



GATE

Subject : CS 2015_Set-1 - SOLUTIONS

TECHNICAL SECTION (Q. NO. 1 – 25) 1 MARKS

1. $g(x) = 1 - x; h(x) = \frac{x}{x-1}$

$$\frac{g(h(x))}{h(g(x))} = \frac{g\left(\frac{x}{x-1}\right)}{h(1-x)}$$

$$= \frac{1 - \frac{x}{x-1}}{1-x}$$

$$= \frac{\frac{(x-1)-x}{x-1}}{1-x}$$

$$= \frac{-1}{x-1} \times \frac{-x}{1-x}$$

$$= \frac{x}{-(1-x)(1-x)}$$

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

Consider option (A),

$$\frac{h(x)}{g(x)} = \frac{x}{x-1} \div 1-x$$

$$= \frac{x}{(x-1)(1-x)}$$

$$\frac{h(x)}{g(x)} = \frac{-x}{(1-x)^2}$$

$$\therefore \frac{g(h(x))}{h(g(x))} = \frac{h(x)}{g(x)}$$

\therefore (A) is the correct answer

$$2. \quad y = \lim_{x \rightarrow \infty} x^{1/x}$$

Take \ln on both sides

$$\therefore \ln y = \lim_{x \rightarrow \infty} \frac{1}{x} \cdot \ln x$$

$$= \lim_{x \rightarrow \infty} \frac{\ln x}{x} \quad \left(\frac{\infty}{\infty} \right) \text{ form}$$

\therefore use L' Hospital's Rule

$$= \ln x = \lim_{x \rightarrow \infty} \frac{1/x}{1}$$

$$= \frac{1}{\infty}$$

$$= 0$$

$$\therefore \ln y = 0$$

$$\therefore y = e^0$$

$$\therefore y = 1$$

(c) is the correct option



3. (i) Prim's algorithm for minimum spanning tree uses Greedy approach to find out the MST.
 (ii) Floyd-warshall algorithm for all pairs shortest paths uses dynamic programming paradigm.
 (iii) Merge sort uses divide and conquer method
 (iv) Hamiltonian circuit in a graph can be done using back tracking
 \therefore (C) is the correct option

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4. In Quick sort, worst case occurs when the elements are sorted in increasing or decreasing order.
 In worst case, all the elements move to only one half the pivot.

Thus the recurrence relation becomes

where 'C' is a constant

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

Time complexity is $O(n^2)$

In best and average case of quick sort, the recurrence relation is

$$T(n) = 2T(n/2) + Cn$$

Time complexity is $O(n^2)$

In best and average case of quick sort, the recurrence relation is

$$T(n) = 2T(n/2) + Cn$$

and time complexity is $O(n \log n)$

\therefore (B) is the correct answer

5. For a binary tree of height 5,
 minimum nodes = 6(left skewed or right skewed binary tree)
 maximum nodes = 63 = [all 0 to 5 levels should be filled]
 \therefore (A) is the correct choice
6. (C) is the correct choice
 Conditional coverage – White box testing
 Equivalence class partitioning – Black box testing
 Volume Testing – Performance Testing
 Alpha Testing – System Testing
7. For a binary search tree, inorder traversals always yield an increasing order sequence. II and III are not in increasing order
 \therefore (B) is the correct choice
8. Viable prefixes are those prefixes that can appear on a stack. Not all prefixes can be viable prefixes
 Eg:
 Let $S \rightarrow XYZW$
 $A \rightarrow XY$
 Let w be a string generated by above grammar
 $W = XYZ$
- | Stack | Input |
|-------|-------|
| \$ | XYZ |
| \$X | YZ |
| \$XY | Z |
| \$A | Z |
| \$AZ | |
- As we can see, XYZ will never appear on a stack. So it is not a viable prefix
 (C) is the correct choice
9. $p \leftrightarrow q = (p \rightarrow q) \wedge (q \rightarrow p) = (\neg p \vee q) \wedge (\neg q \vee p)$
 (A) $(\neg p \vee q) \wedge (p \vee \neg q) = p \leftrightarrow q$
 (B) $(\neg p \vee q) \wedge (q \rightarrow p) = (\neg p \vee q) \wedge (\neg q \vee p) = p \leftrightarrow q$
 (C) $(\neg p \vee q) \vee (p \wedge \neg q) = \neg(p \leftrightarrow q) \neq (p \leftrightarrow q)$
 (D) $(\neg p \wedge \neg q) \vee (p \wedge q) = (\neg p \vee q) \wedge (\neg q \vee p) = p \leftrightarrow q$
 \therefore (C) is the correct option as it is not equivalent to $(p \leftrightarrow q)$

