Q. No. 1 – 5 Carry One Mark Each

1. Which of the following options is the closest in meaning to the phrase underlined in the sentence below?
    It is fascinating to see life forms <u>cope with</u> varied environmental conditions.
    (A) Adopt to   (B) Adapt to   (C) Adept in   (D) Accept with

Answer: (B)

2. Choose the most appropriate word from the options given below to complete the following sentence.
    He could not understand the judges awarding her the first prize, because he thought that her performance was quite _____.
    (A) Superb   (B) Medium   (C) Mediocre   (D) Exhilarating

Answer: (C)

3. In a press meet on the recent scam, the minister said, "The buck stops here". What did the minister convey by the statement?
    (A) He wants all the money   (B) He will return the money
    (C) He will assume final responsibility   (D) He will resist all enquiries

Answer: (C)

4. If $\left(z+1/z\right)^2 = 98,$ compute $\left(z^2+1/z^2\right)$

Answer: (96)

Exp: Expanding

$$z^2 + \frac{1}{z^2} + 2.z.\frac{1}{z} = 98 \Rightarrow z^2 + \frac{1}{z^2} = 96$$

5. The roots of $ax^2 + bx + c = 0$ are real and positive a, b and c are real. Then $ax^2 + b|x| + c = 0$ has
    (A) No roots   (B) 2 real roots   (C) 3 real roots   (D) 4 real roots

Answer: (D)

Exp: $ax^2+bx+c=0$

for roots to be real & +ve

$b^2-4ac>0$

This will have 2 real positive roots.

$ax^2 + b|x| + c = 0$

This can be written as;

$ax^2 + bx + c$

$Discri\min ant = b^2 - 4ac > 0$

$ax^2 - bx + c$

$(-b)^2 - 4ac$

$\Rightarrow b^2 - 4ac$

Is also >0. This will have real roots

$\Rightarrow$ This will have 4 real roots.

Q.No. 6 – 10 Carry One Mark Each

6.   The Palghat Gap (or Palakkad Gap), a region about 30 km wide in the southern part of the Western Ghats in India, is lower than the hilly terrain to its north and south. The exact reasons for the formation of this gap are not clear. It results in the neighbouring regions of Tamil Nadu getting more rainfall from the South West monsoon and the neighbouring regions of Kerala having higher summer temperatures.

What can be inferred from this passage?

(A) The Palghat gap is caused by high rainfall and high temperatures in southern Tamil Nadu and Kerala

(B) The regions in Tamil Nadu and Kerala that are near the Palghat Gap are low–lying

(C) The low terrain of the Palghat Gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala

(D) Higher summer temperatures result in higher rainfall near the Palghat Gap area

Answer: (C)

7.   Geneticists say that they are very close to confirming the genetic roots of psychiatric illnesses such as depression and schizophrenia, and consequently, that doctors will be able to eradicate these diseases through early identification and gene therapy.

On which of the following assumptions does the statement above rely?

(A) Strategies are now available for eliminating psychiatric illnesses

(B) Certain psychiatric illnesses have a genetic basis

(C) All human diseases can be traced back to genes and how they are expressed

(D) In the future, genetics will become the only relevant field for identifying psychiatric illnesses

Answer: (B)

8.   Round–trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is Rs 100, a group of 5 tourists purchasing round–trip tickets will be charged Rs _____

Answer: (850)

Exp: One way force =100

Two way fare per person=200

5 persons=1000/-

Total discount applicable=10+5=15%

Discount amount $= \dfrac{15}{100} \times 1000 = 150$

Amount to be paid=1000-150=850

9. In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter?

		Men	Women
Own vehicle	Car	40	34
	Scooter	30	20
	Both	60	46
Do not own vehicle		20	50

Answer: (48)

Exp: Total respondents=300

Those who don't have scooter

$\Rightarrow$ Men= 40+20=60

$Women = 34 + 50 = \dfrac{84}{144}$

$\% = \dfrac{144}{300} \times 100 = 48\%$

10. When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines? _____

Answer: (6)

1. Consider the statement:

   "Not all that glitters is gold"

   Predicate glitters (x) is true if x glitters and predicate gold (x) is true if x is gold. Which one of the following logical formulae represents the above statement?

   (A) $\forall x;\ \text{glitters}(x) \Rightarrow \neg\text{gold}(x)$ (B) $\forall x;\ \text{gold}(x) \Rightarrow \text{glitters}(x)$

   (C) $\exists x;\ \text{gold}(x) \wedge \neg\text{glitters}(x)$ (D) $\exists x;\ \text{glitters}(x) \wedge \neg\text{gold}(x)$

   Answer: (D)

   Exp: It means "It is false that every glitter is gold" or "some glitters are not gold".

        Then we can say "atleast one glitter object is not gold".

2. Suppose you break a stick of unit length at a point chosen uniformly at random. Then the expected length of the shorter stick is _____ .

   Answer: (0.25)

   Exp: The smaller sticks, therefore, will range in length from almost 0 meters up to a maximum of 0.5 meters, with each length equally possible.

        Thus, the average length will be about 0.25 meters, or about a quarter of the stick.

3. Let G=(V,E) be a directed graph where V is the set of vertices and E the set of edges. Then which one of the following graphs has the same strongly connected components as *G?*

   (A) $G_1 = (V, E_1)$ where $E_1 = \{(u,v) \mid (u,v) \notin E\}$

   (B) $G_2 = (V, E_2)$ where $E_2 = \{(u,v) \mid (v,u) \notin E\}$

   (C) $G_3 = (V, E_3)$ where $E_3 = \{(u,v) \mid \text{there is a path of length} \leq 2 \text{ from } u \text{ to } v \text{ in } E\}$

   (D) $G_4 = (V_4, E)$ where V_4 is the set of vertices in G which are not isolated

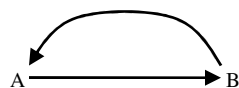   Answer: (B)

   Exp: Take an example for Graph G

   .   .

   A   B

   Then option A and D will be eliminated.

   Let G is below graph

   A ————▶ B

   Then G_3 is a graph with below structure

   A ————▶ B

   In G the numbers of strongly connected components are 2 where as in G_3 it is only one.

4   Consider the following system of equations:

$3x + 2y = 1$

$4x + 7z = 1$

$x + y + z = 3$

$x - 2y + 7z = 0$

The number of solutions for this system is _____

Exp: $3x + 2y = 1$

$4x + 7z = 1$

$x + y + z = 3$

$x - 2y + 7z = 0$

Augmented matrix is $\begin{bmatrix} 3 & 2 & 0 & 1 \\ 4 & 0 & 7 & 1 \\ 1 & 1 & 1 & 3 \\ 1 & -2 & 7 & 0 \end{bmatrix}$

$R_1 \leftrightarrow R_3 \begin{bmatrix} 1 & 1 & 1 & 3 \\ 4 & 0 & 7 & 1 \\ 3 & 2 & 0 & 1 \\ 1 & -2 & 7 & 0 \end{bmatrix}$

$R_2 \rightarrow R_2 - 4R_1 \ R_3 \rightarrow R_3 - 3R_1, \ R_4 \rightarrow R_4 - R_1$

$\begin{bmatrix} 1 & 1 & 1 & 3 \\ 0 & -4 & 3 & -11 \\ 0 & -1 & -3 & -8 \\ 0 & -3 & 6 & -3 \end{bmatrix}$

$R_3 \rightarrow 4R_3 - R_2$

$R_4 \rightarrow 4R_4 - 3R_2$ $\begin{bmatrix} 1 & 1 & 1 & 3 \\ 0 & -4 & 3 & -11 \\ 0 & 0 & -15 & -21 \\ 0 & 0 & 15 & 21 \end{bmatrix}$

$R_4 \rightarrow R_4 + R_3$ $\begin{bmatrix} 1 & 1 & 1 & 3 \\ 0 & -4 & 3 & -11 \\ 0 & 0 & -15 & -21 \\ 0 & 0 & 0 & 0 \end{bmatrix}$

$\rho(A:B) = \rho(A) = 3 = $ no. of variables

$\therefore$ Unique solution exists

5.   The value of the dot product of the eigenvectors corresponding to any pair of different eigen values of a 4-by-4 symmetric positive definite matrix is _____.

