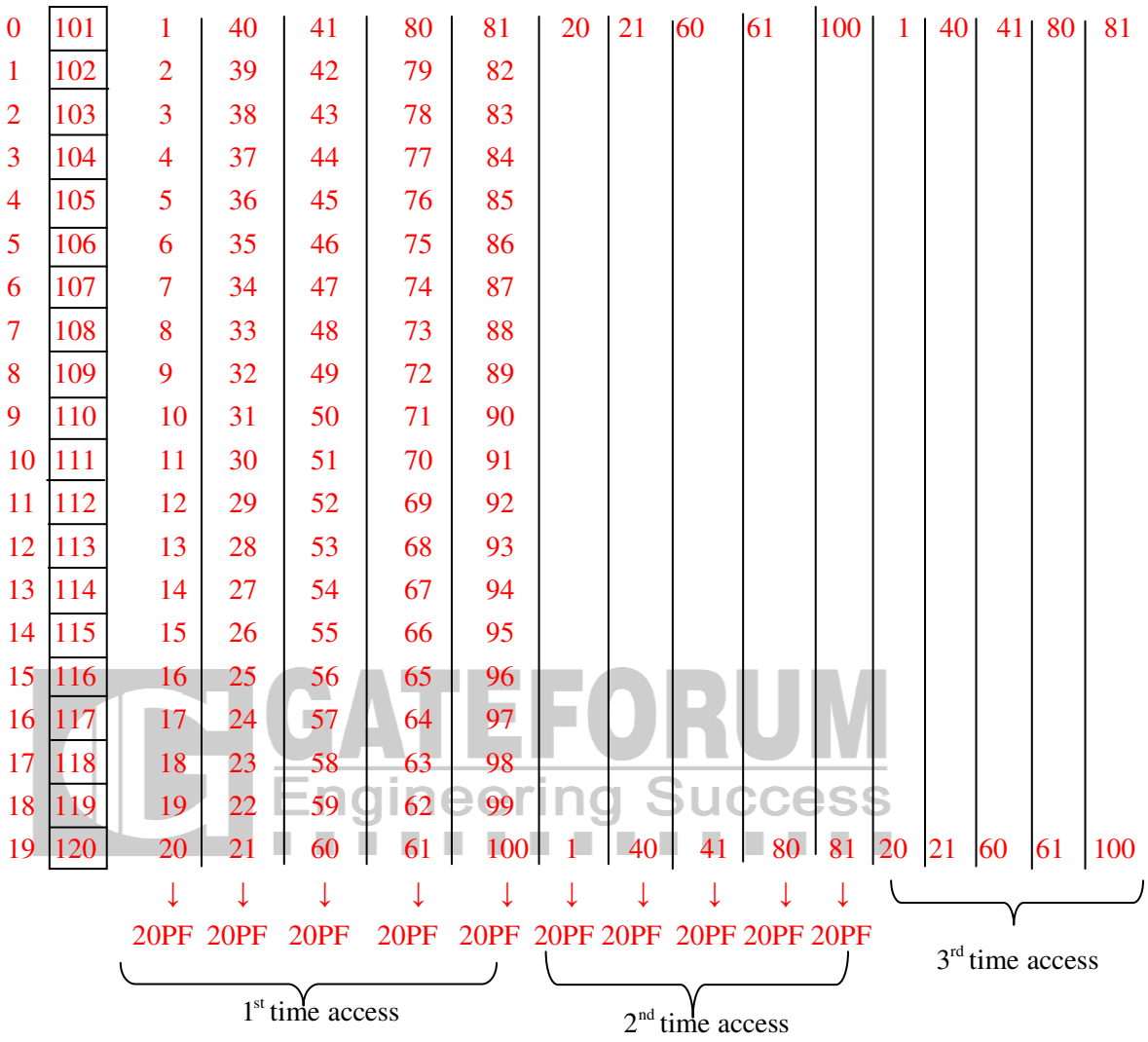
Answer: (D)

Exp: Page reference string for the program will be:-

1, 2, 3, 4, ----------100, 1, 2, 3, 4, ----------100, 1, 2, 3, 4, ----------100,

The current status of 20 frames shows page numbers from 101 to 120.

