Detailed Analysis of GATE 2017 Papers

GATE CSIT Solved Paper 2017 Detailed Analysis

Subject	1 Mark Questions	2 Mark Questions	Total Marks
General Aptitude	5	5	15
Engineering Maths	4	5	14
Digital Logic	2	2	6
Computer Organization	3	4	11
Operating System	2	2	6
Databases	2	3	8
Theory of Computation	2	4	10
Compiler Design	2	1	4
Computer Network	2	3	8
Algorithms	2	2	6
Programming and Data Structures	4	4	12
Total			**100**

GATE 2017 Solved Paper
CSIT: Computer Science Engineering
Set – 1

Number of Questions: 65   **Total Marks:100**

Wrong answer for MCQ will result in negative marks, (−1/3) for 1 Mark Questions and (−2/3) for 2 Marks Question.

GENERAL APTITUDE

Number of Questions: 10   **Section Marks: 15**

Question 1 to Question 5 carry 1 mark each and Question 6 to Question 10 carry 2 marks each.

Question Number: 1   **Question Type: MCQ**

Rahul Murali, Srinivas, and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?

    (A) Rahul and Murali   (B) Srinivas and Arul

    (C) Srinivas and Murali   (D) Srinivas and Rahul

Solution: Hence, the correct option is (C).

Question Number: 2   **Question Type: MCQ**

Find the smallest number y such that $y \times 162$ is a perfect cube.

    (A) 24   (B) 27   (C) 32   (D) 36

Solution: Factorization of 162 is $2 \times 3 \times 3 \times 3 \times 3$ $y \times$ 162 is a perfect cube

$y \times 2 \times 3 \times 3 \times 3 \times 3 =$ Perfect cube

For perfect cube 2's & 3's are two more required each.

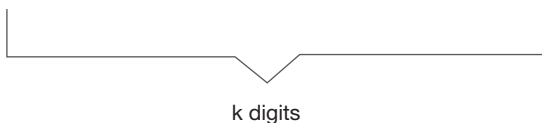Hence, the correct option is (D).

Question Number: 3   **Question Type: MCQ**

The probability that a k-digit number does NOT contain the digits 0, 5, or 9 is

    (A) 0.3^k (B) 0.6^k (C) 0.7^k (D) 0.9^k

Solution:

k digits

Each digit can be filled in 7 ways as 0, 5, and 9 are not allowed. So, each of these places can be filled by 1, 2, 3, 4, 6, 7, 8. So, required probability is $\left(\dfrac{7}{10}\right)^k$ or 0.7^k.

Hence, the correct option is (C).

Question Number: 4   **Question Type: MCQ**

Research in the workplace reveals that people work for many reason _____.

    (A) money beside   (B) beside money

    (C) money besides   (D) besides money

Solution: Hence, the correct option is (C).

Question Number: 5   **Question Type: MCQ**

After Rajendra Chola returned from his voyage to Indonesia, he _____ to visit the temple in Thanjavur.

    (A) was wishing   (B) is wishing

    (C) wished   (D) had wished

Solution: Hence, the correct option is (C).

Question Number: 6   **Question Type: MCQ**

Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is

    (A) 2   (B) 3

    (C) 4   (D) Cannot be determined

Solution: Out of six people, 3 place definitely occupied by right handed people as atleast 2 women are there so these two will sit adjacently. Now, as only one seat is left it will be occupied by a left-handed man because on right side of this seat is sitting a right-handed man.
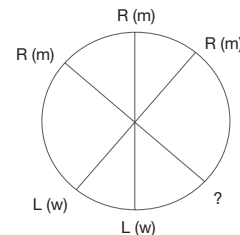
Therefore, answer should be 2 women.

Hence, the correct option is (A).

Question Number: 7   **Question Type: MCQ**

Arun, Gulab, Neel, and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue, and white, respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts, so that, no one has a shirt with a colour he or she dislikes?

   (A) 21   (B) 18   (C) 16   (D) 14

Solution: As there are 4 people A, G, N, S and 4 colours, so without any restriction total ways have to be $4 \times 4 = 16$.

Now, Arun $\rightarrow$ dislikes Red and

Shweta $\rightarrow$ dislikes white.

So, $16 - 2 = 14$ ways.

Hence, the correct option is (D).

Question Number: 8   **Question Type: MCQ**

A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. If in a flood, the water level rises to 525 m, which of villages P, Q, R, S, T get submerged?

   (A) P, Q   (B) P, Q, T

   (C) R, S, T   (D) Q, R, S
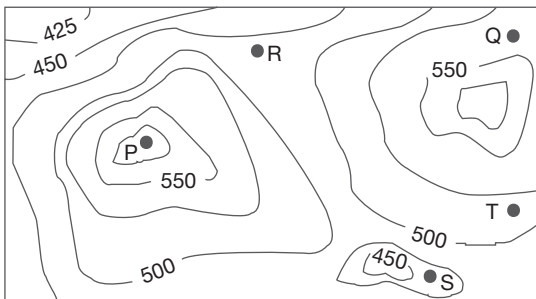
Solution: The given contour is a hill station, the peak point of this hill station is P, it is under a contour of 550.

At floods, the water level is 525 m. So, the village of R, S, and T are under a contour of 500. Therefore, these villages are submerged.

Hence, the correct option is (C).

Question Number: 9   **Question Type: MCQ**

9. "The hold of the nationalist imagination on our colonial past is such that anything inadequately or improperly nationalist is just not history". Which of the following statements best reflects the author's opinion?

   (A) Nationalists are highly imaginative.

   (B) History is viewed through the filter of nationalism.

   (C) Our colonial past never happened.

   (D) Nationalism has to be both adequately and properly imagined.

Solution: Hence, the correct option is (B).

Question Number: 10   **Question Type: MCQ**

The expression $\dfrac{(x+y)-|x-y|}{2}$ is equal to

   (A) the maximum of x and y

   (B) the minimum of x and y

   (C) 1

   (D) None of the above

Solution: If $x > y$; then $|x-y| = x - y$

$$\text{Exp} = \frac{x+y-(x-y)}{2} = y_{min}$$

If $x < y$; then $|x-y| = -(x-y) = y - x$

$$\text{Exp} = \frac{x+y-(y-x)}{2} = x_{min}$$

The expression $\text{Exp} = \dfrac{(x+y)-|x-y|}{2}$ is equal to minimum of x and y.

Hence, the correct option is (B).

COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

Number of Questions: 55   **Section Marks: 85.0**

Question 11 to Question 35 carry 1 mark each and Question 36 to Question 65 carry 2 marks each.

Question Number: 11   **Question Type: MCQ**

Consider a TCP client and a TCP server running on two different machines. After completing data transfer, the TCP client calls **close** to terminate the connectional and a FIN segments is sent to the TCP server. Server-side TCP responds by sending an ACK, which is received by the client-side TCP. As per the TCP connections state diagram (RFC 793), in which state does the client-side TCP connection wait for the FIN from the sever-side TCP?

(A) LAST-ACK   (B) TIME-WAIT
(C) FIN-WAIT-1   (D) FIN-WAIT-2

Solution:

Client*   Server*
 * or vice-versa, though requests typically originate at clients.

3 syn – sent   **2 Listening**
Sent connection – request. 1   Awaiting connection request.
Awaiting acknowledgement.1
Awaiting connection – request. 2
                                           4 Syn – Received
Received acknowledgement. 1   Received connection – request. 1
Received connection – request. 2   Sent acknowledgement. 1
Sent acknowledgement. 2   Sent connection – request. 2
                                            Awaiting acknowledgement. 2

 5 Established   **5 Established**
 The connection is open.   Received acknowledgement. 2
 Data moves both directions.   The connection is open.
                                             Data moves both directions.

6 Fin – waith. 1   **8 Close – wait**
Sent close – request.a   Received close – request.a
Awaiting acknowledgement.a   Sant acknowledgement.a
Awaiting close – request.b   When finished sending data
                                             Will sent close – request.b

7 Fin – wait. 2
Received acknowledgement.a
Still awaiting close – request.b   **9 Last – Ack**
or   Sant close – request.b
10 closing   Awaiting acknowledgement.b
Received Close – request.b
Sent acknowledgement.b
Still awating acknowledgement.a
11 Time – wait
Received acknowledgement.a
Received close – request.b
Sant acknowledgement.b
Allowing time for delivery
of acknowledgement.b

1 closed   **2 Listening**
A "fictional" state;   Awaiting connection request.
There is no connection.

Hence, the correct option is (D).

Question Number: 12 **Question Type: MCQ**

Consider the following context-free grammar over the alphabet $= \{a, b, c\}$ with S as the start symbol.

$$S \rightarrow abScT | abcT$$

$$T \rightarrow bT | b$$

Which one of the following represents the language generated by the above grammar?

(A) $\{(ab)^n (cb)^n | n \geq 1\}$

(B) $\{(ab)^n cb^{m1} cb^m{}_2 \ldots cb^m{}_2 | n, m_1, m_2, \ldots, m_n \geq 1\}$

(C) $\{(ab)^n (cb^m)^n | m, n \geq 1\}$

(D) $\{(ab)^n (cb^n)^m | m, n \geq 1\}$

Solution: The given grammar over $\Sigma = \{a, b, c\}$ with S as the start symbol is

$S \rightarrow abScT | abcT$

$T \rightarrow bT | b$

The minimum length string generated by the grammar is 1.

$S \rightarrow abcT \rightarrow abcb$; hence, all variable greater than 1.

Other cases

$S \rightarrow abScT \rightarrow ab\ abScT\ cT \rightarrow ab\ ab\ abScTcTcT \rightarrow$
$. \ldots \rightarrow (ab)^n (cT)^n$.

Here, T can generate any number of b's starting with single b.

Hence, the language is $L = \{(ab)^n\ cb^m{}_1\ cb^m{}_2\ cb^m{}_3$
$cb^m{}_4 ,. \ldots, cb^m{}_n / m_1, m_2, m_3, m_4 \ldots m_n\ n \geq 1\}$

Hence, the correct option is (B).

Question Number: 13 **Question Type: MCQ**

Consider the first-order logic sentence $F: \forall z(\exists y R(x, y))$. Assuming non-empty logical domains, which of the sentences below are *implied* by F?

I. $\exists y(\exists x R(x, y))$

II. $\exists y(\forall x R(x, y))$

III. $\forall y(x R(x, y))$

IV. $\neg \exists x(\forall y \neg R(x, y))$

(A) IV only

(B) I and IV only

(C) II only

(D) II and III only

Solution: $\forall x(\exists y R\ (x, y)) \Rightarrow \exists y \exists x R(x, y)$

$\exists y \forall x R\ (x, y) \Rightarrow \forall x \exists y R(x, y)$

$\forall x \exists y R(x, y) \Rightarrow \exists y \forall x R\ (x, y)$

$\neg \exists x(\forall y \neg R\ (x, y)) \Leftrightarrow \forall x \exists y R(x, y)$

Hence, the correct option is (B).

Question Number: 14 **Question Type: MCQ**

When two 8-bit numbers $A_7 \ldots A_0$ and B7 .... B0 in 2's complement representation (with A0 and B0 as the least significant bits) are added using a **ripple-carry adder**, the sum bits obtained are S7 .... S0 and the carry bits are C7....C0. An overflow is said to have occurred if

(A) the carry bit C7 is 1.

(B) all the carry bits (C7....C0) are 1.

(C) $(A_7 B_7 \bar{S}_7 + \bar{A}_7 \bar{B}_7 S_7)$ is 1.

(D) $(A_0 B_0 \bar{S}_0 + \bar{A}_0 \bar{B}_0 S_0)$ is 1.

Solution: Overflow flag indicates an overflow condition for a signed operation. Some points to remember in a signed operation:

• MSB is always reserved to indicate sign of the number.

• Negative numbers are represented in 2's-complement.

• An overflow results in invalid operation.

2's complement overflow rules:

• If the sum of two positive numbers yields a negative result, the sum has overflowed.

• If the sum of two negative number yields a positive result, the sum has overflowed.

• Otherwise, the sum has not overflowed.

Overflow for signed numbers occurs when the carry-in into the MSB (most significant bit) is not equal to carry-out. Conveniently, an XOR-operation on these two bits can quickly determine if an overflow condition exists.

Therefore, $((A_7 B_7)) \oplus S_7 = \bar{A}_7 \bar{B}_7 S_7 + A_7 B_7 S_7 = 1)$ has overflowed

Hence, the correct option is (C).

Question Number: 15 **Question Type: NAT**

Consider a database that has the relation schema EMP (EmpId, EmpName, and DeptName). An instance of the schema EMP and a SQL query on it are given in the table.

EMP		
EmpId	**EmpName**	**DeptName**
1.	XYA	AA
2.	XYB	AA
3.	XYC	AA
4.	XYD	AA

EMP		
EmpId	EmpName	DeptName
5.	XYE	AB
6.	XYF	AB
7.	XYG	AB
8.	XYH	AC
9.	XYI	AC
10	XYJ	AC
11.	XYK	AD
12.	XYL	AD
13.	XYM	AE

SELECT AVG(EC.Num) FROM EC
WHERE(DeptName, Num)IN
(SELECTDeptName, COUNT(EmpId)AS
EC(DeptName, Num)
FROMEMP
GROUP BYDeptName)

The output of executing the SQL query is _____.

Solution:

EC	
Dept Name	Num
AA	4
AB	3
AC	3
AD	2
AE	1

Avg (NUM) $= \dfrac{13}{5} = 2.6$

Hence, the correct answer is (2.6).

Question Number: 16   **Question Type: MCQ**

The following functional dependencies hold true for the relational schema $R\{V, W, X, Y, Z\}$:

$$V \rightarrow W$$
$$VW \rightarrow X$$
$$Y \rightarrow VX$$
$$Y \rightarrow Z$$

Which of the following is irreducible equivalent for this set of functional dependencies?

(A) $V \rightarrow W$
    $V \rightarrow X$
    $Y \rightarrow V$
    $Y \rightarrow Z$

(B) $V \rightarrow W$
    $W \rightarrow X$
    $Y \rightarrow V$
    $Y \rightarrow Z$

(C) $V \rightarrow W,$
    $W \rightarrow X$
    $Y \rightarrow V$
    $Y \rightarrow X$
    $Y \rightarrow Z$

(D) $V \rightarrow W$
    $W \rightarrow X$
    $Y \rightarrow V$
    $Y \rightarrow X$
    $Y \rightarrow Z$

Solution:

$V \rightarrow W, \; VW \rightarrow X, \; Y \rightarrow V, \; Y \rightarrow X, \; Y \rightarrow Z$
(W is extraneous)

$V \rightarrow W, V \rightarrow X, Y \rightarrow V, Y \rightarrow X, Y \rightarrow Z$

$\therefore \quad Y \rightarrow X$ is redundant

$\therefore \quad \{V \rightarrow W, V \rightarrow X, Y \rightarrow V, Y \rightarrow Z\}$

Hence, the correct option is (A).

Question Number: 17   **Question Type: MCQ**

Consider the following functions from positive integers to real numbers:

$$10, \sqrt{n}, n, \log_2 n, \frac{100}{n}$$

The CORRECT arrangement of the above functions in increasing order of asymptotic complexity is:

(A) $\log_2 n, \dfrac{100}{n} 10, \sqrt{n}, n,$

(B) $\dfrac{100}{n}, 10, \log_2 n, \sqrt{n}, n,$

(C) $10, \dfrac{100}{n}, \sqrt{n}, \log_2 n, n,$

(D) $\dfrac{100}{n}, \log_2 n, 10, \sqrt{n}, n,$

Solution: $\dfrac{100}{n} < 10 < \log_2 n \sqrt{n}, n$

Hence, the correct option is (B).