Exp: (The eigen vectors corresponding to distinct eigen values of real symmetric matrix are orthogonal)

6. Let the function

$$f(\theta) = \begin{vmatrix} \sin\theta & \cos\theta & \tan\theta \\ \sin(\pi/6) & \cos(\pi/6) & \tan(\pi/6) \\ \sin(\pi/3) & \cos(\pi/3) & \tan(\pi/3) \end{vmatrix}$$

Where $\theta = \in \left[\dfrac{\pi}{6}, \dfrac{\pi}{2}\right]$ and $f'(\theta)$ denote the derivative of f with respect to θ. Which of the following statement is / are TRUE?

(I) There exists $\theta \in \left(\dfrac{\pi}{6}, \dfrac{\pi}{3}\right)$ such that $f'(\theta) = 0$.

(II) There exists $\theta \in \left(\dfrac{\pi}{6}, \dfrac{\pi}{3}\right)$ such that $f'(\theta) \neq 0$.

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

Answer: (C)

Exp: (By Mean value theorem)

7. Consider the following Boolean expression for *F*:

$$F(P,Q,R,S) = PQ + \overline{P}QR + \overline{P}Q\overline{R}S$$

The minimal sum-of products form of F is

(A) $PQ + QR + QS$

(B) $P + Q + R + S$

(C) $\overline{P} + \overline{Q} + \overline{R} + \overline{S}$

(D) $\overline{P}R + \overline{P}\overline{R}S + P$

Answer: (A)

Exp: $PQ + \overline{P}QR + \overline{P}Q\overline{R}S$

$= PQ + \overline{P}Q(R + \overline{R}S)$

$= PQ + \overline{P}Q\left((R + \overline{R})(R + S)\right)\left[\because A + BC = (A + B)(A + C)\right]$

$= PQ + \overline{P}Q(R + S)\left[\because R + \overline{R} = 1\right]$

$= Q(P + \overline{P}(R + S))$

$= Q\left((P + \overline{P})(P + R + S)\right)\left[\because A + BC = (A + B)(A + C)\right]$

$= Q(P + R + S) \qquad \because \left[P + \overline{P} = 1\right]$

$= PQ + QR + QS$

8.   The base (or radix) of the number system such that the following equation holds is_____.

$$\frac{312}{20} = 13.1$$

Exp: Let 'x' be the base or radix of the number system

$$\frac{2 \times x^{\circ} + 1 \times x + 3 \times x^2}{0 \times x^{\circ} + 2 \times x} = 3 \times x^{\circ} + 1 \times x + 1 \times x^{-1}$$

$$\Rightarrow \frac{2 + x + 3x^2}{2x} = 3 + x + \frac{1}{x}$$

$$\Rightarrow \frac{3x^2 + x + 2}{2x} = \frac{3x + x^2 + 1}{x}$$

$$\Rightarrow 3x^2 + x + 2 = 6x + 2x^2 + 2$$

$$\Rightarrow x^2 - 5x = 0$$

$$\Rightarrow x(x - 5) = 0$$

$$\Rightarrow x = 0 \text{ or } x = 5$$

As base or radix of a number system cannot be zero, here $x = 5$

9.   A machine has a 32-bit architecture, with 1-word long instructions. It has 64 registers, each of which is 32 bits long. It needs to support 45 instructions, which have an immediate operand in addition to two register operands. Assuming that the immediate operand is an unsigned integer, the maximum value of the immediate operand is _____.
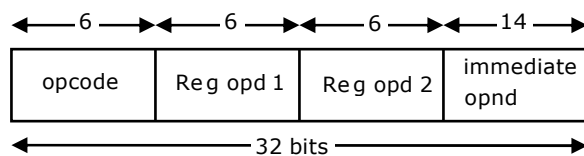
Exp: 1 Word = 32 bits

Each instruction has 32 bits

To support 45 instructions, opcode must contain 6-bits

Register operand1 requires 6 bits, since the total registers are 64.

Register operand 2 also requires 6 bits

14-bits are left over for immediate Operand Using 14-bits, we can give maximum 16383, Since $2^{14} = 16384$ (from 0 to 16383)

10. Consider the following program in C language:

```
# include < stdio.h >
main( )
{
int  i;
int *pi = &i;
scanf ("%d", pi);
printf ("%d\n", i+5);
}
```

Which one of the following statements is **TRUE**?
(A) Compilation fails.
(B) Execution results in a run-time error.
(C) On execution, the value printed is **5** more than the address of variable **i**.
(D) On execution, the value printed is **5** more than the integer value entered.

Answer: (D)

Exp: pi contains the address of i. So scanf("%d",pi) places the value entered in console into variable i.e So printf("%d\n",i+5),prints 5 more than the value entered in console.

11. Let G be a graph with n vertices and m edges. What is the tightest upper bound on the running time of Depth First Search on G, when G is represented as an adjacency matrix?

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

Answer: (C)

Exp: DFS visits each vertex once and as it visits each vertex, we need to find all of its neighbours to figure out where to search next. Finding all its neighbours in an adjacency matrix requires O(V) time, so overall the running time will be O(V²).

12. Consider rooted n node binary tree represented using pointers. The best upper bound on the time required to determine the number of sub trees having exactly 4 nodes is $0(n^a \log^b n)$. Then the value of a + 10b is_____
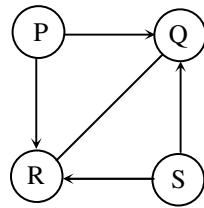
Answer: 1

Exp: int print_subtrees_size_4(node *n)
{
int size=0;
if(node==null)
return 0;
size=print_subtrees_size_4(node->left)+print_subtrees_size_4(node->right)+1;
 if(size==4)
printf("this is a subtree of size 4");
return size;
}
The above function on taking input the root of a binary tree prints all the subtrees of size 4 in O(n) time
so a=1 , b=0 and then a+10b=1

13. Consider the directed graph given below.

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

(A) The graph does not have any topological ordering

(B) Both PQRS and SRQP are topological orderings

(C) Both PSRQ and SPRQ are topological orderings.

(D) PSRQ is the only topological ordering.

Answer: (C)

Exp: Topological ordering of a directed graph is a linear ordering of its vertices such that for every directed edge uv from vertex u to vertex v, u comes before v in the ordering. Topological ordering is possible iff graph has no directed cycles.

(A) As the given graph doesn't contain any directed cycles, it has at least one topological ordering. So option (A) is false

(B) PQRS cannot be topological ordering because S should come before R in the ordering as there is a directed edge from S to R.