10. For a set 'A' power set is denoted by 2^A

$$A = \{5, \{6\}, \{7\}\}$$

$$\therefore 2^A = \{\phi, \{5\}, \{\{6\}\}, \{\{7\}\}, \{5, \{6\}\}, \{\{6\}, \{7\}\}, \{5, \{7\}\}, \{5, \{6\}, \{7\}\}$$

\therefore I $\phi \in 2^A$ is valid

II $\phi \subseteq 2^A$ is valid as one of the subsets of 2^A is ϕ or $\{ \}$

III $\{5, \{6\}\} \in 2^A$ is valid

IV $\{5, \{6\}\} \subseteq 2^A$ is not correct as

$$\{\{5, \{6\}\}\} \subseteq 2^A \text{ whereas } \{5, \{6\}\} \in 2^A$$

\therefore (C) is the correct option

11. Johnson's counter is also known as twisted pair ring counter or switch tail ring counter as complemented output of last shift register is connected to input of first shift register.

Thus, the counting sequence for 4-bit Johnson's counter will be

0000, 1000, 1100, 1110, 1111, 0111, 0011, 0001, 0000

\therefore (D) is the correct choice.

12. For a machine based on 3-address instruction format, each address field can be used to specify either of S1 or S2 as for implied accumulator register, there is no need of specifying an address. Implied instructions are zero address instructions. The opcode and address is implied in the instruction itself.

\therefore (A) is correct.

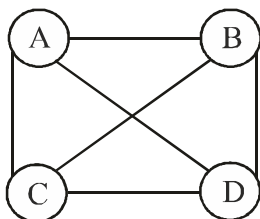
13. I is false because in TCP, sequence number is the first byte number of that window of data. The next expected sequence number will be current sequence number + window size (or data size sent)

III is false as receiver window may change.

II and IV are correct.

\therefore (B) is the correct choice

14. Everyone in a group of N people wants to communicate secretly with (N - 1) other people



A - B, C, D

B - D, C

C - D

\therefore 6 keys for 4 people which is 4C_2

\therefore NC_2 keys for N people

\therefore $\frac{N(N-1)}{2}$ keys are required.

(C) is the correct answer.

15. I is true

II is false as XML is case-sensitive whereas HTML is not.

III is true

IV is false as XML Tags must be closed whereas HTML Tags may or may not be closed

\therefore (C) is the correct choice

16. Barring source address, all other fields of an IP header are modified. TTL is modified by every router (on every hop, it is decremented by 1 usually). Length and checksum are modified during fragmentation.

\therefore (B) is the correct option.

17. FTP uses two connections on 2 different parts 20 and 21, one for control and the other for data transfer respectively.

HTTP uses multiple TCP connections in the form of non-persistent connections i.e. for every object on the webpages (image, etc.) it uses different non-persistent connections. However, HTTP can also establish persistent connection.

\therefore (A) is correct

18. I is true as complement of a CFL is recursive (\therefore CFLs are not closed under complementation)

II is false as RELs are not closed under complementation

III is false as CFL's complement may or may not be a CFL

IV is true \bar{L}_1 is recursive and L_2 is REL

\therefore $\bar{L}_1 \cup L_2$ is REL is true

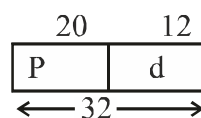
(D) is the correct option.

19. LA = 32 bit

Page size = 4 KB

$$= 2^2 \cdot 2^{10} \text{ B} = 2^{12} \text{ B}$$

\therefore d = 12



$\therefore P = 32 - 12 = 20$

\therefore Size of page table = # pages * PTE size
 $= 2^{20} \times 4 \text{ B}$
 $= 4 \text{ MB}$

\therefore 4 is the correct answer

20. P1 () { (1) C = B - 1; (2) B = 2 × C; }
- P2 () { (3) D = 2 × B; (4) B = D - 1; }

Possible orders of execution are

	1	1	1	3	3	3
	2	3	3	4	1	1
	3	2	4	1	2	4
	4	4	2	2	4	2
Output B =	③	③	②	④	②	②

\therefore B can possibly take value as 2, 3 or 4

\therefore 3 distinct values

3 is the correct answer

21. SELECT in SQL is equal to projection in Rational Algebra
 However Rational Algebra eliminates duplicate tuples whereas SELECT in SQL retains them.