Question Number: 18   **Question Type: NAT**

Let T be a tree with 10 vertices. The sum of the degrees of all the vertices in T is _____.

Solution: A tree with 10 vertices has 9 edges.

As, $$\sum d(v_i) = 2|E|$$
$$\Rightarrow \quad \sum d(v_i) = 2 \times 9 = 18$$
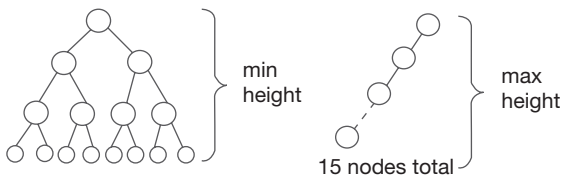
Hence, the correct answer is (18).

Question Number: 19   Question Type: MCQ

Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are:

Note: *The height of a tree with a single node is 0.*

(A) 4 and 15, respectively

(B) 3 and 14, respectively

(C) 4 and 14, respectively

(D) 3 and 15, respectively

Solution:

Min height = floor (log 2 N) = floor (log 15) = 3

Max height = 14, when the tree is either left skewed or right skewed.

Hence, the correct option is (B).

Question Number: 20   Question Type: MCQ

Consider the following C code:

```
# include <stdio.h>
int * assignval (int *x, int val) {
*x = val;
return x;
}
void main ( ) {
int * x= malloc (sizeof (int));
if (NULL = = x) return;
x = assignval (x,0);
if(x) {
x=(int *) malloc (sizeof (int));
if (NULL = = x) return;
x = assignval (x, 10);
}
```

```
printf("%d\n", *x);
free (x);
}
```

The code suffers from which one of the following problems:

(A) compiler error as the return of malloc is not typecast appropriately.

(B) compiler error because the comparison should be made as x == NULL and not as shown.

(C) compiles successfully but execution may result in dangling pointer.

(D) compiles successfully but execution may result in memory leak.

Solution:

(A) is wrong. We don't need to cast the result as void * is automatically and safely promoted to any other pointer type in this case.

(B) It is discarded for obvious reason.

(C) is wrong, because dangling pointer is nothing but the pointer, which is pointing to nonexisting memory (deallocated or deleted memory) which is not happening here.

(D) is the answer. When you are calling malloc second time, new location is assigned to x and previous memory location is lost and now we don't have no reference to that location resulting in memory leak.

Hence, the correct option is (D).

Question Number: 21   Question Type: NAT

Let X be a Gaussian random variable mean 0 and variance σ^2. Let $Y = \max(X, 0)$, where $\max(a, b)$ is the maximum of a and b. The median of Y is _____.

Solution: 'X' is Gaussian random variable
$$\Rightarrow X \sim N(0, \sigma^2) \text{ for } -\infty < X < \infty$$

Given $y = \max(x, 0)$
$$= \begin{cases} 0 \text{ if } -\infty < x \leq 0 \\ x \text{ if } 0 < x < \infty, \text{ is a random variable} \end{cases}$$

Since, median is positional average

Therefore, median of Y is '0'.

Hence, the correct answer is (0).

Question Number: 22   Question Type: NAT

Consider the Karnaugh map given below, where x represents "don't care" and blank represents 0.
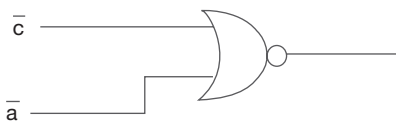
Assume for all inputs (a, b, c, d) the respective complements $(\bar{a}, \bar{b}, \bar{c}, \bar{d})$ are also available. The above logic is implemented 2-input NOR gates only. The minimum number of gates required is _____.

Solution:

$$F(a,b,c,d) = \bar{a}c \Rightarrow \overline{\overline{a.c}} = \overline{\bar{a} + \bar{c}} \quad (\overline{x+y} = \bar{x}.\bar{y})$$
$$= \overline{\overline{\bar{a} + c}}$$

Only 1 NOR gate required.

Hence, the correct answer is (1).

Question Number: 23   **Question Type: MCQ**

The statement $(\neg p) \Rightarrow (\neg q)$ is logically equivalent to which of the statements below?

I. $p \Rightarrow q$ II. $q \Rightarrow p$

III. $(\neg q) \, vp$ IV. $(\neg p) \, vq$

(A) I only   (B) I and IV only

(C) II only   (D) II and III only

Solution: By rule of contrapositive,

$$\neg p \rightarrow \neg q \Leftrightarrow q \rightarrow p$$
$$q \rightarrow p \Leftrightarrow \, \sim qvp$$

Hence, the correct option is (D).

Question Number: 24   **Question Type: MCQ**

Consider the following table:

	Algorithms		Design Paradigms
P.	Kruskal	i.	Divide and Conquer
Q.	Quicksort	ii.	Greedy
R.	Floyd-Warshall	iii.	Dynamic Programming

Match the algorithms to the design paradigms they are based on.

(A) P-(ii), Q-(iii), R-(i)

(B) P-(iii), Q-(i), R-(ii)

(C) P-(ii), Q-(i), R-(iii)

(D) P-(i), Q-(ii), R-(iii)

Solution: Kruskal's algorithm follows greedy approach in order to find MST of a connected graph. Quick sort follows divide and conquer strategy. Floyd Warshal algorithm is used to find the shortest path between every pair of vertices and it follows dynamic programming strategy.

Hence, the correct option is (C).

Question Number: 25   **Question Type: MCQ**

A sender S sends a message m to receiver R, which is digitally signed by S with its private key. In this scenario, one or more of the following security violations can take place.

I. S can launch a birthday attack to replace m with a fraudulent message.

II. A third party attacker can launch a birthday attack to replace m with a fraudulent message.

III. R can launch a birthday attack to replace m with a fraudulent message. Which of the following are possible security violations?

(A) I and II only

(B) I only

(C) II only

(D) II and III only

Solution: Sender can launch a Birthday Attack to replace with fraudulent message, because he has the

signature and he can decrypt the signature by his own public key and gets the hash value. With that same hash value, he can create another message and can be sent instead of original.

Hence, the correct option is (B).

Question Number: 26   Question Type: MCQ

Consider the following grammar.

$$P \to xQRS$$
$$Q \to yz\,z$$
$$R \to w \in$$
$$S \to y$$

What is FOLLOW (Q) ?

(A) $\{R\}$ (B) $\{w\}$

(C) $\{w, y\}$ (D) $\{w, \$\}$

Solution: FOLLOW(Q) is FIRST(R)

Hence, FIRST(R) = $\{w, \in\}$

We add 'w' in FOLLOW(Q) and for $\in$, we calculate FIRST(S)

FIRST(S) = $\{y\}$

FOLLOW(Q) is $\{w, y\}$,

Hence, the correct option is (C).

Question Number: 27   Question Type: NAT

Consider the language L given by the regular expression $(a + b) * b(a + b)$ over the alphabet $\{a, b\}$. The smallest number of states needed in a deterministic finite-state automation (DFA) accepting L is _____.

Solution: The regular expression can be described as "All strings over $\{a, b\}$ ending with "ba" or "bb".

The minimal DFA accepting L is having 4 states:
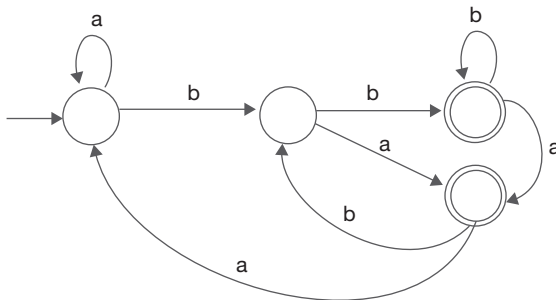
Hence, the correct answer is (4).

Question Number: 28   Question Type: NAT

Consider a two-level cache hierarchy with L1 and L2 caches. An application incurs 1.4 memory accesses per instruction on average. For this application, the miss rate of L1 cache 0.1, the L2 cache experiences, on average, 7 misses per 1000 instructions. The miss rate of L2 expressed correct to two decimal places is _____.

Solution:

$$\left.\begin{array}{l}\text{Number of memory access}\\\text{in 1000 instructions}\end{array}\right\} = 1.4 \times 1000 = 1,400$$

$$\text{Miss Rate} = \frac{7}{1400 \times 0.1} = 0.05$$

Hence, the correct answer is (0.05).

Question Number: 29   Question Type: NAT

Consider the following CPU processes with arrival times (in milliseconds) and length of CPU burst (in milliseconds) as given in the table:

Process	Arrival Time	Burst Time
P1	0	7
P2	3	3
P3	5	5
P4	6	2

If the pre-emptive shortest remaining time first scheduling algorithm is used to schedule the processes, then the average waiting time across all processes is _____ milliseconds.

Solution:

PID	AT	BT	CT	TAT	WT
P1	0	7	12	12	5
P2	3	3	6	3	0
P3	5	5	17	12	7
P4	6	2	8	2	0

Gantt chart:

P_1	P_2	P_2	P_4	P_1	P_3
0	3	5	6	8	12 17
P_1	P_1–4	P_1–4	P_1–4	P_1–4	P_3–5
	P_2–3	P_2–1	P_3–5	P_3–5	
		P_3–5	P_4–2		

P_1	P_2	P_4	P_1	P_3
0	3	6	8	17

$$\text{Average waiting time} = \frac{5+0+7+0}{4} = \frac{12}{4} = 3 \text{ ms}$$

Hence, the correct answer is (3).

Question Number: 30   **Question Type: MCQ**

Threads of a process share

    (A) global variable but not heap.

    (B) heap but not global variables.

    (C) neither global variables nor heap.

    (D) Both heap and global variables.

Solution: Threads of a process can share all resources except stack and register set.

Hence, the correct option is (D).

Question Number: 31   **Question Type: MCQ**

Let $c_1........c_n$ be scalars, not all zero, such that $\sum_{i=1}^{n} c_i a_i = 0$ where a_i are column vectors in R^n. Consider the set of linear equations $Ax = b$

where

$$A = [a_1 . . . a_n] \quad \text{and} \quad b = \sum_{i=1}^{n} a_i.$$

The set of equations has

    (A) a unique solution at $x = J_n$ where J_n denotes a n-dimensional vector of all 1

    (B) no solution

    (C) infinitely many solutions

    (D) finitely many solutions

Solution: Since the scalars are not all zero

$\therefore$ The column vectors a_i for $i = 1, 2,..., n$ are linearly dependent

$\Rightarrow |A| = 0$ and $b = \sum_{i=1}^{n} a_i \Rightarrow Ax = b$ has infinitely many solutions.

Hence, the correct option is (C).

Question Number: 32   **Question Type: MCQ**

Consider the C code fragment given below.

```
typedef struct node {
int data;
node* next ;
} node;
void join (node* m, node* n){
node* p=n ;
while (p->next ! =NULL){
p = p -> next ;
}
```

```
p-> next = m;
}
```

Assuming that m and n point to valid NULL-terminated linked lists, invocation of join will

    (A) append list m to the end of list n for all inputs.

    (B) either cause a null pointer dereference or append list m to the end of list n.

    (C) cause a null pointer dereference for all inputs.

    (D) append list n to the end of list m for all inputs.

Solution: While loop in Join Procedure moves the pointer "p" to the last node of the list "n". And at the last statement, we are initializing the next of the last node of list n to start of list "m".

But in some cases it may dereference to null pointer.

Hence, the correct option is (B).

Question Number: 33   **Question Type: MCQ**

The n-bit fixed-point representation of an unsigned real number real X uses f bits for the fraction part. Let $i = n - f$. The range of decimal values for X in this representation is

    (A) 2^{-f} to 2^i (B) 2^{-f} to $(2^i - 2^{-f})$

    (C) 0 to 2^i (D) 0 to $(2^i - 2^{-f})$

$i = n - f\cdot f$

Solution:

Max value $= 111.....1(i$ times$).111........1(f$ times$)$

$= 2^i - 1 + \left(\dfrac{1}{2} + \dfrac{1}{2^2} + ... + \dfrac{1}{2^f} \right) = 2^i - 1 + \dfrac{2^f - 1}{2^f} = 2^i - 2^{-f}$

$\therefore 0$ to $(2^i - 2^f)$

Hence, the correct option is (D).

Question Number: 34   **Question Type: MCQ**

Consider the following intermediate program in three address code

$$p = a - b$$
$$q = p * c$$
$$p = u * v$$
$$q = p + q$$

Which one of the following corresponds to a *static single assignment* form of the above code

(A) $p_1 = a - b$
  $q_1 = p_1 * c$
  $p_1 = u * v$
  $q_1 = p_1 + q_1$

(B) $p_3 = a - b$
  $q_4 = p_3 * c$
  $p_4 = u * v$
  $q\,5 = p_4 + q_4$

(C) $p_1 = a - b$
  $q_1 = p_2 * c$
  $p_3 = u * v$
  $q_2 = p_4 + q_3$

(D) $p_1 = a - b$
  $q_1 = p* c$
  $p_2 = u * v$
  $q\,2 = p + q$

Solution:

(A) code violates condition for static single assignment since p1 is initialized twice

(C) p_2, p_4, and q_3 are not initialized anywhere

(D) $q_2 = p + q$ is incorrect code

Hence, the correct option is (B).

Question Number: 35   Question Type: MCQ

Consider the C struct defined below:

```
struct data {
int marks [100] ;
char grade;
int cnumber;
};
struct data student;
```

The base address of student is available in register $R1$. The field student-grade can be accessed efficiently using

(A) Post-increment addressing mode. $(R1)+$

(B) Pre-decrement addressing mode, $-(R1)$

(C) Register direct addressing mode, $R1$

(D) Index addressing mode, $X(R1)$, where X is an offset represented in 2's complement 16-bit representation.

Solution: Direct access is possible with only index addressing mode.

Hence, the correct option is (D).

Question Number: 36   Question Type: MCQ

Let $G = (V, E)$ be any connected undirected edge-weighted graph. The weights of the edges in E are positive and distinct. Consider the following statements:

(I) Minimum spanning tree of G is always unique.

(II) Shortest path between any two vertices of G is always unique. Which of the above statements is/are necessarily true?

(A) (I) only

(B) (II) only

(C) Both (I) and (II)

(D) Neither (I) nor (II)

Solution:
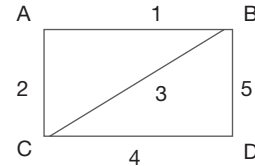
Shortest path from B to C are two B-A-C and B-C both of weight "3"

Hence, the correct option is (A).

Question Number: 37   Question Type: MCQ

A multithreaded program P executes with x number of threads and uses y number of locks for ensuring mutual exclusion while operating on shared memory locations. All locks in the program are *non-reentrant*, *i.e.,* if a thread holds a lock l, then it cannot re-acquire lock l without releasing it. If a thread is unable to acquire a lock, it blocks until the lock becomes available. The *minimum* value of x and the *minimum* value of y together for which execution of P can result in a deadlock are:

(A) $x = 1, y = 2$ (B) $x = 2, y = 1$

(C) $x = 2, y = 2$ (D) $x = 1, y = 1$

Solution: As per given question, there x number of threads and y number of locks for ensuring mutual exclusion while operating on shared memory locations

Option (A): $x = 1; y = 2$

Means that 1 thread and 2 locks clearly showing that no deadlock situation.