SRQP cannot be topological ordering, because P should come before Q in the ordering as there is a directed edge from P to Q

(C) PSRQ and SPRQ are topological orderings as both of then satisfy the above mentioned topological ordering conditions.

(D) PSRQ is not the only one topological ordering as SPRQ is other possibility

14. Let P be a quick sort program to sort numbers in ascending order using the first element as the pivot. Let t_1 and t_2 and t_2 be the number of comparisons made by P for the inputs [1 2 3 4 5] and [4 1 5 3 2] respectively. Which one of the following holds?

(A) $t_1 = 5$ (B) $t_1 < t_2$ (C) $t_1 > t_2$ (D) $t_1 = t_2$

Answer: (C)

Exp: Partition algorithm for quick sort

$Partition(A, P, q) // A[P, ...q]$

$x \leftarrow A[P] // pivot = A[P]$

$i \leftarrow P$

for $j = P + 1$ to q

    do if $A[j] \leq x$

        then $i \leftarrow i + 1$

        exchange $A[i] \leftrightarrow A[j]$

$exchange A[P] \leftrightarrow A[i]$

return i [returning where pivot element is there after partitioning]

Recursively call the above algorithm for the two sub arrays [elements before and after pivot element] to complete the sorting.

x = pivot

1 2 3 4 5   2 ≤ 1 ? NO
i j
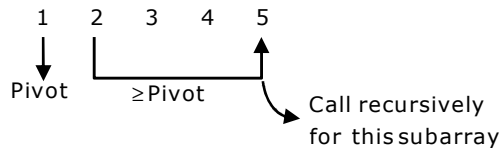
1 2 3 4 5
i   j   3 ≤ 1 ? NO

1 2 3 4 5
i   j   4 ≤ 1 ? NO

1 2 3 4 5
i   j   5 ≤ 1 ? NO
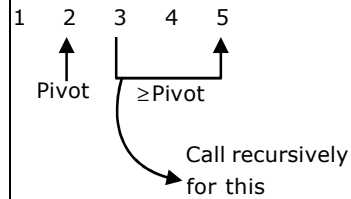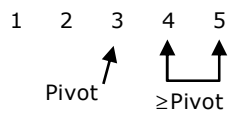
exchange A[P] & A[i]

↗ Pivot = x = A[B]

1 2 3 4 5   3 ≤ 2 ? NO
i j

1 2 3 4 5
i   j   4 ≤ 2 ? NO

1 2 3 4 5
i   j   5 ≤ 2 ? NO

exchange A[P] & A[J]

↗ x = Pivot = A[P]

1 2 3 4 5   4 ≤ 3 ? NO
   i j

1 2 3 4 5
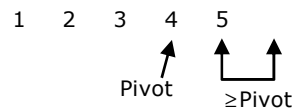   i   j   5 ≤ 3 ? NO

exchange A[P] & A[i]

↗ x = Pivot

1 2 3 4 5   5 ≤ 4 ? NO
      i j

exchange A[P] & A[i]

∴ Total 10 conparisons

$\nearrow$ x = pivot = A[P]

4 1 5 3 2

i   j $1 \le 4?$ Yes

           $i \leftarrow i+1$ exchange A[i] & A[j] & increment j

4 1 5 3 2

   i j $5 \le 4?$ NO

4 1 5 3 2

   i   j $3 \le 4?$ Yes

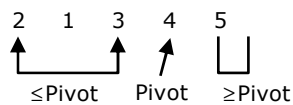 $i \leftarrow i+1$ exchange A[i] & A[j] & increment j

4 1 3 5 2

     i   J $2 \le 4?$ Yes

$i \leftarrow i+1$

4   1   3   2   5

        i   j

exchange A[P] & A[i]
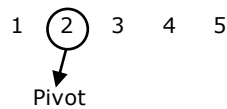

x = pivot = A(P)

2   1   3 |4| 5

i   j $1 \le 2$? yes

2   1   3 |4| 5

   i   j $3 \le 2$? NO

exchange A[P] & A[i]

1 ② 3 4 5

   Pivot

2   1   3   4   5

$\le$Pivot   Pivot $\ge$Pivot

$\therefore 6$ conparisons

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

(A) The language $L = \{a^n b^n \mid n \ge 0\}$ is regular.

(B) The language $L = \{a^n \mid n \text{ is prime}\}$ is regular.

(C) The language $L = \{ w \mid w \text{ has } 3k+1 b's \text{ for some } k \in N \text{ with } \Sigma = \{a,b\} \}$ is regular.

(D) The language $L = \{ww \mid w \in \Sigma^* \text{ with } \Sigma = \{0,1\}\}$ is regular.

Answer: (C)

Exp: (A) $L = \{a^n b^n \mid n \ge 0\}$ is a CFL but not regular, it requires memory for the representation

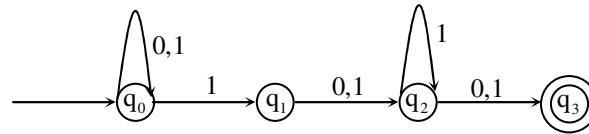(B) $L = \{a^n \mid n \text{ is prime}\}$ is neither regular nor CFL

(C) $L = \{w \mid w \text{ has } 3K+1 b's \text{ for some } k \in N \text{ with}\}$

   $\Sigma = \{a,b\}$

is a regular language, since the total count of b's are multiple of 3 plus one. The regular expression is $a*ba*(a*ba*ba*ba*)*+(a*ba*ba*ba*)*a*ba*$

(D) $L = \{ww \mid w \in \Sigma^* \text{ with } \Sigma = \{0,1\}\}$ is neither regular nor CFL

16.   Consider the finite automaton in the following figure.

What is the set of reachable states for the input string 0011?

(A) $\{q_0, q_1, q_2\}$ (B) $\{q_0, q_1\}$ (C) $\{q_0, q_1, q_2, q_3\}$ (D) $\{q_3\}$

Answer: (A)

Exp: $\delta(q_0, 0011) = \delta(q_0, 011)$

$$= \delta(q_0, 11)$$
$$= \delta(\{q_0, q_1\}, 1)$$
$$= \delta(q_0, 1) \cup \delta(q_1, 1)$$
$$= \{q_0, q_1\} \cup \{q_2\}$$
$$= \{q_0, q_1, q_2\}$$

17.   Which one of the following is **FALSE**?
(A) A basic block is a sequence of instructions where control enters the sequence at the beginning and exits at the end.
(B) Available expression analysis can be used for common subexpression elimination.
(C) Live variable analysis can be used for dead code elimination
(D) $x = 4*5 \Rightarrow x = 20$ is an example of common subexpression elimination

Answer: (D)

Exp: $x = 4 \times 5 \Rightarrow x = 20$ is not an example of common sub-expression but it is constant folding. In constant folding expression consisting of constants will be replaced by their final value at compile time, rather than doing the calculation in run-time.