Implementation of optimal page replacement policy for above given page reference string would be as follows:



So there would be 300 page faults in total (each access 100 page faults).

Also it is visible that every time a replacement is done for the page which is most recently referred as it will be least recently referred in future. So for the given page reference string optimal page replacement policy is working same as most recently used policy and thus number of page faults will be same in both of them.

34. For a C program accessing **X[i] [j] [k]**, the following intermediate code is generated by a compiler. Assume that the size of an **integer** is 32 bits and the size of a **character** is 8 bits.

t0 = i * 1024

t1 = j * 32

t2 = k * 4

t3 = t1 + t0

t4 = t3 + t2

t5 = X[t4]

Which one of the following statements about the source code for the C program is **CORRECT**?

(A) X is declared as "int X[32] [32] [8]".
(B) X is declared as "int X[4] [1024] [32]".
(C) X is declared as "char X[4] [32] [8]".
(D) X is declared as "char X[32] [16] [2]".

Answer: (A)

Exp: It is given that Size of int is 4B and of char is 1B. The memory is byte addressable.
Let the array be declared as Type X[A][B][C] (where Type = int/char and A,B,C are natural numbers).
From t0 = i*1024, we conclude that B*C*(size of Type) = 1024.
From t1 = j*32, we conclude that C*(size of Type) = 32.
From t2 = k*4, we conclude that size of Type = 4.
⇨ Type = int, and
⇨ C = 8, and
⇨ B = 32.

35. Let < M > be the encoding of a Turing machine as a string over $\Sigma = \{0,1\}$. Let L = {<M> |M is a Turning machine that accepts a string of length 2014}. Then, L is
(A) decidable and recursively enumerable
(B) undecidable but recursively enumerable
(C) undecidable and not recursively enumerable
(D) decidable but not recursively enumerable

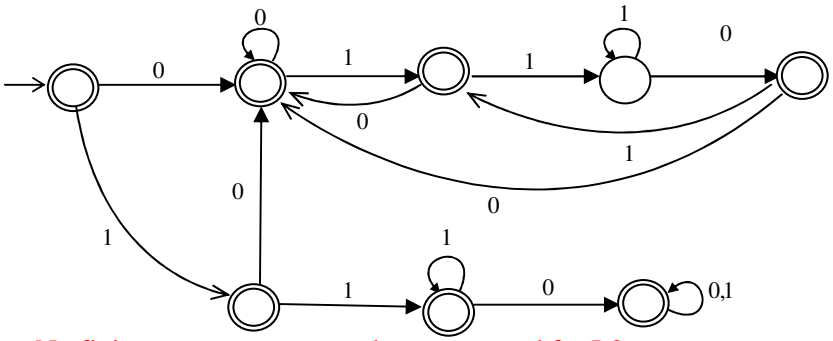
Answer: (B)

Exp: The language accepted by the Turing machine is recursively enumerable. If is undecidable as the Turing machine may halt or it may loop for the strings whose length is not equal to 2014.

36. Let $L_1 = w \in \{0,1\}^* | w$ has at least as many occurrences of (110)'s as (011)'s}. Let $L_2 = \{w \in \{0,1\}^* |$ w has at least as many occurrence of (000)'s as (111)'s}. Which one of the following is TRUE?
(A) L_1 is regular but not L_2
(B) L_2 is regular but not L_1
(C) Both L_1 and L_2 are regular
(D) Neither L_1 nor L_2 are regular

Answer: (A)

Exp: The automaton for L1 is as follows:



No finite state automata can be constructed for L2.

37. Consider two strings A = "q pqrr" and B = "pqprqrp". Let x be the length of the longest common subsequence (not necessarily contiguous) between A and B and let y be the number of such longest common subsequences between A and B. Then $x + 10y$ = ___.