Option (B): $x = 2; y = 1$

Means that 2 threads and 1 lock → No deadlock situation.

After usage of lock by 1 thread, it can release that lock and then 2nd thread can be used that lock. So, no deadlock.

Option (C): $x = 2; y = 2$

Means that 2 threads and 2 locks → Deadlock can arise.

Both threads can hold 1 lock and can wait for release of another lock

Option (D): $x = 1; y = 1$

Means that 1 thread and 1 lock → No deadlock situation.

Hence, the correct option is (C).

Question Number: 38   Question Type: NAT

The values of parameters for the Stop-and-Wait ARQ protocol are as given below:

Bit rate of the transmission channel = 1Mbps

Propagation delay from sender to receiver = 0.75 ms

Time to process a frame = 0.25 ms

Number of bytes in the information frame = 1980

Number of bytes in the acknowledge frame = 20

Number of overhead bytes in the information frame = 20

Assume that there are no transmission errors. Then the transmission efficiency (expressed in percentage) of the Stop-and-Wait ARQ protocol for the above parameters is _____ (correct to 2 decimal places)

Solution: Given Data:

$B = 1$ Mbps

$T_{proc} = 0.25$ ms

$T_p = 0.75$ ms

$L = 1980$ Bytes

$L_{OH} = 20$ Bytes

$L_A = 20$ Bytes

Efficiency (η) = ?

(i) $T_x = \dfrac{L}{B} = \dfrac{(1980+20)\times 8}{10^6} = \dfrac{2\times 8\times 10^3}{10^6} = 16$ ms

(ii) $T_{ACX} = \dfrac{L_A}{B} = \dfrac{20\times 8}{10^6} = 0.16$ ms

In stop-and-wait ARQ, efficiency

$\eta = \dfrac{T_x}{T_x + T_{ACK} + 2T_P + T_{proc}}\dfrac{16\text{ ms}}{17.91\text{ ms}} = 0.8933 \approx 89.33\%$

Hence, the correct answer is (89.33).

Question Number: 39   Question Type: MCQ

A computer network uses polynomials over *GF(2)* for error checking with 8 bits as information bits and uses $x^3 + x + 1$ as the generator polynomial to generate the check bits. In this network, the message 01011011 is transmitted as

(A) 01011011010   (B) 01011011011

(C) 01011011101   (D) 01011011100

Solution: Given generator polynomial $G(x) = x^3 + x + 1 \Rightarrow 1011$ message $m(x) = 01011011$

```
1011) 0101 1 011000 (01000011‾
      0000   ↓
    Ø 1011
      1011   ↓
    Ø 0000
      0000   ↓
    Ø 0001
      0000   ↓
    Ø 0011
      0000   ↓
    Ø 0110
      0000   ↓
    Ø 1100
      1011   ↓
    Ø 1110
      1011
    ( Ø 101 )
```
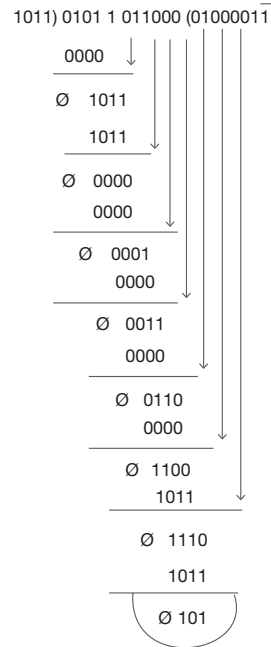
Hence, the correct option is (C).

Question Number: 40   Question Type: MCQ

Let p, q, and r be propositions and the expression $(p \rightarrow q) \rightarrow r$ be a contradiction. Then, the expression $(r \rightarrow p) \rightarrow q$ is,

(A) a tautology

(B) a contradiction

(C) always TRUE when p is FALSE,

(D) always TRUE when q is TRUE

Solution: $(p \rightarrow q) \rightarrow r$ is contradiction only when,

p	q	r
T	T	F
F	T	F
F	F	F

And now for the above combination, the expression $(r \rightarrow p) \rightarrow q$ is always true when q is true. When q is false in the above combination (third one) $(r \rightarrow p) \rightarrow q$ will be false.

Hence, the correct option is (D).

Question Number: 41 **Question Type: NAT**

A cache memory unit with capacity of N words and block size of B words is to be designed. If it is designed as a direct mapped cache, the length of the TAG field is 10 bits. If the cache unit is now designed as a 16-way set-associative cache, the length of the TAG field is _____ bits.

Solution:

$$\text{Total bits} = 10 + \underbrace{\log_2\left(\frac{N}{B}\right)}_{\text{\# of blocks}} + \underbrace{\log_2 B}_{\text{Offset}}$$

$$10 + \log_2(N) = \log_2\left(\frac{N}{16}\right) + T$$

where T is the required length of TAG field

$\therefore T = 14$

Hence, the correct answer is (14).

Question Number: 42 **Question Type: MCQ**

Consider the following two functions.

```
void funl (int n)  void fun2 (int n)
{                  {
if (n = =0 )        if (n = = 0)
return;            return ;
printf ("%d" , n); printf ("%d" , n);
fun2 (n - 2);      fun1(++n) ;
printf ("%d" , n); printf ("%d" , n);
```

The output printed when fun1(5) is called is

    (A) 53423122233445

    (B) 53423120112233

    (C) 53423122132435

    (D) 53423120213243

Solution: In this the fun 1() is calling fun 2() after printing value and after returning from fun 2(), it prints the same value. In the fun 2() also the same thing happens So, by looking options we can judge the correct sequence of output.

Hence, the correct option is (A).

Question Number: 43 **Question Type: MCQ**

Consider a database that has the relation schema CR (StudentName, CourseName). An instance of the schema CR is as given in the table.

CR	
Student Name	**Course Name**
SA	CA
SA	CB
SA	CC
SB	CB
SB	CC
SC	CA
SC	CB
SC	CC
SD	CA
SD	CB
SD	CC
SD	CD
SE	CD
SE	CA
SE	CB
SF	CA
SF	CB
SF	CC

The following query is made on the database.

$T1 \leftarrow \pi$ CourseName (σ StudentName $=_{\text{'SA' (CR))}}$

$T2 \leftarrow CR \div T1$

The number of rows in $T2$ is_____.

Solution:

$T1 = \{CA, CB, CC\}$

$T2 = \{SA, SC, SD, SF\}$

Hence, the correct Answer is (4).

Question Number: 44 **Question Type: MCQ**

Let A be $n \times n$ real valued square symmetric matrix of rank 2 with $\sum_{i=1}^{n}\sum_{j=1}^{n} A_{ij}^2 = 50$. Consider the following statements.

    (I) One eigen value must be in $[-5, 5]$

    (II) The eigen value with the largest magnitude must be strictly greater than 5.

Which of the above statements about eigen values of A is/are necessarily CORRECT?

    (A) Both (I) and (II)   (B) (I) only

    (C) (II) only   (D) Neither (I) nor (II)

Solution:

$\rho(A) < n \Rightarrow |A| = 0 \Rightarrow$ one eigen value must be $0 \in [5, 5]$

(I) is true

Let $A = \begin{bmatrix} 5 & 0 & 0 \\ 0 & -5 & 0 \\ 0 & 0 & 0 \end{bmatrix} \Rightarrow \sum_{i=1}^{n}\sum_{j=1}^{n} A_{ij}^2 = 50$ and $\rho(A) = 2$

but eigen values of A are 0, −5, 5

∴ The eigen value with the largest magnitude is not greater than 5

For $n = 2$ and Let A $A = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix} \Rightarrow$ eigen values = 5, 5

∴ One eigen value must be in [−5, 5] and largest eigen value magnitude is not greater than 5.

∴ **(II)** is false

Hence, the correct option is (B).

Question Number: 45   Question Type: MCQ

Consider the context-free grammars over the alphabet $\{a, b, c\}$ given below. S and T are non-terminals

$G_1 : S \rightarrow aSb|T, \; T \rightarrow cT|\in$

$G_2 : S \rightarrow bSa|T, \; T \rightarrow cT|\in$

The language $L(G_1) \; \subsetneq \; L(G_2)$ is

(A) Finite.

(B) Not finite but regular.

(C) Context-free but not regular.

(D) Recursive but not context-free.

Solution: The context free grammar given over alphabets $\Sigma = \{ a, b, c \}$ with S and T as non-terminals are:

$G_1 : S \rightarrow aSb/T, \; T \rightarrow cT/\in$

$G_2 : S \rightarrow bSa/T, \; T \rightarrow cT/\in$

Lets $L(G_1)$ is the language for grammar G_1 and $L(G_2)$ is the language for grammar G_2

$L(G_1) = \{a^n c^m b^n | \; n, m \geq 0\}$

$L(G_2) = \{b^n c^m a^n | \; n, m \geq 0\}$

$L_1 \; \subsetneq \; L_2 = \{ c^m/m \geq 0 \}$; which is infinite and regular

Hence, the correct option is (B).

Question Number: 46   Question Type: MCQ

Consider a combination of T and D flip-flops connected as shown below. The output of the D flip-flop is connected to the input of the T flip-flop and the output of the T Flip-flop is connected to the input of the D Flip-flop.
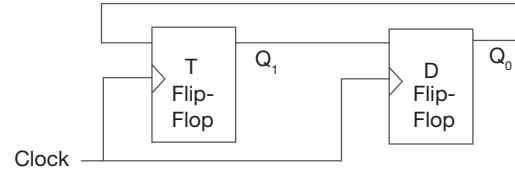
Initially, both Q_0 and Q_1 aarre set to 1 (before the 1st clock cycle). The outputs

(A) $Q_1 Q_0$ after the 3rd cycle are 11 and after the 4th cycle are 00, respectively.

(B) $Q_1 Q_0$ after the 3rd cycle are 11 and after the 4th cycle are 01, respectively.

(C) $Q_1 Q_0$ after the 3rd cycle are 00 and after the 4th cycle are 11, respectively.

(D) $Q_1 Q_0$ after the 3rd cycle are 01 and after the 4th cycle are 01, respectively.

Solution:

CLK	Q_1	Q_0
0	1	1
1	0	1
2	1	0
3	1	1
4	0	1

After 3rd clock pulse :11

After 4th clock pulse: 01

Hence, the correct option is (B).

Question Number: 47   Question Type: NAT

The number of integers between 1 and 500 (both inclusive) that are divisible by 3 or 5 or 7 is _____.

Solution:

$D_3 = \{$integers between 1 to 500 divisible by 3$\}$

$D_5 = \{$integers between 1 to 500 divisible by 5$\}$

$D_7 = \{$integers between 1 to 500 divisible by 7$\}$

To find number of integers between 1 to 500 that are divisible by 3 or 5 or 7 is to find

$|D3 \cup D5 \cup D7|$

$= [|D_3| + |D_5| + |D_7|] - [|D_3 \cap D_7| + |D_5 \cap D_7| + |D_3 \cap D_5 \cap D_7|]$

$= \left(\left[\dfrac{500}{3}\right] + \left[\dfrac{500}{5}\right] + \left[\dfrac{500}{7}\right] \right) - \left(\left[\dfrac{500}{15}\right] + \left[\dfrac{500}{21}\right] + \left[\dfrac{500}{35}\right] \right)$

$+ \left[\dfrac{500}{105}\right]$

$= (166 + 100 + 71) - (33 + 23 + 14) + 4$

$= 337 - 70 + 4 = 271$

Hence, the correct answer is (271).

Question Number: 48   Question Type: NAT

Consider a RISC machine where each instruction is exactly 4 bytes long. Conditional and unconditional branch instructions use PC-relative addressing mode with Offset specified in bytes to the target location of the branch instruction. Further the Offset is always with respect to the address of the next instruction in the program sequence. Consider the following instruction sequence.

Instr. No.	Instruction
i:	add R_2, R_3, R_4
$i + 1$;	sub R_5, R_6, R_7
$i + 2$;	cmp R_1, R_9, R_{10}
$i + 3$;	beq R_1, Offset

If the target of the branch instruction is i, then the decimal value of the Offset is _____.

Solution: $I_1 \ 0 - 3$

$I_2 \ 4-7$

$I_3 \ 8-11$

$I_4 \ 12-15$

$16 - I_4$ is the branch instruction & I_1 is the target.

$0 = 16 +$ relative value

$\therefore$ relative value $= -16$

Hence, the correct answer is (-16).

Question Number: 49   Question Type: MCQ

Consider the C functions foo and bar given below:

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

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

Invocations of foo (3) and bar (3) will result in:

(A) Return of 6 and 6, respectively.

(B) Infinite loop and abnormal termination, respectively.

(C) Abnormal termination and infinite loop, respectively.

(D) Both terminating abnormally.

Solution: Foo (3) calls foo (3) which in turn calls foo(3). This goes on infinite number of times, which causes memory overflow and causes abnormal termination.

Bar(3) → bar(2) → bar(1) → bar(0) (return 0) from here onwards bar (1) will call bar (0) and bar (0) will return 0 to bar (1) and this goes on forever without causing memory overflow.

Hence, the correct answer is (B).

Question Number: 50   Question Type: NAT

In a RSA cryptosystem a participant A uses two prime numbers $p = 13$ and $q = 17$ to generate her public and private keys. If the public key of A is 35. Then the private key of A is _____.

Solution:

Given Data	As per RSA Algorithm
$p = 13$	Step1: Calculate n = $p \times q$ = 13 × 17 = 221
$q = 17$	Step 2: Calculate $\phi(n) = (p - 1)(q - 1) = (12)(16) = 192$
$e = 35$	Step 3: de mod $\phi(n) = 1$ (or) de = 1mod$\phi(n)$
$d = ?$	$\Rightarrow d \times 35$ mod192 = 1 d = 11

Hence, the correct answer is (11).

Question Number: 51   Question Type: MCQ

Let A be an array of 31 numbers consisting of sequence of 0's followed by a sequence of 1's. The problem is to find the smallest index i that $A[i]$ is 1 by probing the minimum numbers of locations in A. The *worst case* number of probes performed by an *optimal* algorithm is _____.

Solution: In the given array the elements are 0's followed by 1's, which means array is already sorted.

So, we can apply binary search. At each stage, we compare $A\left[\dfrac{\text{low} + \text{high}}{2}\right]$.

[Assuming A is an array of 31 elements] with '1' and if it is 1 we check the left part recursively and if it is '0'

we check the right part of the array recursively, which takes log 231 comparisons in the worst case.

Hence, the correct answer is (5).

Question Number: 52   Question Type: MCQ

If G is grammar with productions

$$S \rightarrow SaS \,|\, aSb \,|\, bSa \,|\, SS \,|\, \in$$

where S is the start variable, then which one of the following is not generated by G?

(A) *abab*   (B) *aaab*

(C) *abbaa*   (D) *babba*

Solution:

1. $S \rightarrow SS \rightarrow aSbS \rightarrow abS \rightarrow abaSb \rightarrow abab$
2. $S \rightarrow aSb \rightarrow aSaSb \rightarrow aaaSb \rightarrow aaab$
3. $S \rightarrow SS \rightarrow aSbS \rightarrow abS \rightarrow abbSa \rightarrow abbSaSa \rightarrow abbaa$

Given grammar generates all strings where $n(a) \geq n(b)$

Hence, the correct answer is (D).