18.   Match the following

(1) Waterfall model	(a) Specifications can be developed
(2) Evolutionary model	(b) Requirements compromises are inevitable
(3) Component based software	(c) Explicit recognition of risk
(4) Spiral development	(d) Inflexible partitioning of the project into stages

(A) 1-a, 2-b, 3-c, 4-d   (B) 1-d, 2-a, 3-b, 4-c
(C) 1-d, 2-b, 3-a, 4-c   (D) 1-c, 2-a, 3-b, 4-d

Answer: (B)

Exp: The main drawback of the waterfall model is the difficulty of accommodating change after the process is underway. One phase has to be complete before moving onto the   next   phase. Inflexible partitioning of the project into distinct stages in waterfall model makes it difficult to respond to changing customer requirements.
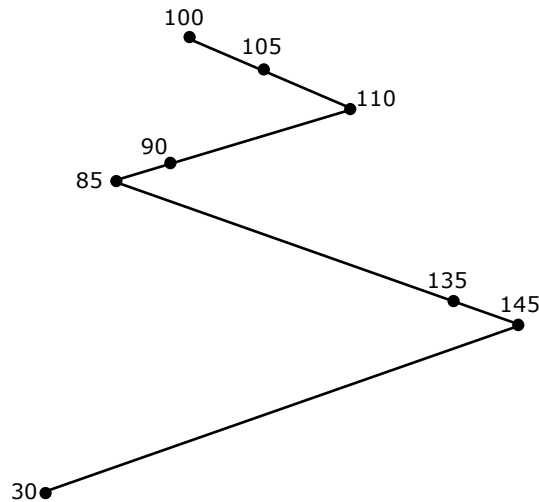
Evolutionary software models are iterative. They are characterized in manner that enables the software engineers to develop increasingly more complete version of software.

In Spiral model, Development can be divided in to smaller parts and more risky parts can be developed earlier which helps better risk management.

19. Suppose a disk has 201 cylinders, numbered from 0 to 200. At some time the disk arm is at cylinder 100, and there is a queue of disk access requests for cylinders 30, 85, 90, 100, 105, 110, 135 and 145. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 90 is serviced after servicing _____ number of requests.

Exp:

Request for cylinder is served after serving 3 requests (100,105 and 110)

20. Which one of the following is **FALSE**?

(A) User level threads are not scheduled by the kernel.

(B) When a user level thread is blocked, all other threads of its process are blocked.

(C) Context switching between user level threads is faster than context switching between kernel level threads.

(D) Kernel level threads cannot share the code segment.

Answer: (D)

Exp: User threads are supported above the kernel and a managed without kernel support. The thread function library to implement user level threads usually runs on top of the system in user mode. Thus these threads with in a process are invisible to the operating system. Since the kernel is unaware of the existence of such threads; when one user level thread is blocked in the kernel all other threads of its process are blocked. So options (A) and (B) are true

(C) The OS is aware of kernel level threads. Kernel threads are scheduled by the OS's scheduling algorithms and require a "lightweight"   context switch to switch between (that is, registers, PC and SP must be changed, but the memory context remains the same among kernel threads in the (same process). User level threads are much faster to switch between as there is not context switch

(D) False

Kernel level threads within the same process share code section, data section and other operating system resources such as open files and signals.

21. Consider the relation scheme R = (E, F, G, H, I, J, K, L, M, N) and the set of functional dependencies $\{\{E,F\} \rightarrow \{G\}, \{F\} \rightarrow \{I,J\}, \{E,H\} \rightarrow \{K,L\} \rightarrow (M), \quad \{K\} \rightarrow \{M\}, \}$ $\{L\} \rightarrow \{N\}$ on R. What is the key for R?

(A) {E, F}　　　(B) {E, F, H}　　　(C) {E, F, H, K, L}　　(D) {E}

Answer: (B)

Exp: $R(EFGHI, JKLMN)$

$F = \{$

$\qquad EF \rightarrow G$

$\qquad F \rightarrow IJ$

$\qquad EH \rightarrow KL$

$\qquad K \rightarrow M$

$\qquad L \rightarrow N$

$\quad \}$

$(EF)^+ = EFGIJ$, E & F Together functionally derive GIJ and if we observe given FDs, H can't be determined by any other attributes. So H must be part of all the (candidate) keys. H along with E determines K and L, K & L functionally determine M and N respectively.

$\therefore (EFH)^+ = EFGIJHKLMN$

$\therefore$ EFH is the only candidate for key.

22. Given the following statements:

S1: A foreign key declaration can always be replaced by an equivalent check assertion in SQL

S2: Given the table R(a,b,c) where a and b together form the primary key, the following is a valid table definition.

CREATE TABLE S (

a INTEGER,

d INTEGER,

e INTEGER,

PRIMARY KEY (d),

FOREIGN KEY (a) references R)

Which one of the following statements is **CORRECT**?

(A) S1 is TRUE and S2 is a FALSE　　　(B) Both S1 and S2 are TRUE

(C) S1 is FALSE and S2 is a TRUE　　　(D) Both S1 and S2 are FALSE

Exp: S₁: Manager (<u>Name</u>, DeptID)

Department (DeptName, <u>Deptid</u>)

In given relation Manager DeptID is a foreign key referencing Deptid (P.K) of relation Department.

Let's declare the foreign key by an equivalent check assertion as follows:-

CREATE TABLE Manager (

    Name Varchar (10)

    DeptID INT (6) check (DeptID IN (select Deptid from Department)),

    PRIMARY KEY (Name)

    );

The above use of check assertion is good to declare the foreign key as far as insertion is considered for relation manager (will not insert any tuple in Manager containing such DeptID value which is not present in any tuple of Department).

But the above declaration will fail to implement changes done in Department relation in terms of deletion & updation. For an instance if a deptid present in Department gets deleted, then respective reference in Manager should also be deleted.

∴ S₁ is false.

S₂: The given table definition is not valid due to invalid foreign key declaration. Attribute a is declared as foreign key which is a single valued attribute and it is referencing the primary key (<u>ab</u>) of relation R (<u>a, b,</u> c), which is a composite key.

A single value attribute cannot refer a composite key.

4 S₂ is false.

23.   Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links

[S1] The computational overhead in link state protocols is higher than in distance vector protocols.

[S2] A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol.

[S3] After a topology change, a link state protocol will converge faster than a distance vector protocol.

Which one of the following is correct about S1, S2, and S3?

(A) S1, S2, and S3 are all true   (B) S1, S2, and S3 are all false.

(C) S1 and S2 are true, but S3 is false   (D) S1 and S3 are true, but S2 is false.

Answer: (D)

Exp: Statement S1

The Distance Vector routing protocols rely on the information from their directly connected neighbours in order to calculate and accumulate route information. Distance Vector routing protocols require very little overhead as compared to Link State routing protocols as measured by memory and processor power while the Link State routing protocols do not rely solely on the information from the neighbours or adjacent router in order to calculate route information. Instead, Link State routing protocols have a system of databases that they use in order to calculate the best route to destinations in the network. This is TRUE

Statement S3

Distance Vector exchanges the routing updates periodically whether the topology is change or not, this will maximize the convergence time which increases the chance of routing loops while the Link State routing protocols send triggered change based updates when there is a topology change. After initial flood, pass small event based triggered link state updates to all other routers. This will minimize the convergence time that's why there is no chance of routing loops. This is TRUE.

24.   Which one of the following are used to generate a message digest by the network security protocols?

(P) RSA   (Q) SHA-1   (R) DES   (S) MD5

(A) P and R only   (B) Q and R only   (C) Q and S only   (D) R and S only

Answer: (C)

Exp: RSA and DES are for Encryption where MD5 and SHA – 1 are used to generate Message Digest.

25.   Identify the correct order in which the following actions take place in an interaction between a web browser and a web server.