Answer: (34)

Exp: Given is

A = "qpqrr" B = "pqprqrp"

The longest common subsequence (not necessarily contiguous) between A and B is having 4 as the length, so x=4 and such common subsequences are as follows:

(1) qpqr

(2) pqrr

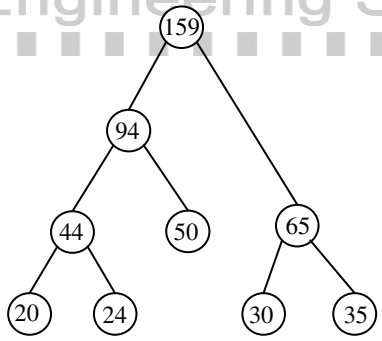
(3) qprr

So y = 3 (the number of longest common subsequences) hence x+10y = 4+10*3 = 34.

38. Suppose P, Q, R, S, T are sorted sequences having lengths 20, 24, 30, 35, 50 respectively. They are to be merged into a single sequence by merging together two sequences at a time. The number of comparisons that will be needed in the worst case by the optimal algorithm for doing this is ____.

Answer: (358)

Exp: The implementation of optimal algorithm for merging sequences is as follows.

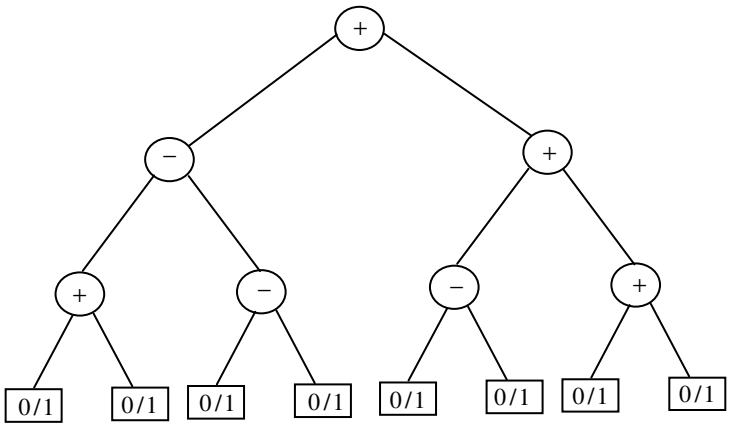


In the above implementation, total number of comparisons is

(44-1)+(94-1)+(65-1)+(159-1) = 358

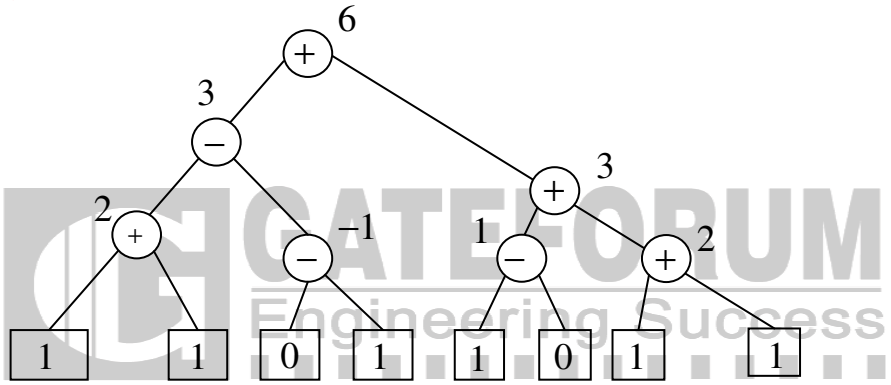
Hint: The number of comparisons for merging two sorted sequences of length m and n is m+n-1.

39. Consider the expression tree shown. Each leaf represents a numerical value, which can either be 0 or 1. Over all possible choices of the values at the leaves, the maximum possible value of the expression represented by the tree is ___.



Answer: (6)

Exp:



So as per the above tree where leaves have been given the values, the maximum possible value of the expression represented by the tree is 6.