\therefore (D) is the correct choice.

22. Since the file ordered, the index used may be primary or clustered.
 As the options do not contain primary index, we can go with clustered index. Also clustered index uses non key for ordering whereas primary index uses key value for ordering

\therefore (C) is the correct

23. Let $A = \begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$

$A = LU$

$= \begin{bmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{bmatrix} \begin{bmatrix} 1 & u_{12} \\ 0 & 1 \end{bmatrix}$

$$\begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix} = \begin{bmatrix} l_{11} & l_{11} \cdot u_{12} \\ l_{21} & l_{22} + l_{21} \cdot u_{12} \end{bmatrix}$$

$$\therefore \boxed{l_{11} = 2} \qquad \therefore \boxed{l_{21} = 4}$$

$$l_{11} \cdot u_{12} = 2 \qquad l_{22} + l_{21} \cdot u_{12} = 9$$

$$2 \cdot u_{12} = 2 \qquad l_{22} + 4(1) = 9$$

$$\therefore \boxed{u_{12} = 1} \qquad \therefore \boxed{l_{22} = 5}$$

\therefore 5 is the correct answer.

24. $a = 4 \quad b = 5 \quad c = 6$

In $f_1()$ parameters are passed by value,

Hence the values of a and b are not affected outside the function f_1

In f_2 addresses of values b and c are passed and f_2 swaps the values of b and c .

\therefore After the call of f_2 , values will be

$$a = 4 \quad b = 6 \quad c = 5$$

$$\text{print}(c - a - b); = 1 - 6 = -5$$

\therefore -5 is the correct answers.

25. For a binary search tree, insertion and deletion of elements takes place in $O(h)$ and in worst case, $h = n - 1$ [in left skewed or right skewed BSTs]

\therefore T.C is $O(n)$ for both insertion and deletion

\therefore (B) is the correct answer

TECHNICAL SECTION (Q. NO. 26 – 55) 2 MARKS

26. $BW = 64 \text{ kbps}$

$$Pt = 20 \text{ msec}$$

$$L(u) \geq 50\%$$

$\begin{aligned} \text{bit rate} &= \text{bandwidth} \\ \text{data rate} &= \text{throughput} \end{aligned}$
--

(atleast 50%)

$$\frac{Tt}{Tt + 2Pt} > = \frac{1}{2}$$

$$2 Tt > = Tt + 2Pt$$

$$\therefore Tt > = 2Pt$$

$$\therefore \frac{L}{BW} > = 2 \cdot Pt$$

$$\therefore L > = BW \cdot Pt$$

$\therefore L \geq 2 \cdot 64 \times 10^3 \text{ bps} \times 20 \times 10^{-3} \text{ sec}$

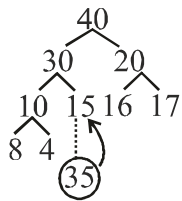
$\therefore L \geq 2560 \text{ bits}$

$\therefore L \geq \frac{2560}{8} \text{ bytes}$

$\therefore L = 320 \text{ bytes}$

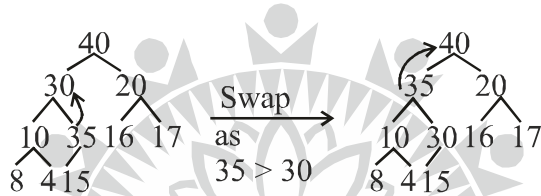
320 bytes is the minimum frame size required

27.



as heaps are stored in complete binary trees (CBT)

35 is inserted at CBT position. Now reverse heapify. Swap as $35 > 15$



Do not swap as $35 < 40$

\therefore Max heap property satisfies i.e.