1. The web browser requests a webpage using HTTP.

2. The web browser establishes a TCP connection with the web server.

3. The web server sends the requested webpage using HTTP.

4. The web browser resolves the domain name using DNS.

(A) 4,2,1,3   (B) 1,2,3,4   (C) 4,1,2,3   (D) 2,4,1,3

Answer: (A)

Exp: First of all the browser must now know what IP to connect to. For this purpose browser takes help of Domain name system (DNS) servers which are used for resolving hostnames to IP addresses. As browser is an HTTP client and as HTTP is based on the TCP/IP protocols, first it establishes a TCP connection with the web server and requests a webpage using HTTP, and then the web server sends the requested webpage using HTTP. Hence the order is 4,2,1,3

Q.No. 26 – 55 Carry Two Marks

26.   Consider a token ring network with a length of 2km having 10 stations including a monitoring station. The propagation speed of the signal is 2 x 10^8 m/s and the token transmission time is ignored. If each station is allowed to hold the token for 2 μsec, the minimum time for which the monitoring station should wait (**in μsec**) before assuming that the token is lost is _____.

Answer: (28μs to 30μs)

Exp: Given Length (d) = 2 Km

No. of Stations (m) = 10

Propagation Speed (v) = 2×10^8 m/s

THT = 2μs

So, Max. TRT = T_P in the Ring + No. of Active Stations * THT

= $10 \times 10^{-6} + 10 \times 2 \times 10^{-6}$

= 30 μs

27. Let the size of congestion window of a TCP connection be 32 KB when a timeout occurs. The round trip time of the connection is 100 msec and the maximum segment size used is 2kB. The time taken (in msec) by the TCP connection to get back to 32KB congestion window is _____

Answer: (1100 to 1300)

Exp: Given that at the time of Time Out, Congestion Window Size is 32KB and RTT = 100ms

When Time Out occurs, for the next round of Slow Start, Threshold = (size of Cwnd) / 2

It means Threshold = 16KB

Slow Start

2KB

   1RTT

4KB

   2RTT

8KB

   3RTT

16KB ----------- Threshold reaches. So Additive Increase Starts

   4RTT

18KB

   5RTT

20KB

   6RTT

22KB

   7RTT

24KB

   8RTT

26KB

   9RTT

28KB

   10RTT

30KB

   11RTT

32KB

So, Total no. of RTTs = 11 → 11 * 100 = 1100

28. Consider a selective repeat sliding window protocol that uses a frame size of 1 KB to send data on a 1.5 Mbps link with a one-way latency of 50 msec. To achieve a link utilization of 60%, the minimum number of bits required to represent the sequence number field is _____.

Exp: Given $L = 1KB$

$\quad\quad\quad B = 1.5 \text{Mbps}$

$\quad\quad\quad T_p = 50\text{ms}$

$\quad\quad\quad \eta = 60\%$

Efficiency formula for SR protocol is

$$\eta = \frac{W}{1+2a} \Rightarrow \frac{60}{100} = \frac{W}{1+2a} \left(\because a = \frac{T_p}{T_x} \right)$$

$$T_x = \frac{L}{B} = \frac{8 \times 10^3}{1.5 \times 10^6} = 5.3\text{ms}$$

$$a = \frac{T_p}{T_x} = \frac{50}{5.3} = \frac{500}{53} = 9.43$$
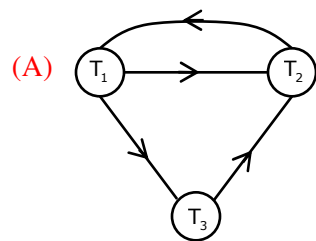
$$\Rightarrow \frac{60}{100} = \frac{W}{19.86} \Rightarrow W = 11.9 \approx 12$$

$$\Rightarrow W = 2^{n-1} = 12 \Rightarrow 2^n = 24 \Rightarrow 2^n = 24 \approx 2^5 \Rightarrow \boxed{n = 5}$$

29. Consider the following four schedules due to three transactions (indicted by the subscript) using read and write on a data item x, denoted r (x) and w (x) respectively. Which one of them is conflict serializable?

(A) $r_1(x)$; $r_2(x)$; $w_1(x)$; $r_3(x)$; $w_2(x)$

(B) $r_2(x)$; $r_1(x)$; $w_2(x)$; $r_3(x)$; $w_1(x)$

(C) $r_3(x)$; $r_2(x)$; $r_1(x)$; $w_2(x)$; $w_1(x)$

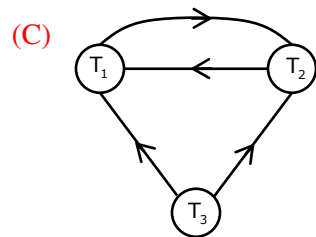(D) $r_2(x)$; $w_2(x)$; $r_3(x)$; $r_1(x)$; $w_1(x)$

Exp: If there is a cycle in precedence graph, then the schedule is not conflict serializable.
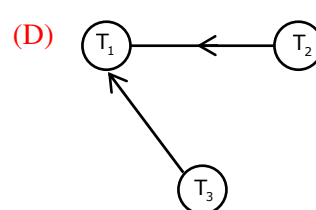

(A)

Not conflict serializable

(B)

not conflict serializable

(C)

Not conflict serializable

(D)

it is conflict equivalent to

$T_2 \rightarrow T_3 \rightarrow T_1$ &

$T_3 \rightarrow T_2 \rightarrow T_1$

30. Given the following two statements:

S1: Every table with two single-valued attributes is in 1NF, 2NF, 3NF and BCNF

S2 : $AB \to C, D \to E, E \to C$ is a minimal cover for the set of functional

dependencies $AB \to C, D \to E, AB \to E, E \to C$

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

(A) S1 is TRUE and S2 is FALSE.   (B) Both S1 and S2 are TRUE.

(C) S1 is FALSE and S2 is TRUE.   (D) Both S1 and S2 are FALSE.

Answer: (A)

Exp: S_1 : True

Consider any table R with two attributes $R(A.B)$

The possible FD sets are

$F_1 = \{$ $F_2 = \{$

    $A \to B$ $B \to A$

  $\}$ $\}$

Key : A and is in BCNF   Key : B and is in BCNF

$F_3 = \{$
                                                        $F_4 = \{$
    $A \to B$

    $B \to A$
                                                        $\}$
  $\}$
                                                    Key : AB and is in BCNF

Key : A & B It is in BCNF

If a table is in BCNF it is also in 1NF, 2NF and 3NF also

S_2 : False

First FD set cannot cover second FD set because in second FD set AB can functionally derive E but that is not happing in first FD set.

31. An operating system uses the *Banker's algorithm* for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the *Allocation* matrix shows the current number of resources of each type allocated to each process and the *Max* matrix shows the maximum number of resources of each type required by each process during its execution.

	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a **safe** state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X, 0 units of Y and 2 units of Z

REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

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

(A) Only REQ1 can be permitted.

(B) Only REQ2 can be permitted.

(C) Both REQ1 and REQ2 can be permitted.

(D) Neither REQ1 nor REQ2 can be permitted.