40. Consider the following function

```
double  f (double x) {
if ( abs (x*x – 3) <  0. 01) return x;
else return f (x / 2 + 1.5/x);
}
```

Give a value q (to 2 decimals) such that f (q) will return q:_____

Answer: (1.72 to 1.74)

Exp: If condition given in function definition should be 'TRUE', for $f(q)$ to return value q.

The condition is as follows:

$\text{if } (\text{abs}(x \times x - 3) < 0.01) \text{ return } x;$

The above condition will be true when x=1.73.

41. Suppose a stack implementation supports an instruction REVERSE, which reverses the order of elements on the stack, in addition to the PUSH and POP instructions. Which one of the following statements is TRUE with respect to this modified stack?

(A) A queue cannot be implemented using this stack.

(B) A queue can be implemented where ENQUEUE takes a single instruction and DEQUEUE takes a sequence of two instructions.

(C) A queue can be implemented where ENQUEUE takes a sequence of three instructions and DEQUEUE takes a single instruction.

(D) A queue can be implemented where both ENQUEUE and DEQUEUE take a single instruction each.

Answer: (C)

Exp: Option (a) is false because queue can be implemented by using the modified stack as by reversing the stack. LIFO will become FIFO.

Implementation of ENQUEUE & DEQUEUE takes four sequence of instructions as follows:

1. Enqueue: Reverse, Push, Revesre
   Dequeue: POP
   (OR)
2. Enqueue: Push
   Dequeue: Reverse, POP, Reverse

42. Consider the C function given below

```
int f(int j)
{
static int i = 50;
int k;
if (i == j)
  {
printf("something");
k = f(i);
return 0;
}
else return 0;
}
```

Which one of the following is **TRUE**?

(A) The function returns 0 for all values of j.

(B) The function prints the string something for all values of j.

(C) The function returns 0 when j = 50.

(D) The function will exhaust the runtime stack or run into an infinite loop when j = 50.

Answer: (D)

Exp: For any value of 'j' other than 50 the function will return 0, for j=50, then condition (i==j) will be true, it will print "something" and function will be called recursively with same value till the run time stack overflows.

43. In designing a computer's cache system, the cache block (or cache line) size is an important Parameter. Which one of the following statements is correct in this context?

(A) A smaller block size implies better spatial locality

(B) A smaller block size implies a smaller cache tag and hence lower cache tag overhead

(C) A smaller block size implies a larger cache tag and hence lower cache hit time

(D) A smaller block size incurs a lower cache miss penalty

Answer: (D)

Exp: When a cache block size is smaller, it could accommodate more number of blocks, it improves the hit ratio for cache, so the miss penalty for cache will be lowered.

44. If the associativity of a processor cache is doubled while keeping the capacity and block size unchanged, which one of the following is guaranteed to be NOT affected?

(A) Width of tag comparator

(B) Width of set index decoder

(C) Width of way selection multiplexor

(D) Width of processor to main memory data bus

Answer: (D)

Exp: When associativity is doubled, then the set offset will be effected, accordingly, the number of bits used for TAG comparator be effected.

Width of set index decoder also will be effected when set offset is changed.

Width of wag selection multiplexer wil be effected when the block offset is changed.

With of processor to main memory data bus is guaranteed to be NOT effected.

45. The value of a *float* type variable is represented using the single-precision 32-bit floating point format of IEEE-754 standard that uses 1 bit for sign, 8 bits for biased exponent and 23 bits for mantissa. A *float* type variable X is assigned the decimal value of -14.25. The representation of X in hexadecimal notation is

(A) C1640000H (B) 416C0000H (C) 41640000H (D) C16C0000H

Answer: (A)

Exp: (A)

S	E	M
1 bit	8 bits	23 bits

$(14.25)_{10} = (1110.01)_2$

1110.01×2^0

$= 1.11001 \times 2^3$

$S: 1$

$E: (3+127)_{10} = (10000010)_2$

$M: 11001000 - - - - -$

Value stored:

$\underbrace{1\,1\,0\,0\,0\,0\,0}_{[C}\ \underbrace{1\,0\,1\,1\,0\,0}_{1}\ \underbrace{1\,0\,0}_{6}\ \underbrace{0\,0}_{4}\ \underbrace{0\,0\,0\,0}_{0\ 0\ 0\ 0\ ]_H} - - -$

46. In the Newton-Raphson method, an initial guess of $x_0 = 2$ is made and the sequence $x_0, x_1, x_2 \ldots$ is obtained for the function

$$0.75x^3 - 2x^2 - 2x + 4 = 0$$

Consider the statements

(I) $x_3 = 0$.