Question Number: 53   Question Type: MCQ

The value of $\lim\limits_{x \to 1} \dfrac{x^7 - 2x^5 + 1}{x^3 - 3x^2 + 2}$

(A) is 0   (B) is −1

(C) is 1   (D) does not exist

Solution: $\lim\limits_{x \to 1} \dfrac{x^7 - 2x^5 + 1}{x^3 - 3x^2 + 2} = \lim\limits_{x \to 1} \dfrac{7x^6 - 10x^4}{3x^2 - 6x} = 1.$

(Using L – Hospital's rule)

Hence, the correct answer is (C).

Question Number: 54   Question Type: MCQ

Instructions execution in a processor is divided into 5 stages. Instruction Fetch (IF), Instruction Decode (ID), Operand Fetch (OF), Execute (EX), and Write Back (WB). These stages take **5, 4, 20, 10, and 3 nanoseconds (ns),** respectively. A pipelined implementation of the processor requires buffering between each pair of consecutive stages with a delay of 2 ns. Two pipelined implementations of the processor are contemplated.

(i) a naïve pipeline implementation (NP) with 5 stages and

(ii) an efficient pipeline (EP) where the OF stage id divided into stages OF1 and OF2 with execution times of 12 ns and 8 ns, respectively.

The speedup (correct to two decimals places) achieved by EP over NP in executing 20 independent instructions with no hazards is _____

Solution: Given,

For Navie pipeline (NP) Number of stages $(k) = 5$

T_p = max (stage delay + buffer delay)

T_p = max (7, 6, 22, 12, 5) = 22 nsec.

Number of instructions $(n) = 20$

So, erection time for navie pipeline

$ET_{NP} = (k + n - 1) \times T_P = (5 + 20 - 1) \times 22 = 528$ nsec

Now, for efficient pipeline

$k = 6$, $n = 20$, $T_p = 14$ nsec.

$E_{EP} = (k + n - 1) \times TP = (6 + 20 - 1) \times 14 = 350$ nsec.

Therefore, Speed up $(s) = \dfrac{ET_{NP}}{E_{EP}} = \dfrac{528}{350}$

Speed up $(s) = 1.508$

350

Hence, the correct answer is (1.508).

Question Number: 55   Question Type: MCQ

Consider a database that has the relation schemas EMP(EmpId, EmpName, DepId). And DEPT(DeptName, DeptId). Note that the DeptId can be permitted to be NULL in the relation EMP. Consider the following queries on the database expressed in tuple relational calculus.

(I) $\{t \,|\, \exists u \in \text{EMP}(t[\text{EmpName}] = u[\text{EmpName}] \vee \forall v \in \text{DEPT}(t[\text{DeptId}] \neq v[\text{DeptId}]))\}$

(II) $\{t \,|\, \exists u \in \text{EMP}(t[\text{EmpName}] = u[\text{EmpName}] \vee \exists v \in \text{DEPT}(t[\text{DeptId}] \neq v[\text{DeptId}]))\}$

(III) $\{t \,|\, \exists u \in \text{EMP}(t[\text{EmpName}] = u[\text{EmpName}] \vee \exists v \in \text{DEPT}(t[\text{DeptId}] \neq v[\text{DeptId}]))\}$

Which of the above queries are safe?

(A) (I) and (II) only

(B) (I) and (III) only

(C) (II) and (III) only

(D) (I), (II) and (III)

Solution: Query which generates infinite number of tuples is called unsafe query. In the given question all the given queries generate finite number of tuples.

Hence, the correct answer is (D).

Question Number: 56   Question Type: MCQ

Recall that Belady's anomaly is that the pages-fault

rate may increase as the number of allocated frames increases. Now, consider the following statements:

Statement 1: *Random page replacement* algorithm (where a page chosen at random is replaced) suffers from Belady's anomaly.

Statement 2: *LRU page replacement* algorithm suffers from Belady's anomaly.

Which of the following is CORRECT?

    (A) S1 is true, S2 is true

    (B) S1 is true, S2 is false

    (C) S1 is false, S2 is true

    (D) S1 is false, S2 is false

Solution: **Statement 1** is "TRUE". Because there can be a case when page selected to be replaced is by FIFO policy.

Statement 2 is "FALSE". Because LRU page replacement algorithm does not suffers from Belady's Anomaly. Only FIFO page replacement algorithm suffers from Belady's Anomaly.

Hence, the correct answer is (B)

Question Number: 57   **Question Type: NAT**

The output of executing the following C program is_____.

```
# include <stdio.h>
int total (int v) {
while (v) {
count + = v & 1;
v>> = 1;
}
return count;
}
void main ( ) {
static int x = 0;
int i = 5;
for (; i> 0; i--) {
x=x + total (i) ;
}
printf ("%d\n", x) ;
}
```

Solution: Count in the function total is static.

I	Count	Total (i)
5	0	2
4	2	3(2 + 1)
3	3	5(3 + 2)
2	5	6(5 + 1)
1	6	7(6 + 1)
		= 23

Hence, the correct answer is (23).

Question Number: 58   **Question Type: NAT**

Consider the following C program.

```
#include <stdio.h>
#include<string.h>
void printlength (char *s, char *t)
{
unsigned int c = 0;
int len = ((strlen(s) - strlen (t))
> c) ? strlen(s): strlen(t);
printf ("%d\n", len);
}
void main ( ) {
char *x = "abc";
char *y ="defgh";
printlength (x,y);
```

Recall that strlen is defined in string.h as returning a value of type size_t, which is an unsigned int. The output of the program is _____.

Solution: x is pointer of string "abc" which is length 3.

S is pointer, that pointed x.

y is pointer of string "defgh" which is length 5.

t is pointer that pointed y.

Now, ((strlen (s)– strlen (t)) > c) is ((3 –5) > 0) is returns true, since (3 − 5 = −2) is nonzero value so, ternary operator '?' is returned strlen(s) which is 3 and assigned to len because ternary-operator returns first if condition is true else second. Therefore, final value is printed 3.

Hence, the correct answer is (3).

Question Number: 59   **Question Type: MCQ**

Consider the following languages over the alphabet $\Sigma = \{a, b, c\}$

Let $L_1 = \{a^n\ b^n\ c^m | m, n \geqslant 0\}$ and $L_2 = \{a^m\ b^n\ c^n | m, n \geq 0\}$

Which of the following are context-free languages?

    I $L_1 \cup L_2$

    II $L_1 \cap L_2$

(A) I only   (B) II only

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

Solution: The language given over alphabets $\Sigma = \{a, b, c\}$ as $L_1 = \{a^n b^n c^m / n, m \geq 0\}$ and $L_2 = \{a^m b^n c^n / n, m \geq 0\}$.

$L_1 \cup L_2 = \{a^n b^m c^k / n = m \text{ or } m = k, n, m \geq 0\}$ is a context free language. The context free grammar is:

$$S \rightarrow AB / CD$$
$$A \rightarrow aAb / \in$$
$$B \rightarrow cB / \in$$
$$C \rightarrow aC / \in$$
$$D \rightarrow bSc / \in$$

$L_1 \cap L_2 = \{a^n b^m c^k / n = m \text{ and } m = k, n, m \geq 0\}$ or $\{a^n b^n c^n / n \geq 0\}$ is a non-context free language.

Hence, the correct answer is (A).

Question Number: 60   **Question Type: NAT**

Consider a 2-way set associative cache with 256 blocks and uses LRU replacement, Initially, the cache is empty. Conflict misses are those misses which occur due the contention of multiple blocks for the same cache set. Compulsory misses occur due to first time access to the block. The following sequence of accesses to memory blocks.

$(0, 128, 256, 128, 0, 128, 256, 128, 1, 129, 257, 129, 1, 129, 257, 129)$

is repeated 10 times. The number of *conflict misses* experienced by the cache is _____.

Solution: A miss is not considered a conflict miss if the block is accessed for the first time.

1st round: $(2 + 2)$ misses

2nd round: $(4 + 4)$ misses

$\therefore$ Total $= 4 + (8 \times 9) = 76$ conflict misses

Hence, the correct answer is (76).

Question Number: 61   **Question Type: MCQ**

Let u and v be two vectors in R_2 whose Euclidean norms satisfy $\|u\| = 2\|v\|$. What is the value of a such that $w = u + av$ bisects the angle between u and v?

(A) 2   (B) 1/2

(C) 1   (D) −1/2

Solution: Let $u = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$ and $v = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$

$\Rightarrow \|u\| = z.\|v\|$ and $w = \begin{pmatrix} 2 \\ \alpha \end{pmatrix}$

Now $\cos(u, w) = \cos(v, w)$

$\Rightarrow \dfrac{4}{(2)\sqrt{\alpha^2 + 4}} = \dfrac{\alpha}{(1)\sqrt{\alpha^2 + 4}} \Rightarrow \alpha = 2$

Hence, the correct answer is (A).

Question Number: 62   **Question Type: NAT**

Consider the following grammar:

stmt $\rightarrow$ if expr then else expr; s tmt 0

expr $\rightarrow$ term relop term term

term $\rightarrow$ id | number

if $\rightarrow$ a | b | c
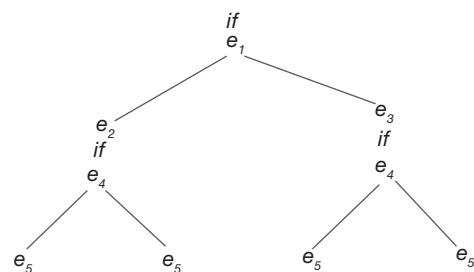
number $\rightarrow [0 - 9]$

where **relop** is a relational operate (e.g $<$, $>$,….) ---O refers to the empty statement, and **if, then, else** are terminals.

Consider a program P following the above grammar containing ten if terminals. The number of control flows paths in P is_____. For example the program

if e_1 **then** e_2 **else** e_3

has 2 controls flow paths $e_1 \rightarrow e_2$ and $e_1 \rightarrow e_3$

Solution: For 2 "if statements", $2^2 = 4$ control flow paths are possible:

So for 10 "If statements", 2^{10} control flow paths will be there.

Hence, the correct answer is (1024).

Question Number: 63   Question Type: MCQ

In a database system, unique time stamps are assigned to each transaction using Lamport's logical clock. Let $TS(T_1)$ and $TS(T_2)$ be the timestamps of transactions T_1 and T_2 respectively. Besides, T_1 holds a lock on the resource R, and T_2 has requested a conflicting lock on the same resource R. The following algorithm is used to prevent deadlocks in the database system assuming that a killed transaction is restarted with the same timestamp.

if $TS(T_2) < TS(T_1)$ then T_1 is killed else T_2 waits.

Assume any transactions that is not killed terminates eventually. Which of the following is TRUE about the database system that uses the above algorithm to prevent deadlocks?

- (A) The database system is both deadlock-free and starvation-free.
- (B) The database system is deadlock- free, but not starvation-free.
- (C) The database system is starvation-free but not deadlock- free.
- (D) The database system is neither deadlock-free nor starvation-free.

Solution: Elder kills younger and youngers waits on elder. So both are not waiting for each other. Hence no deadlock and there won't be any starvation as well because the transaction who got killed will be starting with same time stamp.

Hence, the correct answer is (A).

Question Number: 64   Question Type: MCQ

Let A and B be infinite alphabets and let # be a symbol outside both A and B. Let f be a total functional from A* to B*. We say f is *computable* if there exists a Turning machine M which given an input x in A*, always halts with $f(x)$ on its tape. Let Lf denote the language {x #f (x)|x∈ A*}.Which of the following statements is true:

- (A) f if computable if and only if Lf is recursive.
- (B) f is computable if and only Lf recursively enumerable.
- (C) If f is computable then Lf is recursive, but not conversely.
- (D) If f is computable then Lf is recursively enumerable, but not conversely.

Solution: A TM is recursive iff it halts for every input string (either in accept or reject state).

Here, a computable function is defined in a similar way.

Hence, the correct answer is (A).

Question Number: 65   Question Type: MCQ

Consider the expression $(a - 1)* (((b + c)/ 3) +d)$. Let X be the minimum number of registers required by an *optimal* code generation (without any register spill) algorithm for a load/store architecture in which *(i) only loads and store instructions can have memory operands and (ii) arithmetic instructions can have only register or immediate operands*. The value of X is_____.

Solution:
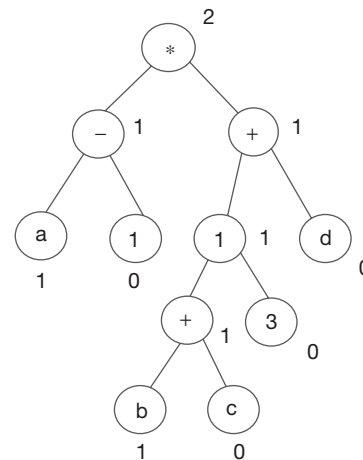
The given expression is $(a - 1)*(((b + c)/3)+d)$

The optimal generated code is:

LOAD R_1 b $R_1 \leftarrow$ b

LOAD R_2 C $R_2 \leftarrow$ c

ADD R_1 R_2 $R_1 \leftarrow R_1 + R_2$

DIV R_1 3 R_1 $R_1/3$

LOAD R_2 d $R_2 \leftarrow$ d

ADD R_1 R_2 $R_1 \leftarrow R_1 + R_2$

LOAD R_2 a $R_2 \leftarrow$ a

SUB R_2 1 R_2 $R_2 - 1$

MUL R_2 R_1 $R_2 \leftarrow R_2 * R_1$

Hence, the correct answer is (2).

GATE 2017 Solved Paper
CSIT: Computer Science and Information Technology
Set – 2

Number of Questions: 65   **Total Marks:100**

Wrong answer for MCQ will result in negative marks, (–1/3) for 1 Mark Questions and (–2/3) for 2 Marks Question.

General Aptitude

**Number of Questions: 10**   **Section Marks: 15**

Question 1 to Question 5 carry 1 mark each and Question 6 to Question 10 carry 2 marks each.

Question Number: 1   **Question Type: MCQ**

There are five buildings called V, W, X, Y, and Z in a row (not necessarily in that order). V is to the west of W. Z is to the East of X and the West of V. W is to the West of Y. Which is the building in the middle?

(A) V   (B) W   (C) X   (D) Y

Solution: From the given data, the following is formed
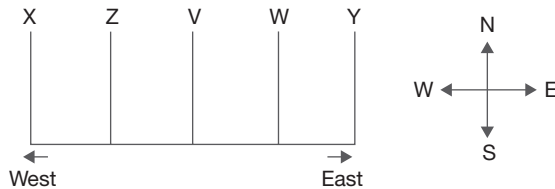
∴ The building 'V' is in the middle

Hence, the correct option is (A).

Question Number: 2   **Question Type: MCQ**

A test has twenty questions worth 100 marks in total. There are two types of questions, multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?

(A) 12   (B) 15   (C) 18   (D) 19

Solution: $x + y = 20$ (x = MCQ, y = Essay type)

$$3x + 11y = 100$$
$$\Rightarrow x = 15, y = 5$$

Hence, the correct option is (B).

Question Number: 3   **Question Type: MCQ**

Saturn is _____ to be seen on a clear night with the naked eye.

(A) enough bright   (B) bright enough

(C) as enough bright   (D) bright as enough

Hence, the correct option is (B).

Question Number: 4   **Question Type: MCQ**

There are 3 red socks, 4 green socks, and 3 blue socks, you choose 2 socks. The probability that they are of the same colour is _____.

(A) 1 5   (B) 7 30

(C) 1 4   (D) 4 15

Solution: Required probability $= \dfrac{3_{C_2} + 4_{C_2} + 3_{C_2}}{10_{C_2}} = \dfrac{4}{15}$

Hence, the correct option is (D).