Answer: (B)

Exp: REQ1

Once P_0 is allocated with $(0,0,2)$, the status of the system will be as follows

Allocation	Max	Need	Available
X Y Z	X Y Z	X Y Z	X Y Z
0 0 3	8 4 3	8 4 0	3 2 0
3 2 0	6 2 0	3 0 0	
2 1 1	3 3 3	1 2 2	

With available $(3,2,0)$ only P_1 can be served. Once P_1 is executed, available will be $(6,4,0)$, with $(6,4,0)$ we can't serve either P_0 or P_2. Hence there is no safe sequence. Hence REQ1 can't be permitted.

REQ2

Once P_1 is allocated with $(2,0,0)$, the status of the system will be as follows

	Allocated	Max	Need	Available
	X Y Z	X Y Z	X Y Z	X Y Z
P_0	0 0 1	8 4 3	8 4 2	1 2 2
P_1	5 2 0	6 2 0	1 0 0	
P_2	2 1 1	3 3 3	1 2 2	

With available $(1,2,2)$, we can serve either P_1 or P_2.

If we serve P_1 then the safe sequence is $\langle P_1, P_2, P_0 \rangle$. If we serve P_2 then the safe sequence is $\langle P_2, P_1, P_0 \rangle$. As true is at least one safe sequence we can permit REQ2.

32.   Consider the following set of processes that need to be scheduled on a single CPU. All the times are given in milliseconds

Process Name	Arrival Time	Execution Time
A	0	6
B	3	2
C	5	4
D	7	6
E	10	3

Using the *shortest remaining time first* scheduling algorithm, the average process turnaround time (in msec) is _____.

Answer: (7.2)

Exp:

A	B	A	C	E	D

0   3   5   8   12   15   21

$$\text{Average turn around time} = \frac{(8-0)+(5-3)+(12-5)+(21-7)+(15-10)}{5}$$

$$= \frac{36}{5} \Rightarrow 7.2\,\text{ms}$$

33. Assume that there are 3 page frames which are initially empty. If the page reference string 1, 2, 3, 4, 2, 1, 5, 3, 2, 4, 6, the number of page faults using the optimal replacement policy is _____

Answer: (7)

Exp:

1	2	3	4	2	1	5	3	2	4
		3	4	4	4	4	4	4	4
	2	2	2	2	2	2	2	2	6
1	1	1	1	1	1	5	3	3	3
F	F	F	F	H	H	F	F	H	H	F

7 page faults

34. A canonical set of items is given below

$$s \to L . > R$$
$$Q \to R.$$

On input symbol $<$ the set has

(A) a shift-reduce conflict and a reduce-reduce conflict.

(B) a shift-reduce conflict but not a reduce-reduce conflict.

(C) a reduce-reduce conflict but not a shift-reduce conflict.

(D) neither a shift-reduce nor a reduce-reduce conflict.

Answer: (D)

Exp:

From above diagram, we can see that there is no shift- reduce or reduce-reduce conflict.

35. Let L be a language and $\overline{L}$ be its complement. Which of the following is NOT a viable possibility?

(A) Neither L nor $\overline{L}$ is recursively enumerable (r.e.).

(B) One of L and $\overline{L}$ is r.e. but not recursive; the other is not r.e.

(C) Both L and $\overline{L}$ are r.e. but not recursive.

(D) Both L and $\overline{L}$ are recursive.

Answer: (C)

Exp: Recursive languages are closed under complement.

If a language L is recursive enumerable but not recursive then its complement is not a recursive enumerable, so both L and $\overline{L}$ are recursive enumerable but not recursive is not a viable possibility.

36. Which of the regular expressions given below represent the following DFA?

I) 0*1(1+00*1)*
II) 0*1*1+11*0*1
III) (0+1)*1
(A) I and II only   (B) I and III only
(C) II and III only   (D) I, II, and III

Answer: (B)

Exp: Given DFA will accept all the strings over $\varepsilon = \{0,1\}$ which are ending with 1.

$0*1(1+00*1)*$ and $(0+1)*1,$ are the regular expressions for ending with 1.

37. There are 5 bags labelled 1 to 5. All the coins in a given bag have the same weight. Some bags have coins of weight 10 gm, others have coins of weight 11 gm. I pick 1, 2, 4, 8, 16 coins respectively from bags 1 to 5. Their total weight comes out to 323 gm. Then the product of the labels of the bags having 11 gm coins is ____.

Answer: 12

Exp: Let the weight of coins in the respective bags (1 through 5) be a,b,c,d and e-each of which can take one of two values namely 10 or 11 (gm).

Now, the given information on total weight can be expressed as the following equation:

1.a+2.b+4.c+8.d+16.e = 323

$\Rightarrow$ a must be odd $\Rightarrow$ a = 11

The equation then becomes:

11+2.b+4.c+8.d+16.e = 323

$\Rightarrow$ 2.b+4.c+8.d+16.e = 312

$\Rightarrow$ b+2.c+4.d+8.e = 156

$\Rightarrow$ b must be even $\Rightarrow$ b = 10

The equation then becomes:

10+2.c+4.d+8.e = 156

$\Rightarrow$ 2.c+4.d+8.e = 146

$\Rightarrow$ c+2.d+4.e = 73

$\Rightarrow$ c must be odd $\Rightarrow$ c = 11

The equation now becomes:

11+2.d+4.e = 73

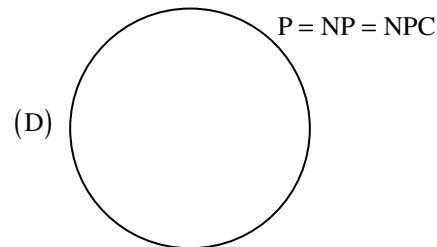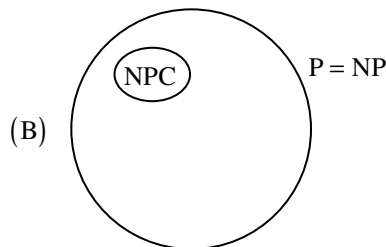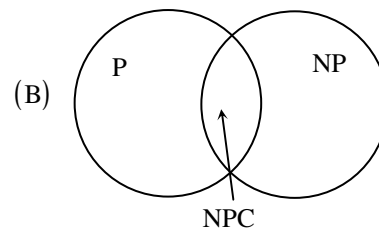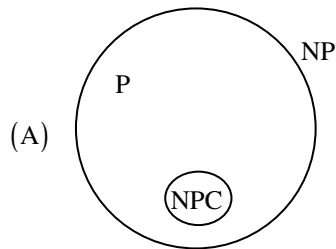$\Rightarrow$ 2.d+4.e = 62

$\Rightarrow$ d+2.e = 31

$\Rightarrow$ e = 11 and e = 10

Therefore, bags labelled 1, 3 and 4 contain 11 gm coins $\Rightarrow$ Required Product = 1*3*4* = 12.

38.   Suppose a polynomial time algorithm is discovered that correctly computes the largest clique in a given graph. In this scenario, which one of the following represents the correct Venn diagram of the complexity classes P, NP and NP Complete (NPC)?

(A)

NP

P

NPC

(B)

P   NP

NPC

(B)

NPC   P = NP

(D)

P = NP = NPC

39. The minimum number of comparisons required to find the minimum and the maximum of 100 numbers is _____.

Exp: From the list of given n numbers [say n is even],

Pick up first two elements, compare them

$$\text{assign} \quad \text{Current} - \min = \min \text{ of two numbers}$$

$$\text{Current} - \max = \max \text{ of two numbers}$$

From the remaining $n - 2$ numbers, take pairs wise and follow this process given below.