(II) The method converges to a solution in a finite number of iterations.

Which of the following is TRUE?

(A) Only I (B) Only II (C) Both I and II (D) Neither I nor II

Answer: (A)

Exp: $f(x) = 0.75\,x^3 - 2x^2 - 2x + 4; f'(x) = 2.25x^2 - 4x - 2$

$x_0 = 2, f_0 = -2; f_0' = -1$

$\therefore x_1 = x_0 - \frac{f_0}{f_0'} = 0$

$\Rightarrow f_1 = 4; f_1' = -2$

$\therefore x_2 = x_1 - \frac{f_1}{f_1'} = 2$

$\Rightarrow f_2 = -2, f_2' = -1$

$\therefore x_3 = x_2 - \frac{f_2}{f_2'} = 0$

Also, root does not lies between 0 and 1.

So, the method diverges if $x_0 = 2$

$\therefore$ only (I) is true.

47. The product of the non-zero eigenvalues of the matrix

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

is_____.

Answer: (6)

Exp: Let $A = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}$

Let $X = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$ be eigen vector

By the definition of eigen vector, $AX = \lambda X$

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \lambda \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

$x_1 + x_5 = \lambda x_5$

$x_2 + x_3 + x_4 = \lambda x_2$

$x_2 + x_3 + x_4 = \lambda x_3$

$x_2 + x_3 + x_4 = \lambda x_4$

$x_1 + x_5 = \lambda x_4 \Rightarrow x_1 + x_5 = \lambda x_5 = \lambda x_4$

and $x_2 + x_3 + x_4 = \lambda x_2 = \lambda x_3 = \lambda x_4$

(1) If $\lambda \neq 0$ say $x_1 = x_5 = a$

$x_2 = x_3 = x_4 = b$

$\Rightarrow x_1 + x_5 = \lambda a \Rightarrow 2a = \lambda a \Rightarrow \lambda = 2$

$x_2 + x_3 + x_4 = \lambda a \Rightarrow 3a = \lambda a \Rightarrow \lambda = 3$

(2) if $\lambda = 0 \Rightarrow$ eigen value =0

$\therefore$ Three distinct eigen values are 0,2,3 product of non zero eigen values =2×3=6

48. The probability that a given positive integer lying between 1 and 100 (both inclusive) is NOT divisible by 2, 3 or 5 is _____ .

Answer: (0.259 to 0.261)

Exp: Let A = divisible by 2, B = divisible by 3 and C = divisible by 5, then

n(A) = 50, n(B) = 33, n(C) = 20

n(A∩B) = 16, n(B∩C) = 6, n(A∩C) = 10

n(A∩B∩C) = 3

P(A∪B∪C) = P(A)+P(B)+P(C) – P(A∩B)-P(B∩C)-P(A∩C)+P(A∩B∩C) = 74/100

$\therefore$ Required probability is $P(\overline{A} \cap \overline{B} \cap \overline{C}) = 1 - P(A \cup B \cup C) = 0.26.$

49. The number of distinct positive integral factors of 2014 is _____

Answer: (8)

Exp: 2014 = 2×19×53 i.e., product of prime factors

$\therefore$ Number of distinct positive integral factors of 2014 is (2)×(2)×(2) = 8.

50. Consider the following relation on subsets of the set S of integers between 1 and 2014. For two distinct subsets U and V of S we say U < V if the minimum element in the symmetric difference of the two sets is in U.

Consider the following two statements:

S1: There is a subset of S that is larger than every other subset.
S2: There is a subset of S that is smaller than every other subset.

Which one of the following is CORRECT?