**Question Number: 5**   **Question Type: MCQ**

Choose the option with words that are not synonyms.

(A) aversion, dislike

(B) luminous, radiant

(C) plunder, loot

(D) yielding, resistant

Hence, the correct option is (D).

Question Number: 6   **Question Type: MCQ**

An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.
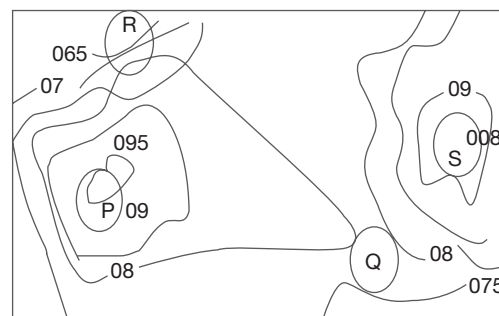
If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region, which of

the following regions is most likely to have a thunderstorm?

(A) P   (B) Q

(C) R   (D) S

Solution:

Region	Air Pressure Difference
P	0.95 – 0.90 = 0.05
Q	0.80 – 0.75 = 0.05
R	0.85 – 0.65 = 0.20
S	0.95 – 0.90 = 0.05

In general thunder storms are occurred in a region, where suddenly air pressure changes (*i.e.,*) sudden rise (or) sudden fall of air pressure. From the given contour map in 'R' region only more changes in air pressure. So, the possibility of a thunder storms in this region. So option (C) is correct.

Hence, the correct option is (C).

Question Number: 7   **Question Type: MCQ**

The number of roots of $e^x + 0.5x^2 - 2 = 0$ in the range [−5, 5] is

(A) 0   (B) 1   (C) 2   (D) 3

Solution: $f(x) = e^x + 0.5x^2 - 2$

$f(-5) = 10.50$; $f(-4) = 6.01$, $f(-2) = 0.135$; $f(-1) = -1.13$;

$f(0) = -1, f(1) = 1.21, f(2) = 7.38, f(3), f(4), f(5)$ also + ve.

∴ As there are 2 sign changes from +ve to −ve and −ve to +ve, two roots will be there in the range [−5, 5].

Hence, the correct option is (A).

Question Number: 8   **Question Type: MCQ**

"We lived in a culture that denied any merit to literary works, considering them important only when they were handmaidens to something seemingly more urgent—namely ideology. This was a country where all gestures, even the most private, were interpreted in political terms."

The author's belief that ideology is not as important as literature is revealed by the word:

(A) "culture"   (B) "seemingly"

(C) "urgent"   (D) "political"

Hence, the correct option is (B).

Question Number: 9   **Question Type: MCQ**

X is a 30 digit number starting with the digit 4 followed by the digit 7, then the number X^3 will have

(A) 90 digits   (B) 91 digits

(C) 92 digits   (D) 93 digits

Solution: $X = (47\ldots)$ 30 digits

Suppose $(47)^3_{30\,digits} = (2 + 2 + 2)\,$digits in $(47)^3$

Similarly $(47)^3_{30\,digits} = \text{contains}\,(30 + 30 + 30)\,$digits

$$= 90 \text{ digits}$$

Hence, the correct option is (A).

Question Number: 10   **Question Type: MCQ**

There are three boxes, one contains apples, another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labelled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes?

(A) The box labelled "Apples"

(B) The box labelled "Apples and Oranges"

(C) The box labelled "Oranges"

(D) Cannot be determined

Solution: The person who is opening the boxes, he knew that all 3 are marked wrong.

Suppose if 3 boxes are labelled as below.

(1) Apples   (2) Oranges   (3) Apples and Oranges

If he inspected from Box (1), picked one fruit, found orange, then he don't know whether box contains oranges (or) both apples and oranges.

Similarly, if he picked one fruit from Box (2), found apple then he don't know whether box contain apples (or) both apples and oranges.

But, if he picked one fruit from Box (3), *i.e.,* labelled is "apples and oranges", if he found apple then he can decide compulsorily that Box (3) contains apples and as he knew all boxes are labelled as incorrect, he can tell Box (2) contains both apples and oranges, Box (1) contain remaining oranges. So, he should open box labelled "Apples and Oranges" to determine contents of all the three boxes.

Hence, the correct option is (B).

COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

Number of Questions: 55   **Section Marks: 85.0**

Question 11 to Question 35 carry 1 mark each and Question 36 to Question 65 carry 2 marks each.

Question Number: 11   Question Type: NAT

Consider the following tables T1 and T2.

P	Q	R	S
2	2	2	2
3	8	8	3
7	3	3	2
5	8	9	7
6	9	5	7
8	5	7	2
9	8		

In table T1, **P** is the primary key and **Q** is the foreign key referencing **R** in table T2 with on-delete cascade and on-update cascade. In table T2, **R** is the primary key and **S** is the foreign key referencing **P** in table T1 on-delete set NULL and on-update cascade. In order to delete record 3, 8 from table T1, the number of additional records that need to be deleted from table T1 is

_____.

Solution: Only (8, 3) will be deleted from T2.

Hence, the correct answer is (0).

Question Number: 12   Question Type: MCQ

Which of the following is/are shared by all the threads in a process?

I. Program counter	II.	Stack
III. Address space	IV.	Registers

(A) I and II only   (B) III only

(C) IV only   (D) III and IV only

Solution:
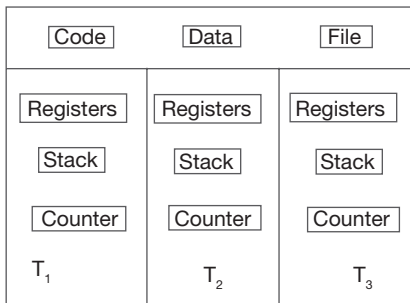
Single process P with 3 threads Multi threading
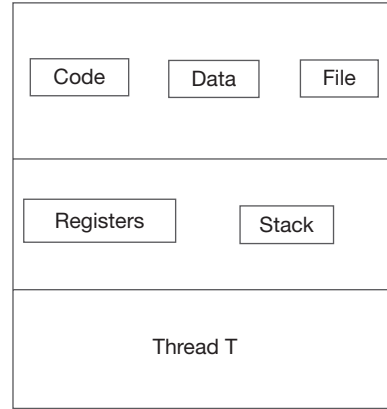

Single threads process

Hence, the correct option is (B).

Question Number: 13   Question Type: MCQ

A circular queue has been implemented using a single linked list where each node consists of a value and a single pointer pointing to the next node. We maintain exactly two external pointers **FRONT** and **REAR** pointing to the front node and the rear node of the queue, respectively. Which of the following statements is/are **CORRECT** for such a circular queue, so that, insertion and deletion operation can be performed in O (1) time?

  I. Next pointer of front node points to the rear node.
 II. Next pointer of rear node points to the front node.

(A) I only

(B) II only

(C) Both I and II

(D) Neither I nor II

Solution: Next pointer of the front node would point to the second node, if any.
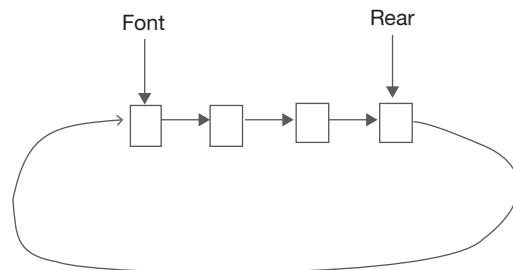
Hence, the correct option is (B).

Question Number: 14   **Question Type: MCQ**

Given the following binary number in 32-bit (single precision) IEEE-754 format:

00111110011011010000000000000000

The decimal value closest to this floating- point number is

    (A) 1.45×10^1

    (B) 1.45×10^{-1}

    (C) 2.27×10^{-1}

    (D) 2.27×10^1

Solution: Sign

0 01111100	11011010000000000000000

+1 124

+1 2^{-3} $[2^{-1} + 2^{-2} + \text{-------}]$ $= 0.227\ldots$

    $[1+]0.8515625$

Hence, the correct option is (C).

Question Number: 15   **Question Type: MCQ**

An *ER* model of a database consists of entity types *A* and *B*. These are connected by a relationship *R*, which does not have its own attribute. Under which one of the following conditions, can the relational table for *R* be merged with that of *A*?

    (A) Relationship *R* is one-to-many and the participation of *A* in *R* is total.

    (B) Relationship *R* is one-to-many and the participation of *A* in *R* is partial.

    (C) Relationship *R* is many-to-one and the participation of *A* in *R* is total.

    (D) Relationship *R* is many-to-one and the participation of *A* in *R* is partial.

Solution:

A & R
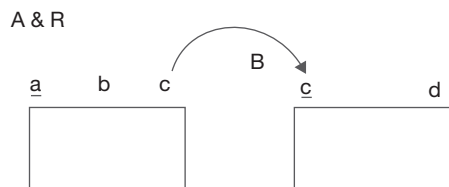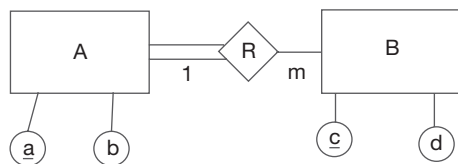
Note: only $M : N$ relationship needs exclusive table: If a relationship is $1 : M$ or $M : 1$ thenthat relation could be included in the many side table with the help of foreign key concept.

Hence, the correct option is (C).

Question Number: 16   **Question Type: MCQ**

Match the algorithms with their time complexities:

Algorithm			Time complexity
P.	Towers of Hanoi with *n* disks	i.	$\theta(n^{-2})$
Q.	Binary search given *n* sorted numbers	ii.	$\theta(n \log n)$
R.	Heap sort given *n* numbers at the worst case	iii.	$\theta(2^n)$
S.	Addition of two $n \cdot n$ matrices	iv.	$\theta(\log n)$

    (A) P-(iii), Q-(iv), R-(i), S-(ii)

    (B) P-(iv), Q-(iii), R-(i), S-(ii)

    (C) P-(iii), Q-(iv), R-(ii), S-(i)

    (D) P-(iv), Q-(iii), R-(ii), S-(i)

Solution: *P*. Towers of Hanoi $\Rightarrow T(n) = 2T(n-1) + 1$ $\Rightarrow \theta(2°)$

Q. Binary search $\Rightarrow T(n) = T\left(\dfrac{n}{2}\right) + C \Rightarrow \theta(\log n)$

R. Heap sort $\Rightarrow \theta(n \log n)$

S. Addition of two $n \times n$ matrices $\Rightarrow \theta(n^r)$

Hence, the correct option is (C).

Question Number: 17   **Question Type: MCQ**

Match the following according to input (from the left column) to the complier phase (in the right column) that processes it.

Column-1		Column-2	
P.	Syntax tree	i.	Code generator
Q.	Character stream	ii.	Syntax analyser
R.	Intermediate representation	iii.	Semantic analyser
S.	Token stream	iv.	Lexical analyser

    (A) P-(ii), Q-(iii), R-(iv), S-(i)

    (B) P-(ii), Q-(i), R-(iii), S-(iv)

    (C) P-(iii), Q-(iv), R-(i), S-(ii)

    (D) P-(i), Q-(iv), R-(ii), S-(iii)

Solution: Lexical Analysis phase processes character stream and generates tokens, e.g., identifier or keywords.

Tokens are processed by Syntax analysis analyzer.

Syntax tree is processed by Semantic analyzer.

Intermediate code such as 3—address code is used for code generation process.

Hence, the correct option is (C).

Question Number: 18   Question Type: MCQ

Consider the following statements about the routing protocols, Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) in an IPv4 network.

I. RIP uses distance vector routing.

II. RIP packets are sent using UDP.

III. OSPF packets are sent using TCP.

IV. OSPF operation is based on link-state routing.

Which of the statements above are CORRECT?

    (A) I and IV only

    (B) I, II and III only

    (C) I, II and IV only

    (D) II, III and IV only

Solution: Statement (1): RIP uses distance vector routing. "CORRECT"

RIP is one of the oldest DVR protocol which employ the hop count as a routing metric.

Statement (2): RIP packets are sent using UDP. "CORRECT"

RIP uses the UDP as its transport protocol, and is assigned the reserved port no 520.

Statement (3): OSPF packets are sent using TCP. "INCORRECT"

OSPF does not use a transport protocol, such as UDP (or) TCP, but encapsulates its data directly in IP packets.

Statement (4): OSPF operation is based on link state routing. "CORRECT"

OSPF is a routing protocol which uses link state routing (LSR) and works within a single autonomous system.

Hence, the correct option is (C).

Question Number: 19   Question Type: MCQ

If $f(x) = R\sin\left(\dfrac{\pi x}{2}\right) + S, f\left(\dfrac{1}{2}\right) = \sqrt{2}$ and $\int_0^1 f(x) = dx = \dfrac{2R}{\pi}$, then the constants R and S are, respectively

    (A) $\dfrac{2}{\pi}$ and $\dfrac{16}{\pi}$ (B) $\dfrac{2}{\pi}$ and 0

    (C) $\dfrac{4}{\pi}$ and 0 (D) $\dfrac{4}{\pi}$ and $\dfrac{16}{\pi}$

Solution:

$$f^1(x) = \dfrac{2\pi}{2}\cos\left(\dfrac{\pi x}{2}\right)$$

$$\Rightarrow f^1(1/2) = \sqrt{2} \text{ gives } \dfrac{R\pi}{2\sqrt{2}} = \sqrt{2} \Rightarrow R = \dfrac{4}{\pi}$$

Also $\int_0^1 f(x)\,dx = \dfrac{2R}{2}$ gives $\dfrac{-2R}{\pi}\left(\cos\dfrac{\pi x}{2}\right) + S(x)_0^1 = \dfrac{2R}{\pi}$

$$\Rightarrow S = 0$$

Hence, the correct option is (C).

Question Number: 20   Question Type: MCQ

In a file allocation system, which of the following allocation schemes(s) can be used if no external fragmentation is allowed?

I. Contiguous

II. Linked

III. Indexed

    (A) I and III only   (B) II only

    (C) III only   (D) II and III only

Solution: Contiguous allocation suffer from external fragmentation. But, linked and indexed allocation schemes free from external fragmentation.

Hence, the correct option is (D).

Question Number: 21   Question Type: NAT

Consider a quadratic equation $x^2 - 13x + 36 = 0$ with coefficients in a base b. The solutions of this equation in the same base b are $x = 5$ and $x = 6$. Then $b =$ _____ .

Solution: Clearly $13 = 1 \cdot 10 + 3$ and $36 = 3 \times 10 + 6$ $\Rightarrow$ base $b = 10$.

The quadratic equation with solutions $x = 5$ and $x = 6$ is $x^2 - 11x + 30 = 0$

According to the given condition, we have $b + 3 = 11$ and $3b + 6 = 30 \Rightarrow b = 8$

Answer is 8.

Alternate Solution:

$x^2 - 13x + 36 = 0$ (given quadratic equation)

In base b, $13 = 1 \times b^1 + 3 \times b^0 = b + 3$ and

$36 = 3 \times b^1 + 6 \times b^0 = 3b + 6$

So, the equation becomes $x^2 - b + 3x + 3b + 6 = 0$

Since, $x = 5$ is a solution

$5^2 - b + 3 \cdot 5 + 3b + 6 = 0 \Rightarrow b = 8.$

Similarly, by putting $x = 6$, we get $b = 8$.

Hence, the correct answer is (8).