Every parent \geq its children

Now store the heap in an array, do its level order traversal

\therefore New heap is

40 35 20 10 30 16 17 8 4 15

\therefore (B) is the correct option

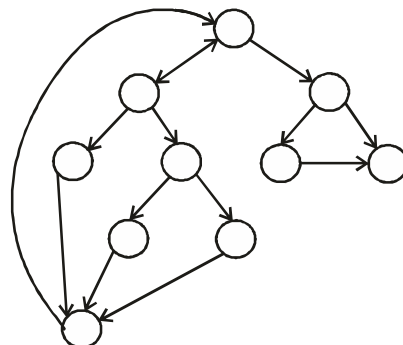
28. Cyclomatic complexity of a single program is given by

$C = E - V + 2$

E – edges of graph

V – vertices

The control flow graph of the given program is :



Here $E = 13$, $V = 10$

$$\therefore C = 13 - 10 + 2 = 5$$

$\therefore 5$ is the correct answer

29. Collision will not occur only if exactly one out of 4 stations transmit and the rest do not transmit the frame

$$P(\text{No collision}) = S_1 \bar{S}_2 \bar{S}_3 \bar{S}_4 + \bar{S}_1 S_2 \bar{S}_3 \bar{S}_4 + \bar{S}_1 \bar{S}_2 S_3 \bar{S}_4 + \bar{S}_1 \bar{S}_2 \bar{S}_3 S_4$$

$$= (0.1)(0.8)(0.7)(0.6) + (0.9)(0.2)(0.7)(0.6) + (0.9)(0.8)(0.7)(0.4) + (0.9)(0.8)(0.3)(0.6)$$

$$= 0.336 + 0.0756 + 0.2016 + 0.1296$$

$$= 0.4404$$

$\therefore 0.4404$ is the correct answer

30.

p	q	
0	0	0
0	1	1
1	0	1
1	1	0

$p \neq q$

\neq operator is actual XOR operator as $0 \neq 0 = 0$ and $1 \neq 1 = 0$

Also $(1 \neq 0) = (0 \neq 1) = 1$

It computes $p \oplus q = \bar{p}q + p\bar{q}$

$$(p \oplus q) \oplus r = p \oplus (p \oplus r)$$

\therefore XOR is associative

also $p \oplus q = q \oplus p$

\therefore XOR is commutative

To test associativity, let $p = 0$, $q = 1$, $r = 0$

$$\therefore (0 \oplus 1) \oplus 0 = 1 \oplus 0 = 1$$

$$0 \oplus (1 \oplus 0) = 0 \oplus 1 = 1$$

$\therefore \neq$ is both commutative and associative

(A) is correct.

$$\begin{aligned}
 31. \quad & \sum_{x=1}^{99} \frac{1}{x(x+1)} \\
 &= \sum_{x=1}^{99} \frac{1}{x} - \frac{1}{x+1} \\
 &= \left(\frac{1}{1} - \frac{1}{2}\right) + \left(\frac{1}{2} - \frac{1}{3}\right) + \dots + \left(\frac{1}{98} - \frac{1}{99}\right) + \left(\frac{1}{99} - \frac{1}{100}\right) \\
 &= 1 - \frac{1}{100} \\
 &= \frac{99}{100} \\
 &= 0.99 \\
 &\therefore 0.99 \text{ is the correct answer}
 \end{aligned}$$

$$\begin{aligned}
 32. \quad & \text{No. of triplets in } L3 = \text{No. of ways to choose 3 elements from 5 (not necessarily distinct)} \\
 &= 5 \times 5 \times 5 = 125
 \end{aligned}$$

\therefore for $x = t$

no of ways of choose y and $z = 5 \times 5 = 25$

for $x = r, y = p$ and $z = p$, the given condition is satisfied

$$\therefore \text{probability} > \frac{25}{125} > \frac{1}{5}$$

But probability $\neq 1$ as for

$x = q, y = r, z = s$, the given condition is not satisfied

\therefore (D) is the correct choice

33. A function is fictionally complete if it does not belong to of the following :

- (i) $f0$ (ie. on input 0, it produces 0)
- (ii) $f1$ (i.e. on input 1, it produces 1)
- (iii) f is linear
- (iv) f is monotone
- (v) f is self dual

f is linear when for every 1-value of f , the number of 1's in corresponding input is odd and for every 0-value of f , the no of 1's in the corresponding input is even.

f is monotone if for every i/p , changing any input variable from 0 to 1 can result only in changing function's value from 0 to 1 and never from 1 to 0

f is self dual if $f = f(\text{dual})$

only 'f' satisfies the given properties and not 'g'