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

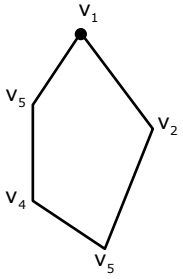
Answer: (A)

Exp: From given data S1 is true ,since null set is larger than every other set ,and S2 is true since the universal set {1,2,...,2014} is smaller than every other set.
Both s1 and s2 are true.

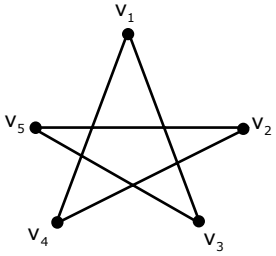
51. A cycle on *n* vertices is isomorphic to its complement. The value of *n* is _____.

Answer: (5)

Exp: The number of edges in C_n is n where as the number of edges in C_n' is $n_{c_2} - n$
Cycle graph C_n and its complement C_n' have different number of edges if $n \neq 5$
Consider a cycle on five vertices C_5



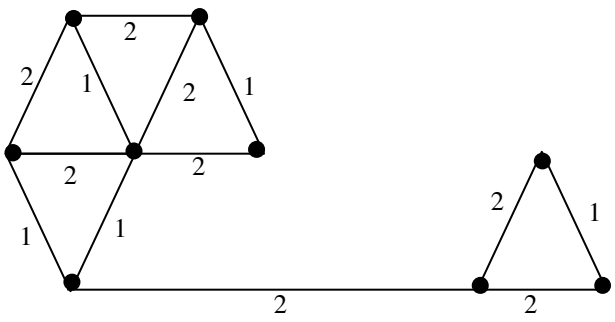
C_5



C_5 and C_5' are isomorphic
$\therefore n = 5$

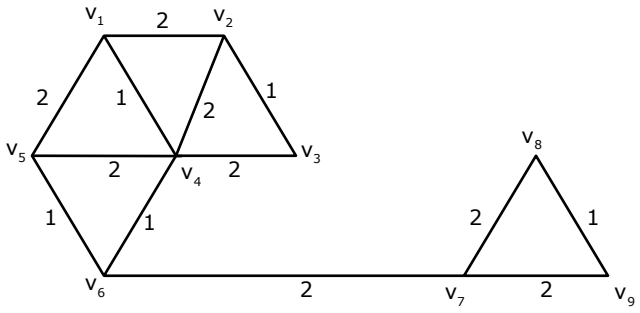
$(\text{complement of } C_5) = C_5'$

52. The number of distinct minimum spanning trees for the weighted graph below is



Answer: (6)

Exp: Consider the connected weighted graph (Application of Kruskal's Algorithm)



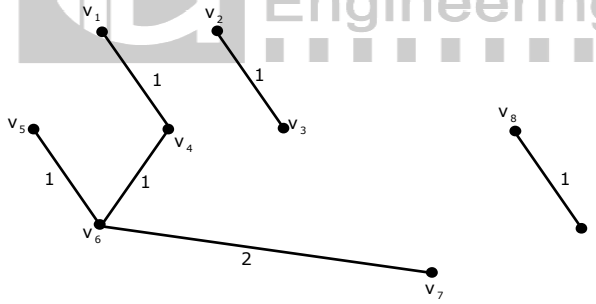
Sort the edges by increasing edges costs (weights)

$[\{v_1,v_4\},\{v_2,v_3\},\{v_4,v_6\},\{v_5,v_6\},\{v_8,v_9\}(\text{Cost}-1)$

$[\{v_1,v_2\},\{v_2,v_4\},\{v_4,v_3\},\{v_4,v_5\},\{v_1,v_5\}$ (3)

$\{v_6,v_7\},\{v_7,v_8\},\{v_7,v_9\}(\text{cost}-2)]$ (2)

Selection of edges of cost-1, will not form a cycle, so



Selection of $\{v_4,v_5\}$ and $\{v_1,v_5\}$ forms a cycle, so we will not consider the edges. The edge $\{v_6,v_7\}$ can be choosen because of connectedness.