1. Compare two elements

   Assign   min = min of two numbers

                  max = max of two numbers

2. Compare min and current - min

   Assign $\text{current} - \min = \min\{\text{current} - \min, \min\}$

3. Compare max and current - max

   Assign $\text{current} - \max = \max\{\text{current} - \max, \max\}$

Repeat above procedure for all the remaining pairs of numbers. We can observe that each of pair requires 3 comparisons

1. for finding min and max

2. For updating current – min

3. for updating current – max

But for initial pair we need only one comparison not 3.

$$\therefore \text{total number of comparisons} = \frac{3(n-2)}{2} + 1 = \frac{3n}{2} - 3 + 1 = \frac{3n}{2} - 2$$
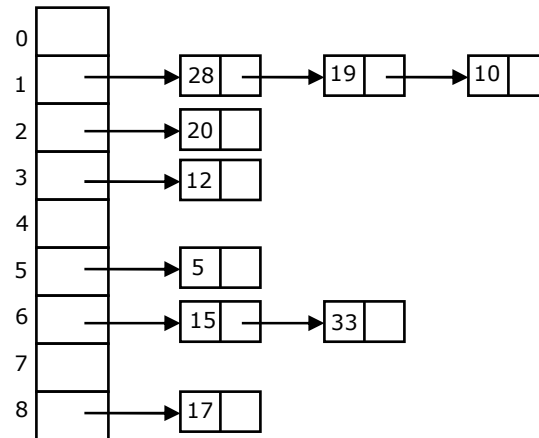
Here $n = 100,$ so number of comparisons = 148.

40. Consider a hash table with 9 slots. The hash function is $h(k) = k \mod 9$. The collisions are resolved by chaining. The following 9 keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17, 10. The maximum, minimum, and average chain lengths in the hash table, respectively, are

(A) 3, 0, and 1   (B) 3, 3, and 3   (C) 4, 0, and 1   (D) 3, 0, and 2

Exp:

41.   Consider the following C function in which **size** is the number of elements in the array **E**:

```
int MyX(int *E, unsigned int size)
{
  int Y = 0;
  int Z;
  int i, j, k;

for(i = 0; i < size; i++)
    Y = Y + E[i];
for(i = 0; i < size; i++)
  for(j = i; j < size; j++)
  {
Z = 0;
for(k = i; k <= j; k++)
Z = Z + E[k];
if (Z > Y)
   Y = Z;
}
  return Y;
}
```

The value returned by the function **MyX** is the

(A) maximum possible sum of elements in any sub-array of array **E**.

(B) maximum element in any sub-array of array **E**.

(C) sum of the maximum elements in all possible sub-arrays of array **E**.

(D) the sum of all the elements in the array **E**.

Exp: int Myx $(int *E, unsinged\ int\ sixe)$

{

int $Y = 0;$

int z;

int $i, j, k;$

for$(i = 0; i < size; i++)$ $\left.\begin{array}{l}\end{array}\right]$ Calculates sum of the elements

    $Y = Y + E[i]$ ∫ of the array E and stores it in Y

for$(i = 0;\ i < size;\ i++)$ $\left.\begin{array}{l}\end{array}\right\}$

  for$(j = i;\ j < size;\ j++)$

    {   calculates the sum of elements of

      $z = 0;$ all posible subarrays of E

      for $(k = i; k <= j;\ k++)$

        $z = z + E[k];$

    if $(z > Y) \rightarrow$ Checks whether sum of elements of each subarray

      $Y = z;$ is greaer than the sum of elements of array if so, that sum

    }   is assigned to Y, if not 'Y' will be the sum of elements of

return Y;   complete array

}

Ultimately returns the maximum possible sum of elements in any sub array of given array E.

42. Consider the following pseudo code. What is the total number of multiplications to be performed?

D= 2

for i = 1 to n do

for j = i to n do

 for k = j + 1 to n do

 D = D * 3

(A) Half of the product of the 3 consecutive integers

(B) One-third of the product of the 3 consecutive integers.

(C) One-sixth of the product of the 3 consecutive integers.

(D) None of the above.

Answer: (C)

Exp:
$i = 1, j = 1, k = 2$ to $n \Rightarrow n - 1$ times

$\left.\begin{array}{l} i = 1, j = 2, k = 3 \text{ to } n \Rightarrow n - 2 \text{ times} \\ i = 1, j = 3, k = 4 \text{ to } n \Rightarrow n - 3 \text{ times} \\ \vdots \\ i = 1, j = n - 2, k = n - 1 \text{ to } n \Rightarrow 2 \text{ times} \end{array}\right\} \Sigma(n-1) \text{ times}$

$i = 1, j = n - 1, k = n$ to $n \Rightarrow 1$ time

$\left.\begin{array}{l} i = 2, j = 2, k = 3 \text{ to } n \Rightarrow n - 2 \text{ times} \\ i = 2, j = 3, k = 4 \text{ to } n \Rightarrow n - 3 \text{ times} \\ \vdots \quad \vdots \\ \vdots \quad \vdots \\ i = 2, j = n - 1, k = n \text{ to } n \Rightarrow 1 \text{ time} \end{array}\right\} \Sigma(n-2) \text{ times}$

$\vdots$

$\vdots$

$i = n - 1, j = n - 1, k = n$ to $n \Rightarrow 1$ time $\} \; \Sigma 1$ times

$\therefore$ Total number of multiplications

$\Rightarrow \Sigma 1 + \Sigma 2 + \Sigma 3 + \ldots \ldots \Sigma(n-1)$

$= \underset{\underset{S_1}{\downarrow}}{1} + \underset{\underset{S_2}{\downarrow}}{(1+2)} + \underset{\underset{S_3}{\downarrow}}{(1+2+3)} + \ldots + \underset{\underset{S_{n-1}}{\downarrow}}{(1+2+3+\ldots n-1)}$

$= \sum_{i=1}^{n-1} S_i = \Sigma \dfrac{n(n-1)}{2}$

$= \dfrac{1}{2}\Sigma n^2 - \dfrac{1}{2}\Sigma n$

$= \dfrac{1}{2}\dfrac{n(n+1)(2n+1)}{6} - \dfrac{1}{2}\dfrac{n(n+1)}{2} = \dfrac{(n-1)(n)(n+1)}{6}$

43. Consider a 6-stage instruction pipeline, where all stages are perfectly balanced. Assume that there is no cycle-time overhead of pipelining. When an application is executing on this 6-stage pipeline, the speedup achieved with respect to non-pipelined execution if 25% of the instructions incur 2 pipeline stall cycles is _____.

Answer: (4)

Exp: For 6 stages, non- pipelining takes 6 cycles.

There were 2 stall cycles for pipelining for 25% of the instructions

So pipe line time $= \left(1 + \dfrac{25}{100}2\right)$
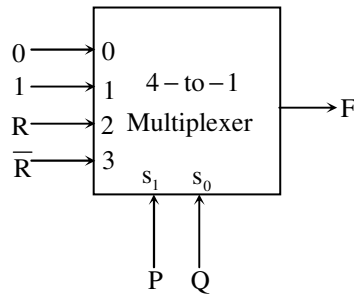
$= \dfrac{3}{2} = 1.5$

Speed up $= \dfrac{\text{Non} - \text{pipeline time}}{\text{Pipeline time}} = \dfrac{6}{1.5} = 4$

44. An access sequence of cache block addresses is of length N and contains n unique block addresses. The number of unique block addresses between two consecutive accesses to the same block address is bounded above K. What is the miss ratio if the access sequence is passed through a cache of associativity $A \geq k$ exercising least-recently-used replacement policy?