\therefore (B) is the answer

34. For a connected planer graph,

$$e \leq 3v - 6$$

where e – no. of edges and v – no. of vertices

$$\therefore v = 10$$

$$\therefore e \leq 3(10) - 6$$

$$\therefore e = 24$$

Alternative solution :

we know

$f = e - v + 2$; f faces or regions

Also the question says that the number of edges on each face is 3

$$\therefore 2e = 3f \quad \dots (i)$$

$$f = e - v + 2$$

$$\therefore \frac{2e}{3} = e - v + 2 \quad \dots \text{from (i)}$$

$$\therefore \frac{e}{3} = v - 2$$

$$e = 3v - 6$$

and for $v = 10$, $e = 24$

\therefore 24 is the correct answer

35. a_n - no. of bit strings of length 'n' containing two consecutive 1s

n	a_n	# strings
1	{ }	0
2	{11}	1
3	{011, 110, 111}	3
4	{0011, 0110, 0111, 1011, 1100, 1101, 1110, 1111}	8

$\therefore a_1 = 0$, $a_2 = 1$, $a_3 = 3$ and $a_4 = 8$

$a_n = a_{n-2} + a_{n-1} + 2^{n-2}$ satisfies for the values

for $n = 3$

$$\begin{aligned}
 a_3 &= a_1 + a_2 + 2^{3-2} \\
 &= 0 + 1 + 2_1 \\
 &= 3
 \end{aligned}$$

$$\therefore a_3 = 3$$

\therefore (A) is the correct choice

36. In compiler theory, live variable analysis is a classic data-flow analysis performed by compilers to calculate for each program point the variables that may be potentially read before their next write, i.e. the variables that are live at the exit from each program point.

\therefore As per given 3 conditions, only (C) follows

\therefore (C) is the answer

37. In a static single assignment (SSA), the assignment variables i.e. variables at the left hand side cannot be repeated

The given statement is :

$$q + r/3 + s - t * 5 + u * v/w$$

$$t_1 = u * v$$

$$t_2 = t_1/w$$

$$t_3 = t * s$$

$$t_4 = r/3$$

$$t_5 = q + t_4$$

$$t_6 = t_5 + 5$$

$$t_7 = t_6 - t_3$$

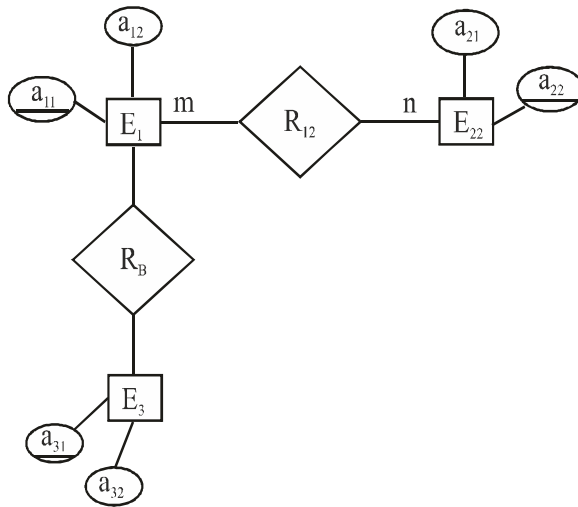
$$t_8 = t_7 + t_2$$

SSA is a form of 3 address code used in compilers for optimization process

A three address code can have atmost 3 operands (constant + variables) in each instruction

\therefore 8 temporary variables are required

38.



$E_1 \{ \underline{a_{11}}, a_{12} \}$
 $E_2 \{ a_{21}, \underline{a_{22}} \}$
 $E_3 \{ \underline{a_{31}}, a_{32} \}$

Each strong entity set will form will a table

Since R_{12} is a $m : n$ relationship

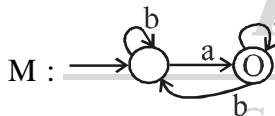
$\therefore \{ a_{11}, a_{22} \}$ will be a key

We can combine R_{12} and R_{13} to R_{123} and key will be $\{ a_{11}, a_{22}, a_{31} \}$

and the relation is still in 3NF

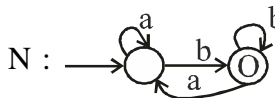
\therefore Minimum no. of tables needed = 4

39.