Selection of $\{v_1,v_2\}$ and $\{v_7,v_8\}$ forms one minimum spanning tree.

Selection of $\{v_1,v_2\}$ and $\{v_7,v_9\}$ forms one minimum spanning tree.

Selection of $\{v_2,v_4\}$ and $\{v_7,v_8\}$ forms one minimum spanning tree.

Selection of $\{v_2,v_4\}$ and $\{v_7,v_9\}$ forms one minimum spanning tree.

Selection of $\{v_3,v_4\}$ and $\{v_7,v_8\}$
Selection of $\{v_3,v_4\}$ and $\{v_7,v_9\}$
} forms two minimum spanning trees

$\therefore$ There are 6 distinct minimum spanning trees.

53 Which one of the following Boolean expressions is NOT a tautology?

(A) $((a \to b) \wedge (b \to c)) \to (a \to c)$

(B) $(a \leftrightarrow c) \to (\sim b \to (a \wedge c))$

(C) $(a \wedge b \wedge c) \to (c \wedge a)$

(D) $a \to (b \to a)$

Answer: (B)

Exp: (D) $a \to (b \to a) (\Rightarrow \neg a \vee (b \to a)) (\Rightarrow \neg a \vee (\neg b \vee a)) \Leftrightarrow T(\text{tautology})$

(C) $(a \wedge b \wedge c) \to (c \vee a) \Leftrightarrow \neg(a \wedge b \wedge c) \vee (c \vee a)$

$\Leftrightarrow (\neg a \vee \neg b \vee \neg c) \vee (c \vee a)$

$\Leftrightarrow (\neg a \vee a) \vee P$ (where P is disjunction of literals)

$\Leftrightarrow T \vee P \Rightarrow T$

(a) $\dfrac{\begin{array}{l} a \to b \\ b \to c \end{array}}{\therefore a \to c}$ by hypothetical syllogism

$((a \to b) \wedge (b \to c)) \to (a \to c)$ is a tautology

Answer is B which is not tautology.

54 SQL allows duplicate tuples in relations, and correspondingly defines the multiplicity of tuples in the result of joins. Which one of the following queries always gives the same answer as the nested query shown below:

Select * from R where a in (select S. a from S)

(A) Select R. * from R, S where R. a=S. a

(B) Select distinct R. * from R,S where R. a=S. a

(C) Select R. * from R, (select distinct a from S) as S1 where R. a=S1.a

(D) Select R. * from R, S where R.a = S. a and is unique R

Answer: (C)

Exp: Consider the following instances of R & S

a	b	c
1	2	3
1	2	3
3	4	5
3	4	5

a	d	e

1	2	3
2	3	4
3	4	6
3	4	6

O/P of given nested query is

a b c

1	2	3
1	2	3
3	4	5
3	4	5

(A) O/P:- multiplicity of tuples is disturbed

a b c

1	2	3
1	2	3
3	4	5
3	4	5
3	4	5
3	4	5

(B) O/P:-

a b c

1	2	3
3	4	5

(C) O/P:-

a b c Multiplicity of tuples is maintained

1	2	3
1	2	3
3	4	5
3	4	5

Multiplicity of duplicate tuples will be distributed when there is a match between R.a and S.a and for that match S.a's value is repeated.

55 Consider a main memory system that consists of 8 memory modules attached to the system bus, which is one word wide. When a write request is made, the bus is occupied for 100 nanoseconds (ns) by the data, address, and control signals. During the same 100 ns, and for 500 ns thereafter, the addressed memory module executes one cycle accepting and storing the data. The (internal) operation of different memory modules may overlap in time, but only one request can be on the bus at any time. The maximum number of stores (of one word each) that can be initiated in 1 millisecond is _____

Answer: (10000)

Exp: Each write request, the bus is occupied for 100 n.s

Storing of data requires 100 n.s.

In 100 n.s – 1 store

$\frac{100}{10^6}$ n.s = 1 store

1 m.s = $\frac{10^6}{100}$ stores

= 10000 stores