Question Number: 22   Question Type: MCQ

Identify the language generated by the following grammar, where S is start variable.

$$S \rightarrow XY$$
$$X \rightarrow aX \mid a$$
$$Y \rightarrow aYb \mid \in$$

(A) $\{a^m a^n \mid m \geq n, n > 0\}$

(B) $\{a^m a^n \mid m \geq n, n \geq 0\}$

(C) $\{a^m a^n \mid m > n, n \geq 0\}$

(D) $\{a^m a^n \mid m > n, n > 0\}$

Solution: The given grammar with S as start symbol is

$$S \rightarrow XY$$
$$X \rightarrow aX/a$$
$$Y \rightarrow aYb/\in$$

From Non-terminal X, we can generate any number of a's including a single 'a' and from Y equal number of a's and b's.

Hence, $L = \{a^m b^n / m > n, n \geq 0\}$

Hence, the correct option is (C).

Question Number: 23   Question Type: MCQ

The representation of the value of a 16-bit unsigned integer X in hexadecimal number system is BCA9. The representation of the value of X in octal number system is

(A) 571244   (B) 736251

(C) 571247   (D) 136251

Solution: $(BCA9)_{16} \rightarrow (136251)_8$

Convert hexadecimal to octal number system.

Hence, the correct option is (D).

Question Number: 24   Question Type: MCQ
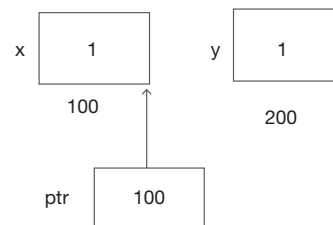
Consider the following function implemented in C:

```
void printxy (int x, int y) {
```

```
int *ptr ;
x = 0;
ptr = &x;
y = * ptr;
* ptr = 1;
print f ("%d, %d," x, y);
}
```

The output of invoking printxy (1, 1) is

(A) 0,0   (B) 0,1   (C) 1,0   (D) 1,1

Solution:

$\therefore$ 1,0 is printed

Hence, the correct option is (C).

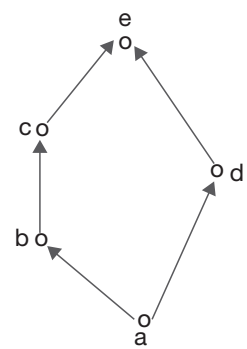**Question Number: 25   Question Type: NAT**

The maximum number of IPv4 router addresses that can be listed in the record route (RR) option field of an IPv4 header is _____.

Solution: A record route option is used to record the internet routers that handles the datagram. It can list up to nine router addresses. It can be used for debugging and management purpose.

Hence, the correct answer is (9).

Question Number: 26   Question Type: MCQ

Consider the set $X = \{a, b, c, d, e\}$ under the partial ordering $R = \{(a, a), (a, b), (a, c), (a, d), (a, e), (b, b), (b, c), (b, e), (c, c), (c, e), (d, d), (d, e), (e, e)\}$. The Hasse diagram of the partial order (X, R) is shown below.

The minimum number of ordered pairs that need to be added to R to make (X, R) a lattice is _____.

Solution: Given POSET is already a lattice so no need to add any ordered pairs.

Hence, the correct answer is (0).

Question Number: 27   Question Type: MCQ
Which of the following statements about parser is/are CORRECT?

  I. Canonical LR is more powerful than SLR.
 II. SLR is more powerful than LALR.
III. SLR is more powerful than Canonical LR.

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

Solution: Bottom up parsers in decreasing order of their power: CLR >> LALR >> SLR >> LR (0)

The given statements:

  I. Canonical LR is more powerful than SLR is **CORRECT**.
 II. SLR is more powerful than LALR is **INCORRECT.**
III. SLR is more powerful than Canonical LR is **INCORRECT**.

P.	static char var;	i.	Sequence of memory locations to store addresses
Q.	M = malloc (10); m = NULL;	ii.	A variable located in data section of memory
R.	char * ptr [10]	iii.	Request to allocate a CPU register to store data
S.	register int var1;	iv.	A lost memory which cannot be freed

Hence, the correct option is (A).

Question Number: 28   Question Type: MCQ
Match the following:

    (A) P-(ii), Q-(iv), R-(i), S-(iii)
    (B) P-(ii), Q-(i), R-(iv), S-(iii)
    (C) P-(ii), Q-(iv), R-(iii), S-(i)
    (D) P-(iii), Q-(iv), R-(i), S-(ii)

Solution: **P.** static char var:

var is defined as character variable whose associated storage class is static because of this it is given memory from data segment .

Q. m = malloc(10);

  m = NULL;

10 contiguous bytes of memory is allocated is address of first byte is stored in 'm' and later it is updated with NULL. Now we lost the address of first bytes of that chunk of memory completely. So, we can't free that space as we need the address of first byte to free it up

R. char * ptr [10]:

ptr is an array of 10 pointers pointing to character variables.

S. register int var1:

Suggesting the complier to store the var1 "value" in CPU register.

Hence, the correct option is (A).

Question Number: 29   Question Type: MCQ
Let L_1 L_2 be any two context free languages and R be any regular language. Then which of the following is/are CORRECT?

  I. $L_1 \cup L_2$ is context—free
 II. L_1 is context—free
III. $L_1 - R$ is context—free
 IV. $L_1 \cap L_2$ is context—free

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

Solution: Given L_1 and L_2 are context free languages and R is a regular language.

  I. $L_1 \cup L_2$ is context free is **CORRECT**, context free language are closed under union operation.
 II. $\bar{L}_1$ is context free is **INCORRECT**, context free languages are not closed under complement operation.
III. $L_1 - R$ is Context free is **CORRECT**. $L_1 - R = L_1 \cap \bar{R}$, Context free intersection Regular is always Context free.
 IV. $L_1 \cap L_2$ is context free is **INCORRECT**; context free languages are not closed under complement operation.

Hence, the correct option is (B).

Question Number: 30   Question Type: NAT
G is undirected graph with n vertices and 25 edges such that each vertex of G has degree at least 3. Then the maximum possible value of n is _____.

Solution: If every vertex has degree at least k then

$$K|V| \le 2(E)$$

$$3|V| \le 2 \times 25$$

$$|V| \le \left|\frac{50}{3}\right|$$

$$|V| \le 16$$

Hence, the correct answer is (16).

Question Number: 31   **Question Type: MCQ**

Let p, q, r denote the statements "It is raining," "It is cold", and " It is pleasant," respectively. Then the statement "It is not raining and it is pleasant, and it is not pleasant only if it is raining and it is cold" is represented by

(A) $(\leftarrow p \wedge r) \wedge (\leftarrow r \rightarrow (p \wedge q))$

(B) $(\leftarrow p \wedge r) \wedge ((p \wedge q) \rightarrow \leftarrow r)$

(C) $(\leftarrow p \wedge r) \vee ((p \wedge q) \rightarrow \leftarrow r)$

(D) $(\leftarrow p \wedge r) \vee (r \rightarrow (p \wedge q))$

Solution: X only if Y is same as $X \Rightarrow Y$

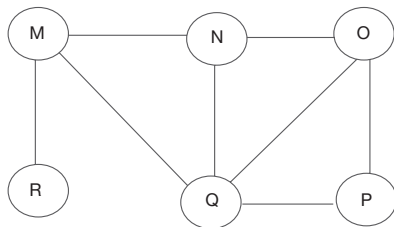"it is not raining and it is pleasant" $= \neg p \wedge r$

"it is not pleasant only if it is raining and it is cold" $= \neg r \rightarrow (p \wedge q)$

$\therefore (\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q))$.

Hence, the correct option is (A).

Question Number: 32   **Question Type: MCQ**

The Breadth First Search (BFS) algorithm has been implemented using the queue data structure. Which one of the following is a possible order of visiting the nodes in the figure below?

(A) MNOPQR

(B) NQMPOR

(C) QMNROP

(D) POQNMR

Solution: BFS: Start at root (some arbitrary node of a graph, sometimes referred to as "search key") and explore the neighbour nodes first, before and moving to the next level neighbours.

Hence, the correct option is (D).

Question Number: 33   **Question Type: NAT**

Let $P = \begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$ and $Q = \begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$

be two matrices.

Then the rank of $P + Q$ is _____.

Solution:

$$P + Q = \begin{bmatrix} 0 & -1 & 12 \\ 8 & 9 & 10 \\ 8 & 8 & 8 \end{bmatrix}$$

$$R_1 \leftrightarrow R_2 \sim \begin{bmatrix} 8 & 9 & 10 \\ 0 & -1 & -2 \\ 1 & 1 & 1 \end{bmatrix}$$

$$\frac{R_3}{8}$$

$$8R_3 - R_1 \sim \begin{bmatrix} 8 & -9 & 10 \\ 0 & -1 & -2 \\ 0 & -1 & -2 \end{bmatrix}$$

$$R_3 - R_2 \sim \begin{bmatrix} 8 & -9 & 10 \\ 0 & -1 & -2 \\ 0 & 0 & 0 \end{bmatrix}$$

$\therefore$ Rank is 2

Hence, the correct answer is (2).

Question Number: 34   **Question Type: MCQ**

Consider socket API on a Linux machine that supports connected UDP sockets. A connected UDP socket is a UDP socket on which **connect** function has already been called. Which of the following statements is/are CORRECT?

I. A connected UDP socket can be used to communicate with multiple peers simultaneously.

II. A process can successfully call **connect** function again for an already connected UDP socket.

(A) I only

(B) II only

(C) Both I and II

(D) Neither I nor IIs

Solution: A process with a connected UDP socket can call connect again for that socket for one of two reasons:

(1) To specify a new IP address and port.

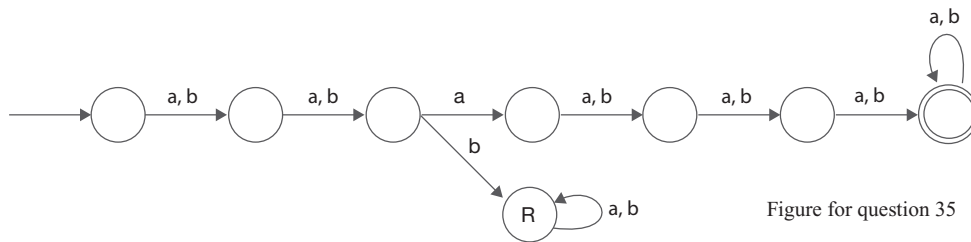(2) To unconnect the socket.

Hence, the correct option is (B).

Question Number: 35   **Question Type: NAT**

The minimum possible number of states of a deterministic automaton that accepts the regular language

$L = \{w_1 \, aw_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$ is
_____.

Solution: The given regular language is

$L = \{w_1 aw_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2 \, |w_2| \geq 3\}$

The minimal deterministic finite automata accepting L is:

Figure for question 35
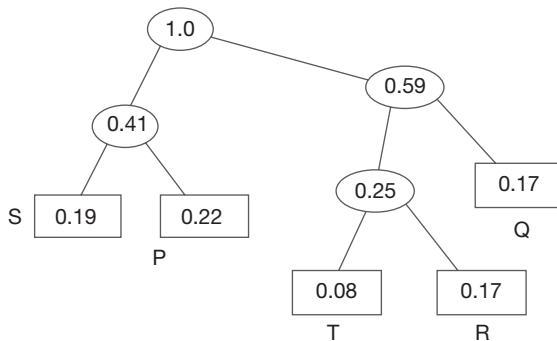
Hence, the correct answer is (8).

Question Number: 36   **Question Type: NAT**

A message is made up entirely of characters from the set $X = \{P, Q, R, S, T\}$. The table of probabilities for each of the characters is shown below:

Character	Probability
P	0.22
Q	0.34
R	0.17
S	0.19
T	0.08
Total	1.00

If a message of 100 characters over X is encoded using Huffman coding, then the expected length of the encoded message in bits is _____

Solution: Huffman tree is as follows

Average length of the character

$= 2(0.19 + 0.22) + 2(0.34) + 3(0.08 + 0.17)$

$= 2(0.41) + 2(0.34) + 3(0.25)$

$= 0.82 + 0.68 + 0.75$

$= 2.25$ bits

$\therefore$ Message length $= 100 \times 2.25$ bits $= 225$ bits.

Hence, the correct answer is (225).

Question Number: 37   **Question Type: MCQ**

The next state table of a 2-bit saturating up-counter is given below.

Q_1	Q_0	Q_1^+	Q_0^+
0	0	0	1
0	1	1	0
1	0	1	1
1	1	1	1

The counter is built as a synchronous sequential circuit using T flip-flops. The expression for T_1 and T_0 are

(A) $T = QQ$, $T_0 = \bar{Q}_1\bar{Q}_0$

(B) $T_1 = \bar{Q}_1\bar{Q}_0$, $T_0 = \bar{Q}_1 + \bar{Q}_0$

(C) $T_1 = Q_1 + Q_0$, $T_0 = \bar{Q}_1 + \bar{Q}_0$

(D) $T_1 = Q_1Q_0$, $T_0 = \bar{Q}_1 + \bar{Q}_0$

Solution:

Q_1	Q_0	Q_1^+	Q_0^+	T_1	T_0
0	0	0	1	0	1
0	1	1	0	1	1
1	0	1	1	0	1
1	1	1	1	0	0

$T_1 = \overline{Q_1}Q_0$

$T_0 = \overline{Q_1} + \overline{Q_0}$

Hence, the correct option is (B).

Question Number: 38   Question Type: NAT

Consider the set of processes with arrival time (in milliseconds). CPU burst time (in milliseconds), and priority (0 is the highest priority) shown in the table. None of the processes have I/O burst time.

Process	Arrival Time	Burst Time	Priority
P_1	0	11	2
P_2	5	28	0
P_3	12	2	3
P_4	2	10	1
P_5	9	16	4

The average waiting time (in milliseconds) of all the processes using pre-emptive priority scheduling algorithm is _____

Solution:

PID	AT	BT	Priority	CT	TAT	Waiting Time
P_1	0	11	2	4	49	38
P_2	5	28	0	33	28	0
P_3	12	2	3	51	39	37
P_4	2	10	1	40	38	28
P_5	9	16	4	67	58	42

Gantt Chart

P_1	P_4	P_2	P_4	P_1	P_3	P_6
0	2	5	33	40	49	51 67

Therefore,

$$\text{Average waiting time} = \frac{(38+0+37+28+42)}{5} = \frac{145}{5}$$
$$= 29 \text{ ms}$$

Hence, the correct answer is (29).

Question Number: 39   Question Type: MCQ

For any discrete random variable X, with probability mass function $P(X = j) = p_j$, $p_j \geq 0$, $j \in \{0,.....,$ $N\}$ and $\sum_{j=0}^{N} p_j = 1$, define the polynomial function

$g_x(z) = \sum_{j=0}^{N} p_j z^j$.

For a certain discrete random variable Y, there exists a scalar $\beta \in [0,1]$ such that $gY(z) = (1 - \beta + \beta z)N$. The expectation of Y is

(A) $N\beta(1 - \beta)$

(B) $N\beta$

(C) $N(1 - \beta)$

(D) Not expressible in terms of N and β alone

Solution: Hence, the correct option is (B).

Question Number: 40   Question Type: NAT

The read access times and the hit ratios for different caches in a memory hierarchy are as given in the table.