$L(M) = \{ a, aa, ba, baaa, \dots \}$

i.e. strings ending in 'a'

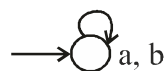


$L(N) = \{ b, bb, ab, abab, bbab, \dots \}$

i.e. strings ending in 'b'

$\therefore L(M) \cap L(N) = \phi$

DFA for $L(M) \cap L(N)$



\therefore Minimum DFA has only one state.

(1) is the correct answer

40. In state q_0 , for each 1, a 1 is pushed onto the stack

For each 0, a 0 is pushed onto the stack.

In state q_1 for each 0, a 1 is popped out and for each 1, a 0 is popped out of the stack.

The given PDA accepts strings of the form $w0\bar{w}$, $w1\bar{w}$ or $w\bar{w}$ where \bar{w} is reverse of bit complement strings (or here, 1's complement strings)

For the given sequence 101100, length = 6 and length of strings given options = 5

\therefore string must be of the form $w0\bar{w}$ or $w1\bar{w}$.

But since the given sequence is ending in 0, hence the string is of the form

$w0\bar{w} \therefore w = 10110$ and hence

\bar{w} will be 01001

and reverse of \bar{w} is 10010

\therefore (B) is the correct option

41. For an undirected graph, if an edge (u, v) is in its BFS tree, so (v, u) is also in its BFS tree Shortest path of a vertex u from source 'S' is $d(u)$ and shortest path of a vertex v from source 'S' is $d(v)$

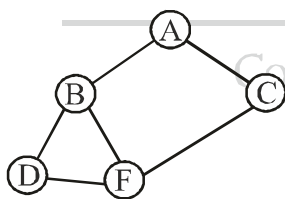
and since (u, v) is an edge

\therefore shortest path is atmost 1

i.e. it cannot be greater than 1

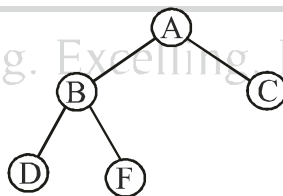
consider the graph G as

G :



BFS Tree of G will be

T :



DF is an edge in G but not in T

$\therefore d(D)$ from source A is 2

$d(F)$ from source A is 2

$\therefore d(D) - d(F) = 0$. It can be atmost 1 but not greater than 1.

\therefore (D) is the correct choice

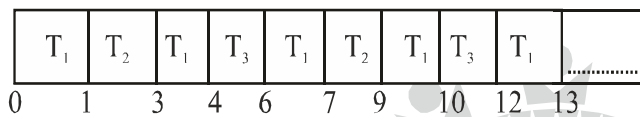
42. Arrival times of T_1, T_2, T_3

T_1 : 0, 3, 6, 9, 12, 15, at intervals of 3

T_2 : 0, 7, 14, 21, 28, at intervals of 7

T_3 : 0, 20, 40, 60, at intervals of 20

Task	A.T	B.T	priority (inverse of its burst time)
T1	0	1	$\frac{1}{1} = 1$ (Highest)
T2	0	2	$\frac{1}{2} = 0.5$
T3	0	4	$\frac{1}{4} = 0.25$ (lowest)



At $t = 3$, T1 will arrive

At $t = 6$, T1 will arrive,

At $t = 7$, T2 will arrive

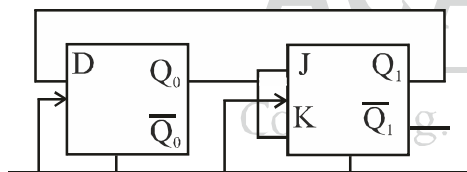
At $t = 9$, T1 will arrive

T3 will complete its remaining 2 units from $t = 10$ to $t = 12$

\therefore T3 completes its first instance at the end of 12 milliseconds

\therefore 12 is the correct answer

43.



Initially $Q_0 = 1$ and $Q_1 = 0$

when $Q_0 = 1, J = K = 1 \therefore Q_{1(new)} = \bar{Q}_{1(old)}$

$\therefore Q_1 = 1$

But $Q_{0(new)} = Q_{1(old)} = D$

$\therefore Q_{0(new)} = 0$

$\therefore J = K = 0$

$Q_{1(new)} = Q_{1(old)}$

$Q_1 = 1$

\therefore Output sequence at Q_1 will follow the sequence 011011011 ...