(A) n/N   (B) l/N   (C) 1/A   (D) k/n

Answer: (A)

45. Consider the 4-to-1 multiplexer with two lines S_1 and S_0 given below.

The minimal sum of-products form of the Boolean expression for the output F of the multiplexer is

(A) $\overline{P}Q + QR + P\overline{Q}R$ (B) $\overline{P}Q + \overline{P}Q\overline{R} + PQ\overline{R} + P\overline{Q}R$

(C) $\overline{P}QR + \overline{P}Q\overline{R} + Q\overline{R} + P\overline{Q}R$ (D) $PQ\overline{R}$

Answer: (A)

Exp: $\overline{P}\overline{Q}.0 + \overline{P}Q.1 + P\overline{Q}.R + PQ\overline{R}$

$= \overline{P}Q + P\overline{Q}.R + PQ\overline{R}$

Hence the minimized expression is $\overline{P}Q + Q\overline{R} + P\overline{Q}R$

46. The function f(x) = x sin x satisfies the following equation. f"(x) + f(x) +tcosx = 0. The value of t is_____.

Answer: -2

Exp: Given $f''(x) + f(x) + t\cos x = 0$

and $f(x) = x\sin x$

$f'(x) = x\cos x + \sin x$

$f''(x) = x(-\sin x) + \cos x + \cos x$

$= 2\cos x - x\sin x$

$= 2\cos x - f(x)$

$\therefore 2\cos x - f(x) + f(x) + t\cos x = 0$

$\Rightarrow 2\cos x = -t\cos x \Rightarrow t = -2$

47. A function f(x) is continuous the interval [0,2]. It is known that f(0) = f(2) = -1 and f(1) = 1. Which one of the following statements must be true?

    (A) There exists a y in the interval (0,1) such that f(y) = f(y + 1)
    (B) For every y in the interval (0,1), f(y) = f(2 - y)
    (C) The maximum value of the function in the interval (0.2) is 1
    (D) There exists a y in the interval (0,1) such that f(y) =f(2 – y)

Answer: (A)

Exp: Define g(x) =f(x)-f(x+1) in [0,1]. g(0) is negative and g(1) is positive. By intermediate value theorem there is y∈(0,1) such that g(y)=0

That is f(y) =f(y+1).

Thus answer is (a)

48. For fair six-sided dice are rolled. The probability that the sum of the results being 22is $\frac{X}{1296}$. The value of X is _____

Answer: (10)

Exp: 22 occurred in following ways

    6 6 6 4 → 4ways

    6 6 5 5 →6ways

Required probability = $\frac{6+4}{2296} = \frac{10}{2296} \Rightarrow x = 10$

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

Answer: (89)

Exp: No twos: 1111111111⇒1 pennant

Single two: 211111111⇒9!/8!1! = 9 pennants

Two twos: 22111111⇒8!/6!.2! = 28

Three twos: 2221111⇒7!/3!.4! = 35

Four twos: 222211⇒6!/4!.2! = 15

Five twos: 22222⇒1

Total = 89 pennants.

50. Let S denote the set of all functions $f : \{0,1\}^4 \to \{0,1\}$. Denote by N the number of functions from S to the set {0,1}. The value of $\log_2 \log_2 N$ is_____.

Answer: (16)

Exp: The number of functions from A to B where size of A = |A| and size of B = |B| is $|B|^{|A|}$

$\{0,1\}^4 = \{0,1\}X\{0,1\}X\{0,1\}X\{0,1\} = 16$

$|S| = 2^{16}$

$N = 2^{|S|}$

loglog N = log log $2^{|S|}$ = log |S| = log 2^{16} = 16

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

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

(A) (1, 1, 1, 1, 1, 1)   (B) (2, 2, 2, 2, 2, 2)

(C) (3, 3, 3, 1, 0, 0)   (D) (3, 2, 1, 1, 1, 0)

53. Which one of the following propositional logic formulas is TRUE when exactly two of p, q, and r are **TRUE**?

(A) $\left((p \leftrightarrow q) \wedge r \right) V (p \wedge q \wedge \sim r)$ (B) $\left(\sim (p \leftrightarrow q) \wedge r \right) V (p \wedge q \wedge \sim r)$

(C) $\left((p \rightarrow q) \wedge r \right) V (p \wedge q \wedge \sim r)$ (D) $\left(\sim (p \leftrightarrow q) \wedge r \right) \wedge (p \wedge q \wedge \sim r)$

Exp: P = T   q=F and r=T

Option A will become false.

Option C will become false.

Option D is always false.

54.   Given the following schema:

employees(emp-id, first-name, last-name, hire-date,

dept-id, salary)

departments(dept-id, dept-name, manager-id, location-id)

You want to display the last names and hire dates of all latest hires in their respective departments in the location ID 1700. You issue the following query:

SQL>SELECT last-name, hire-date

FROM employees

WHERE (dept-id, hire-date) IN

(SELECT dept-id, MAX(hire-date)

FROM employees JOIN departments USING(dept-id)

WHERE location-id = 1700

GROUP BY dept-id);

What is the outcome?

(A) It executes but does not give the correct result.

(B) It executes and gives the correct result.

(C) It generates an error because of pairwise comparison.

(D) It generates an error because the GROUP BY clause cannot be used with table joins in a sub-query.

Answer: (B)

Exp: In the inner sub query, "employees" and "departments" tables are joined by "using" clause (first Cartesian product of those two tables will be done and then and wherever these is a match on the dept-ids that tuple will be filtered). After this, the tuples of the resultant table will be filtered by using the condition "location-id=1700" and then will grouped on dept-id(all the tuples having equal values under dept-id will come into one group). After grouping, the columns dept-id in location-id 1700 and maximum of hire dates in that respective dept-id will be selected. Format of the tuples in the resultant table will be dept-id in location-id 1700 along with the latest hire date in the respective dept (two columns). Outer query takes each tuple from "employees" table and it will check whether dept-id and hire-date pair for this tuple is contained in the table given by inner sub query. If this is the case it will display the last-name of respective employee

IN operator compares one or multiple expressions on the left side of the operator to a set of one or more values on the right side of the operator. When using multiple expressions (like 2 columns - pair wise comparison), the number and data types of expressions in the list must match on both sides of the operator.

55.   Consider two processors P_1 and P_2 executing the same instruction set. Assume that under identical conditions, for the same input, a program running on P_2 takes 25% less time but incurs 20% more CPI (clock cycles per instruction) as compared to the program running on P_1. If the clock frequency of P_1 is 1GHz, then the clock frequency of P_2 (in GHz) is _____.

Answer: (1.6)

Exp: 1 cycle time for $p_1 = \dfrac{10^9}{1GH} = 1 \text{n.s}$

Assume p_1 takes 5 cycles for a program then p_2 takes 20% more, means, 6 cycles.

p_2 Takes 25% less time, means, if p_1 takes 5 n.s, then p_2 takes 3.75 n.s.

Assume p_2 clock frequency is x GHz.

p_2 Taken 6 cycles, so $\dfrac{6 \times 10^9}{x \text{ GH}} = 3.75$, $x = 1.6$