Cache	Read Access Time (in nanoseconds)	Hit Ratio
I-cache	2	0.8
D-cache	2	0.9
L_2-cache	8	0.9

The read access time of main memory is 90 nanoseconds. Assume that the caches use the referred word-first read policy and the write back policy. Assume that all the caches are direct mapped caches. Assume that the dirty bit is always 0 for all the blocks in the caches. In execution of a program, 60% of memory reads are for instruction fetch and 40% are for memory operand fetch. The average read access time in nanoseconds (up to 2 decimal places) is _____.

Solution: Given,

Cache	I-Cache	D-Cache	$L2$-Cache	Main Memory
Read Access Time (in ns)	2	2	8	90
Hit Ratio	0.8	0.9	0.9	1.0

And in execution of program 60% of memory reads are for instruction fetch and 40% are for memory operand fetch. Now,

Average instruction fetch time = I-cache access time + I-cache miss ratio * L_2-cache access time + I-cache miss rate * L_2-cache miss ratio * main memory access time = $2 + (1 - 0.8)8 + (1 - 0.8)(1 - 0.9)90 = 5.4$ nsec

And

Average data fetch time = D-cache access time + D-cache miss ratio* L_2-cache access time + D-cache miss ratio * L_2-cache miss ratio * main memory access time $2 + (1 - 0.9)8 + (1 - 0.9) \times (1 - 0.9) \times 90 = 3.7$ nsec

Therefore,

Average memory access time = Fraction of instruction fetch * Average instruction fetch time + Fraction of data fetch * Average data fetch time = $0.6 \cdot 5.4 + 0.4 \cdot 3.7 = 4.72$ (in nsec)

Hence, the correct answer is (4.72).

Question Number: 41   **Question Type: NAT**

If the ordinary generating function of a sequence $\{a_n\}_{n=0}^{\infty}$ is $\dfrac{1+z}{(1-z)^3}$, then $a_3 - a_0$ is equal to _____.

Solution:

$$f(z) = \frac{1}{1-z} = 1 + z + z^2 + \ldots$$

$$f'(z) = \frac{1}{(1-z)^2} = 1 + 2z + 3z^2 + \ldots$$

Consider $\dfrac{1+z}{(1-z)^3} = \dfrac{1}{(1-z)^2} + \dfrac{2z}{(1-z)^3}$

$$\frac{1}{(1-z)^2} = 1 + 2z + 3z^2 + 4z^3 \ldots$$

$$f''(z) = \frac{2}{(1-z)^3} = 2 + 6z + 12z^2 \ldots$$

$$\frac{1}{(1-z)^2} + \frac{2z}{(1-z)^3} = (1 + 2z + 3z^2 + 4z^3 - \ldots)$$

$$= 1 + 4z + 9z^2 + 16z^3 \ldots$$

$$= a_0 + a_1 z + a_2 z^2 + a_3 z^3 \ldots$$

$$a_0 = 1$$

$$a_3 = 16$$

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

Hence, the correct answer is (15).

Question Number: 42   **Question Type: NAT**

Consider the following snippet of a C program. Assume that swap (&x, &y) exchanges the contents of x and y.

```c
int main ( ) {
int array[]={3,5,1,4,6,2};
int done =0 ;
int i ;
while (done = = 0) {
done = 1;
for (i = 0; i <=4; i ++) {
if (array [i] < array [i +1]) {
swap (& array [i], &array [i+1]);
done = 0;
}
}
for (i = 5 ; i > =1; i --) {
if (array [i] > array [ i-1]) {
swap ( & array [i] , &array [i-1]);
done = 0;
}
}
}
printf ( " %d " , array [3] );
}
```

The output of the program is _____.

Solution: The final contents of the array is

6	5	4	3	2	1

$\therefore$ a[3] = 3 will be printed

Hence, the correct answer is (3).

Question Number: 43   **Question Type: NAT**

Consider the following C program.

```c
# include <stdio.h>
int main ( ) {
int m = 10;
int n, n1;
n = ++m;
n1 = m++;
n--;
```

```
--n₁;
n - = n₁;
printf ("%d", n) ;
return 0;
}
```

The output of the program is _____.

Solution: $m = 10$

$n = {++}m$ will increment m and assign it to $n \Rightarrow n = 11$ & $m = 1$

$n_1 = m{++}$ will assign m to n_1 and then increment m by 1 $\Rightarrow n_1 = 11$, $m = 12$

$n{-}{-}$; decrement n by1 $\Rightarrow n$ 10

$-{-}n$; decrement n by1 $\Rightarrow n$ 10

$n{-} = n$; sameas $n = n - n = 10 - 10 = 0$

$\therefore$ '0' is printed

Hence, the correct answer is (0).

Question Number: 44   Question Type: NAT

Consider the following database table named *top_scorer*.

top_scorer.

Player	Country	Goals
Klose	Germany	16
Ronald	Brazil	15
G Muller	Germany	14
Fontaine	France	13
Pele	Brazil	12
Klinsmann	Germany	11
Kocsis	Hungary	11
Batistuta	Argentina	10
Cubillas	Peru	10
Lato	Poland	10
Lineker	England	10
T Miller	Germany	10
Rahn	Germany	10

Consider the following SQL query:

SELECT ta.player FROM top _scorer AS ta

WHERE ta.goals > ALL (SELECT tb. goals

FROM top _ scorer AS tb

WHERE tb.country = 'Spain')

AND ta.goals > ANY (SELECT tc. goals

FROM top_ scorer AS tc

WHERE tc.country = 'Germany')

The number of tuples returned by the above SQL query is _____.

Solution: Player

Klose

Ronaldo

G Muller

Fontaine

Pele

Klinsmann

Kocsis

Hence, the correct answer is (7).

Question Number: 45   Question Type: MCQ

Given $f(w, x, y, z) = \Sigma_m (0, 1, 2, 3, 7, 8, 10) + \Sigma d(5, 6, 11, 15)$, where d represents the do not care condition in Karnaugh maps. Which of the following is a minimum product-of-sums (POS) form of $f(w, x, y, z)$?
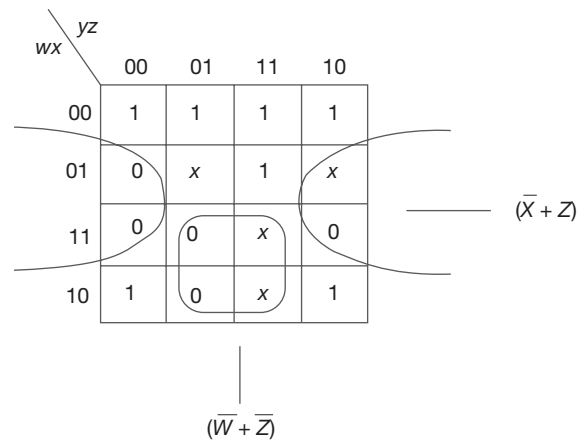
(A) $f = (\bar{w} + \bar{z})(\bar{x} + z)$

(B) $f = (\bar{w} + z)(x + z)$

(C) $f = (w + z)(\bar{x} + z)$

(D) $f = (w + \bar{z})(\bar{x} + z)$

Solution:

$= (\bar{w} + \bar{z})(\bar{x} + z)$

Hence, the correct option is (a).

Question Number: 46   Question Type: NAT

In a B+ tree, if the search-key value is 8 bytes long, the block size is 512 bytes and the block pointer size

is 2 bytes, then maximum order of the B+ tree is

_____.

Solution: Let 'K' be the order

$K(2) + (K-1)(8) \leq 512$

$\Rightarrow 2K + 8k - 8 \leq 512$

$\Rightarrow 10K \leq 520 \Rightarrow K \leq \dfrac{520}{10}$

$\therefore K \leq 52$

Hence, the correct answer is (52).

Question Number: 47   Question Type: MCQ

Let $L(R)$ be the language represented by regular expression R. Let $L(G)$ be the language generated by a context free grammar G. Let $L(M)$ be the language accepted by a Turning machine M. Which of the following decision problems are undecidable?

 I. Given a regular expression R and a string w, is $w \in L(R)$?

 II. Given a context-free grammar G, $L(G) = \varnothing$?

 III. Given a context-free grammar G, is $L(G) = \Sigma^*$ for some alphabet Σ?

 IV. Given a Turning machine M and a string w, is $w \in L(M)$?

 (A) I and IV only

 (B) II and III only

 (C) II, III and IV only

 (D) III and IV only

Solution: $L(R)$ is the language represented by regular expression.

$L(G)$ is the language generated by context free grammar.

$L(M)$ is the language accepted by Turing Machine.

I. The problem a given regular expression R and a string w, is $w \in L(R)$? , is a membership problem. Membership problem is decidable for Finite state machine and regular expression.

III. A given context free grammar G, is $L(G)$ is Σ^* for some alphabet Σ?, is undecidable problem. We cannot check whether $L(G) = \Sigma^*$ or not but rather we can check complement of $L(G)$ is ϕ .Since, context free language are not closed under complement operation $\overline{L(G)}$ may be language accepted by Turing Machine and we cannot check emptiness for Turing machine.

IV. Given a Turing Machine M and a string w, is $w \in L(M)$? , is a membership problem for TM. Membership problem is not a decidable problem for TM.

Hence, the correct option is (D).

Question Number: 48   Question Type: NAT

Consider a machine with a byte addressable main memory of 2^{32} bytes divided into blocks of size 32 bytes. Assume that a direct mapped cache having 512 cache lines is used with this machine. The size of the tag field in bits is _____.

Solution:

$$32 - (5 + 9) = 18$$

Total block size   block identifier

Hence, the correct answer is (18).

Question Number: 49   Question Type: MCQ

Let δ denote that transition function and $\hat{\delta}$ denote the extended transition function of the $\in-$ NFA whose transition table is given below:

δ	$\in$	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	(q_0)
q_1	$\{q_2\}$	$\{q_2\}$	(q_0)
q_2	$\{q_0\}$	$\varnothing$	$\varnothing$
q_3	$\varnothing$	$\varnothing$	$\{q_2\}$

Then $\hat{\delta}$ $(q_2, aba$ is)

 (A) $\varnothing$

 (B) $\{q_0, q_1, q_3\}$

 (C) $\{q_0, q_1, q_2\}$

 (D) $\{q_0, q_2, q_3\}$

Solution:

NFA-$\in$ Transition is shown in the table

δ	$\in$	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	(q_0)
q_1	$\{q_2\}$	$\{q_2\}$	(q_3)
q_2	$\{q_0\}$	Φ	Φ
q_3	Φ	Φ	$\{q_2\}$

The process is, we start with $\in$-closure of q_2 then for each input first take the transition then calculate $\in$-closure.

q_2 is the start for processing, we take $\in$-closure which is $\{q_0, q_2\}$ and process "aba"

$\bar\delta\ (q_2,\ aba)$ — Take c closure and process "aba"

$\bar\delta\ (q_2,\ aba)$ $\bar\delta\ (q_0,\ aba)$ — Take Transition

ϕ $\bar\delta\ (q_1,\ ba)$ — Calculac c closure

$\bar\delta\ (q_1,\ ba)$ $\bar\delta\ (q_2,\ ba)$ $\bar\delta\ (q_0,\ ba)$ — Take Transition

$\delta\ (q_3,\ a)$ ϕ $\delta\ (q_0,\ a)$ — Calculac c closure

$\delta\ (q_3,\ a)$ $\delta\ (q_0,\ a)$ $\delta\ (q_2,\ a)$ — Take Transition

q1 ϕ — Calculac c closure

$\{q_0,\ q_1,\ q_2\}$ — Final Answer
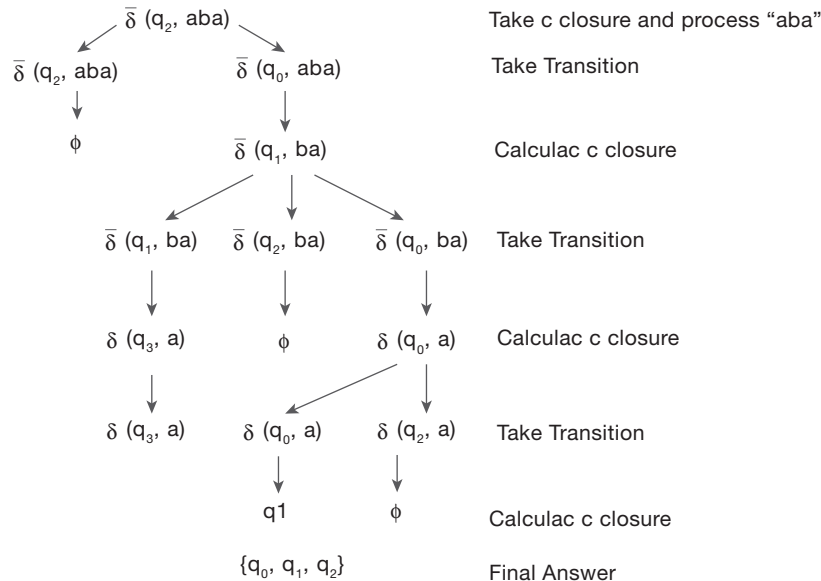
Hence, the correct option is (C).

Question Number: 50   **Question Type: MCQ**

Consider the following languages.

$L_1 = \{a^p \mid p \text{ is a prime number}\}$

$L_2 = \{a^n\ b^m\ c^{2m} \mid n \ge 0,\ m \ge 0\}$

$L_3 = \{a^n\ b^n\ c_2{}^n \mid n \ge 0\}$

$L_4 = \{a^n\ b^n \mid n \ge 1\}$

Which of the following are CORRECT?

I. L_1 is context-free but not regular.

II. L_2 is not context-free.

III. L_3 is not context-free but recursive.

IV. L_4 is deterministic context-free.

  (A) I , II and IV only   (B) II and III only

  (C) I and IV only   (D) III and IV only

Solution: The given languages are

$L_1 = \{a^p \mid p \text{ is a prime number}\}$

$L_2 = \{a^n b^m c^{2m} \mid n \ge 0,\ m \ge 0\}$

$L_3 = \{a^n b^n c^2 n \mid n \ge 0\}$

$L_4 = \{a^n b^n \mid n \ge 1\}$

Statements are:

I. L_1 is context free but not regular is **INCORRECT**, It required a Turing machine to accept L_1.

II. L_2 is not context free is **INCORRECT**; the context free grammar is

$S \to XY$

$X \to aX \mid \in$

$Y \to bYcc \mid \in$

III. L_3 is not context free but recursive is **CORRECT**. L_3 is standard context sensitive language.

IV. L_4 is deterministic context free is **CORRECT**; the grammar is $S \to aSb/ab$.

Hence, the correct option is (D).

Question Number: 51   **Question Type: MCQ**

Consider a binary code that consists of only four valid code words as given below:

00000,01011,10101,11110

Let the minimum Hamming distance of the code be p and the maximum number of erroneous bits that can be corrected by the code be q. Then the values of p and q are

  (A) $p = 3$ and $q = 1$ (B) $p = 3$ and $q = 2$

  (C) $p = 4$ and $q = 1$ (D) $p = 4$ and $q = 2$

Solution: Given:

Code 1 00000

Code 2 01011

Code 3 10101

Code 4 11110

Hamming distance between code 1 and code 2 is 3.

Hamming distance between code 1 and code 3 is 3.

Hamming distance between code 1 and code 4 is 4.

Hamming distance between code 2 and code 3 is 4.

Hamming distance between code 2 and code 4 is 3.

Hamming distance between code 3 and code 4 is 3.

So, as per Hamming code, minimum Hamming distance of all code words is considered as Hamming distance, *i.e.,* $3(p)$.

Now, the max number of erroneous bits that can be corrected by the Hamming code is $2d + 1$.

So, $2d + 1 = 3 \Rightarrow d = 1$

Hence, the correct option is (A).

Question Number: 52   Question Type: MCQ

A system shares 9 tape drives. The current allocation and maximum requirement of tape drives for three processes are shown in the table:

Process	Current Allocation	Maximum Requirement
P_1	3	7
P_2	1	6
P_3	3	5

Which of the following best describes current state of the system?

(A) Safe, Deadlocked

(B) Safe, Not Deadlocked

(C) Not Safe, Deadlocked

(D) Not Safe, Not deadlocked

Solution:

PID	Current Allocation	Max Need	Available	Need
P_1	3	3	2	4
P_2	1	6	–	5
P_3	3	5	–	2

With the above state of systems, we can get the following 2 safe sequences.

(1) $<P_3, P_2, P_1>$

(2) $<P_3, P_1, P_2>$

Hence, system is in safe state, no deadlocked Option B is correct.

Hence, the correct option is (B).

Question Number: 53   Question Type: NAT

Two transactions T_1 and T_2 are given as:

$T_1 : r_1 (X) w_1 (X) r_1 (Y) w_1 (Y)$

$T_2 : r_2 (Y) w_2 (Y) r_2 (Z) w_2 (Z)$

where $ri(V)$ denotes a read operation by transaction Ti on a variable V and $wi(V)$ denotes a *write* operations by transaction I, T on a variable V. The total number of conflict serializable schedules that can be formed by T_1 and T_2 is _____.

Solution: Conflict conditions RW WR WW

$\therefore$ 5 conflicts

$T_1–T_2$


```
           a      b   c     d
       r₁ (X) w₁ (X) r₁ (Y) w₁ (y)

       r₂ (Y) w₂ (Y) r₂ (Z) r₂ (Z)

        1      2     3      4
    Constraints:
      a < b < c < d
      1 < 2 < 3 < 4
      d < 1      (or)      2 < c
    only 1 way
      Total = 70 = 70 – (12 + 5)
```
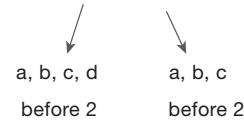
Therefore, $53 + 1 = 54$

Hence, the correct answer is (54).

Question Number: 54   Question Type: MCQ

If w, x, y, z are Boolean variables, then which one of the following is INCORRECT?

(A) $wx + w(x + y) + x(x + y) = x + wy$

(B) $\overline{w\overline{x}(y + \overline{z})} + \overline{w}x = \overline{w} + x + \overline{y}z$

(C) $(w\overline{x}(y + x\overline{z}) + \overline{w}x)y = x\overline{y}$

(D) $(w + y)(wxy + wyz) = wxy + wyz$

Solution:

(A) LHS: $w_x + w(x + y) + x (x + y) = x + wy$

RHS:

$\Rightarrow wx + wy + x + xy \ [xx = x]$

$\Rightarrow x[1 + y + w] + wy \ [1 + x = 1]$

$\Rightarrow x + wy$

$\Rightarrow$ L.H.S=R.H.S

(B) L.H.S: $\overline{w\overline{x}(y+\overline{z})}+\overline{w}x = \overline{w}x + \overline{y}z$

R.H.S: $\overline{w\overline{x}(y+\overline{z})}+\overline{w}x$

Apply De'Morgan theorem

$\Rightarrow \overline{w\overline{x}}\overline{(y+\overline{z})}+\overline{w}x = [\overline{x+y}=\overline{x}\overline{y}]$

$\Rightarrow (\overline{w}+x)+(\overline{y}z)+\overline{w}x$

$\Rightarrow \overline{w}+x+\overline{y}z+\overline{w}x$

$\Rightarrow \overline{w}+x+\overline{y}z = $ R.H.S

L.H.S=R.H.S

(C) $\{[w\overline{x}(y+\overline{z})]+\overline{wx}\}y = x\overline{y}$

L.H.S $\neq$ R.H.S

(D) L.H.S: $(w+y)(wxy+wyz) = wxy+wyz$

$(w+y)(wxy+wyz)$

$\Rightarrow wxy+wyz+wxy\,wyz$

$\Rightarrow wxy+wyz$

L.H.S = R.H.S

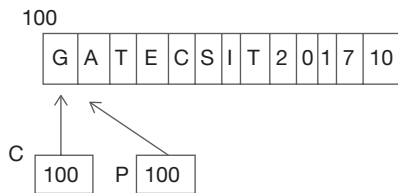Hence, the correct option is (C).

Question Number: 55   **Question Type: NAT**
Consider the following C Program.
```
# include <stdio.h>
#include< string.h>
#int main ( ) {
char* c = "GATECSIT2017";
char* p = c;
printf("%d", (int) strlen
(c+2[p]-6[p]-1));
return 0;
}
```
The output of the program is _____.
Solution:

100

| G | A | T | E | C | S | I | T | 2 | 0 | 1 | 7 | 10 |

C

| 100 | P | 100 |

strlen (c + 2[p] – 6[p] –1)
↓   ↓   ↓
100 + T – I –1

Note: Whenever, we have characters in the arithmetic expressions, we can replace those with their ASCII values

Strlen $(100 + x + 11 - x - 1$ [assume x has the ASCII value of I]

$\Rightarrow$ Strlen 110

2 is printed

Hence, the correct answer is (2).

Question Number: 56   **Question Type: MCQ**
P and Q are considering to apply for a job. The probability that P applies for the job is $\dfrac{1}{4}$. The probability that P applies for the job given that Q applies for the job is $\dfrac{1}{2}$, and the probability that Q applies for the job given that P applies for the job $\dfrac{1}{3}$. Then the probability that P does not apply for the job given that Q does not apply for the job is

(A) $\dfrac{4}{5}$ (B) $\dfrac{5}{6}$

(C) $\dfrac{7}{8}$ (D) $\dfrac{11}{12}$

Solution: Let A, B be the events denote that P, Q, respectively applies for a job

$\Rightarrow P_r(A) = \dfrac{1}{4}, P_r(A/B) = \dfrac{1}{2}$ (1)

$P_r(B/A) = \dfrac{1}{3}$ (2)

(2) gives $P_r(A \cap B) = \dfrac{1}{12}$

$\therefore$ gives $P_r(B) = \dfrac{1}{6}$

$\therefore \left(\dfrac{\overline{A}}{\overline{B}}\right) = \dfrac{r(\overline{A}\cap\overline{B})}{P_r(\overline{B})} = \dfrac{1-P_r(A\cup B)}{1-P_r(B)} = \dfrac{1-\left(\dfrac{1}{4}\times\dfrac{1}{6}-\dfrac{1}{12}\right)}{1-\dfrac{1}{6}}$

$= \dfrac{2}{3}\times\dfrac{6}{5} = \dfrac{4}{5}$

$\left(\text{Here } P_r \text{ is Probability and } P(A/B) = \dfrac{P(A\cup B)}{P(B)}\right)$

Hence, the correct option is (A).

Question Number: 57   **Question Type: NAT**
If the characteristics polynomial of 3×3 matrix M over R (the set of real numbers) is $\lambda^3 - 4\lambda^2 + a\lambda + 30$, $a \in R$, and one eigenvalue of M is 2, then the largest among the absolute values of the eigenvalues of M is _____.

Solution: $E(X) = 5 \Rightarrow (X^2) = 30$,

where $X \sim P(\lambda)$, $(\lambda) = 5$

$\therefore E[(X+2)^2] = E(X^2) + 4.E(X) + 4 = 30 + 20 + 4 = 54$

$(\therefore V(X) = E(X^2) - (E(X))^2)$

Since, one eigenvalue of Mis 2

$\therefore 2^3 - 4(2^2) + a(2) + 30 = 0$

$\Rightarrow a = -11$

$\therefore$ Characteristic polynomial is

$\lambda^3 - 4\lambda^2 - 11\lambda 30 = 0$

$(\lambda - 2)(\lambda - 5)(\lambda - 3) = 0$

$\therefore \lambda = 2.5, -3$

Largest absolute value of 'λ' is 5

Hence, the correct answer is (271).

Question Number: 58 **Question Type: MCQ**

Consider the following expression grammar G:

$$E \to E - T | T$$
$$T \to T + F | F$$
$$F \to (E) | id$$

Which of the following grammars is not left recursive, but is equivalent to G?

(A) $E \to E - T | T$
　　$T \to T + F | F$
　　$F \to (E)\ id$

(B) $E \to E - TE$
　　$E' \to TE' | \in$
　　$T \to T + F | F$
　　$F \to (E) | id$

(C) $E \to TX$
　　$X \to TX | \in$
　　$T \to FY$
　　$Y \to FY | \in$
　　$F \to (E) | id$

(D) $E \to TX | (TX)$
　　$X \to TX | + TX | \in$
　　$T \to id$

Solution: The rule for removal of left recursion is

$A \to A\alpha | \beta$ will be

$A \to \beta A'$

$A' \to \alpha A' | \in$

The given grammar is:

$E \to E - T/T$; in this α is "–T" and β is T

$T \to T + F/F$, In this α is "+F" and β is F

$F \to (E) | id$

Hence after removal of the left recursion:

$$E \to TX$$
$$X \to -TX | \in$$
$$T \to FY$$
$$Y \to +FY | \in$$
$$F \to (E) | id$$

Hence, the correct option is (C).

Question Number: 59 **Question Type: MCQ**

In a two-level cache system, the access times of 1 2 L and L caches are 1 and 8 clock cycles, respectively. The miss penalty from L2 cache to main memory is 18 clock cycles . The miss rate of L1 cache is twice that of L2. The average memory access time (AMAT) of this cache system is 2 cycles. This miss rates of L1 and L2 respectively are :

(A) 0.111 and 0.056
(B) 0.056 and 0.111
(C) 0.0892 and 0.1784
(D) 0.1784 and 0.0892

Solution: $2 = 1 + 2\,m \times 8 + m \times 18$

$\therefore m = \dfrac{1}{34}$

Hence, the correct option is (A).

Question Number: 60 **Question Type: MCQ**

Consider two hosts X and Y, connected by a single direct link of rate 10^6 bits/sec. The distance between the two hosts is 10,000 km and the propagation speed along the link is 2×10^8 msec. Host X sends a file of 50,000 bytes as one large message to host Y continuously. Let the transmission and propagation delays be p milliseconds and q milliseconds, respectively. Then the values of p and q are

(A) $p = 50$ and $q = 100$
(B) $p = 50$ and $q = 400$
(C) $p = 100$ and $q = 50$
(D) $p = 400$ and $q = 50$

Solution: Given data

$B = 10^6$ bits/sec

$D = 10,000$ km $= 10^4 \times 10^3$ m

$V = 2 \times 10^8$ m/s

$L = 50,000$ Bytes

$\therefore$ Transmission time $(p) = \dfrac{L}{B} = \dfrac{50,000 \times 8}{10^6} = 400$ ms

$\therefore$ Propagation Time $(q) = \dfrac{d}{v} = \dfrac{10^7}{2 \times 10^8} = 50$ ms

Hence, the correct option is (D).

Question Number: 61 **Question Type: MCQ**

Consider the recurrence function

$$T(n) = \begin{cases} 2T(\sqrt{n}) + 1, & n > 2 \\ 2, & 0 < n \leq 2 \end{cases}$$

Then $T(n)$ in terms of θ notation is

    (A) $\theta(\log \log n)$ (B) $\theta(\log n)$

    (C) $(\theta\sqrt{n})$ (D) $\theta(n)$

Solution:

$T(n) = 2T(\sqrt{n}) + 1$

$Put\ n\ =\ 2^K$

$T(2^K) = 2T(2^{K/2}) + 1$

Assume $T(2^K) = \delta(K)$

$\Rightarrow \delta(K) = 2\delta\left(\dfrac{K}{2}\right) + 1$

By master's theorem

  $\delta(K) = \theta(K)$

$T(2^K) = \theta(K)$

  $T(n) = \theta(\log n)$

$\therefore\ 2^k = n$

Hence, the correct option is (B).

Question Number: 62 **Question Type: NAT**

If a random variable X has a Poisson distribution with mean 5, then the expectation $E[(X+2)^2]$ equals _____.

Solution: $E(X) = 5 \Rightarrow E(X^2) = 30$, where $X - P(\lambda)$, $\lambda = 5$

$\therefore E[(X+2)^2] = E(X^2) + 4E(X) + 4$

            $= 30 + 20 + 4 = 54$

      $(V(X) = E(X^2) - (E(X))^2)$

Hence, the correct answer is (54).

Question Number: 63 **Question Type: MCQ**

Consider the following C function

```
int fun (int n) {
int i, j;
for (i = 1; i < = n; i++) {
for (j = 1 ; j < n ; j+=i) {
printf ("%d %d , i, j ) ;
}
}
}
```

Time complexity of fun in terms of q notation is

    (A) $\theta(n\sqrt{n})$ (B) $\theta(n^2)$

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

Solution: for $i = 1$

j will run from 1 to n by incrementing by '1' in each step $\Rightarrow$ 'j' will run for n times For $i = 2$

j will run from 1 ton by incrementing by '2' in each step

$\Rightarrow j$ will run for $\dfrac{n}{2}$ times and so on

Time Complexity $(Tc) = n + \dfrac{n}{2} + \dfrac{n}{3} + \ldots + \dfrac{n}{n}$

$= n\left(1 + \dfrac{1}{2} + \dfrac{1}{3} + \ldots + \dfrac{1}{n}\right) = \theta(n\ \log\ n)$

Hence, the correct option is (C).
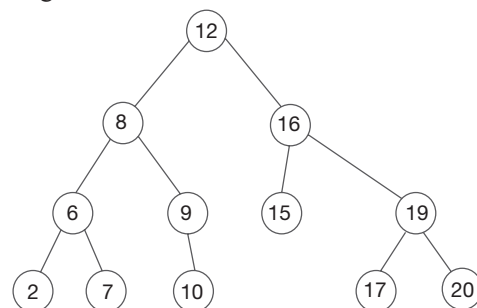
Question Number: 64 **Question Type: MCQ**

The pre-order transversal of a binary search tree is given by 12,8,6,2,7,9,10,16,15,19,17,20. Then the post-order traversal of this tree is:

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

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

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

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

Solution: Given: Preorder ! 12,8,6,2,7,9,10,16,15,19, 17,20

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

Note: BST In order will give ascending order Corresponding BST is

$\therefore$ Post order is 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12

Hence, the correct option is (B).

Question Number: 65 **Question Type: MCQ**

Consider the C program fragment below which is meant to divide x by y using repeated subtractions. The variables x, y, q and r are all unsigned int.

```
while (r >= y) {
r = r - y;
q = q +1;
}
```
Which of the following conditions on the variables x, y, q and r before the execution of the fragment will ensure that the loop terminates in a state satisfying the condition $x == (y*q + r)$?

    (A) $(q == r)$ && $(r == 0)$

    (B) $(x > 0)$ && $(r == x)$ && $(y > 0)$

    (C) $(q == 0)$ && $(r == x)$ && $(y > 0)$

    (D) $(q == 0)$ && $(y > 0)$

Solution: Given, program is:
```
while (r ≥ y){
r = r - y;
q = q + 1;
}
```
If we want to final value as $x == (y \times q + r)$. Then initial value of r should be equal to x (Since y is subtracted from r each time in given code). Q incremented by 1 (q is quotient here). To avoid undefined behavior , value of y should be greater than zero.

Therefore, $(q == 0)$&&$(r == x)$&&$(y > 0)$

Hence, the correct option is (C).