\therefore (A) is the correct option

44. $t_{\text{seek}} = 4$ milliseconds

$$\text{RPM} = 10000$$

600 sectors per track

and 1 track has 512 B of data

$$\therefore \text{Disk capacity} = 600 \times 512 \text{ B} = 307200 \text{ B}$$

For a file,

2000 sectors

$$\therefore \text{Data} = 2000 \times 512 \text{ B}$$

$$\text{RPS} = \frac{\text{RPM}}{60} = \frac{1000}{60} = \frac{1000}{6}$$

$$\therefore \text{Rotational delay} = \frac{1}{\text{RPS}} = \frac{6}{1000} \text{ sec}$$

$$\therefore \text{R.D} = 6 \text{ msec}$$

$$\text{Average RD} = \frac{6}{2} = 3 \text{ msec}$$

In one rotation, 1 track of data can be read

$$\therefore 600 \times 512 \text{ B} \rightarrow 1 \text{ rotation (6 msec)}$$

$$2000 \times 512 \text{ B} \rightarrow x \text{ rotations}$$

$$\therefore x = \frac{2000 \times 512 \text{ B}}{600 \times 512 \text{ B}}$$

$$\therefore x = 3.33 \text{ rotations}$$

$$\therefore \text{Data transfer time} = 3.33 \times 6 \text{ msec}$$

$$= 20 \text{ msec}$$

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$$\text{Time to read the file} = T_{\text{seek}} + T_{\text{avg}} \text{ R.D.} + \text{Data transfer time}$$

But every sector necessitates a seek and avg R.D.

\therefore for 2000 sectors,

$$T_{\text{avg}} \text{ R.D.} + T_{\text{seek}} = (4 + 3) \times 2000 \text{ msec}$$

$$= 7 \times 2000$$

$$= 14000 \text{ msec}$$

$$\therefore \text{Total time} = \text{Data transfer time} + 14000 \text{ msec}$$

$$= 20 \text{ msec} + 14000 \text{ msec}$$

$$= 14020 \text{ msec}$$

\therefore 14020 is the correct answer

45. For a non-pipelined processor,
clock rate = 2.5 GHz

$$\therefore CT = \frac{1}{\text{clock rate}} = 0.4 \times 10^{-9} \text{ sec} = 0.4 \text{ nsec}$$

$$CPI = 4$$

\therefore For 100 instructions,

Execution Time (T_1)

$$= 100 \times CPI \times CT$$

$$= 100 \times 4 \times 0.4 \text{ nsec}$$

$$\therefore T_1 = 160 \text{ nsec}$$

\therefore For a pipelined processor,

k (no. of stage) = 5

clock rate = 2GHz

$$\therefore CT_p = \frac{1}{2 \times 10^9} = 0.5 \text{ nsec}$$

For 100 instructions

CPI = 1 for pipelined processor

$$\text{Execution time } (T_2) = CPI \times 100 \times CT_p$$

$$= 1 \times 100 \times 0.5 \text{ nsec}$$

$$= 50 \text{ nsec}$$

$$\therefore \text{Speedup of pipeline} = \frac{\text{Performance of pipeline}}{\text{Performance of non-pipelined processor}}$$

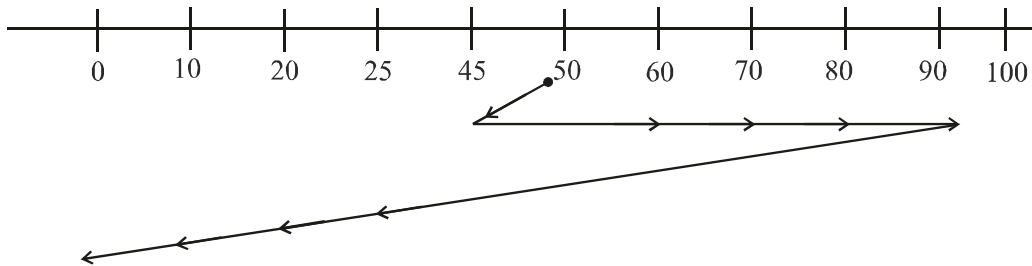
$$= \frac{\text{Execution time of non pipelined processor}}{\text{Execution time of pipelined processor}}$$

$$\left(\text{As performance} \propto \frac{1}{\text{Execution Time}} \right)$$

$$\therefore \text{Speed up of pipeline} = \frac{160 \text{ n sec}}{50 \text{ n sec}} = 3.2$$

\therefore 3.2 is the answer

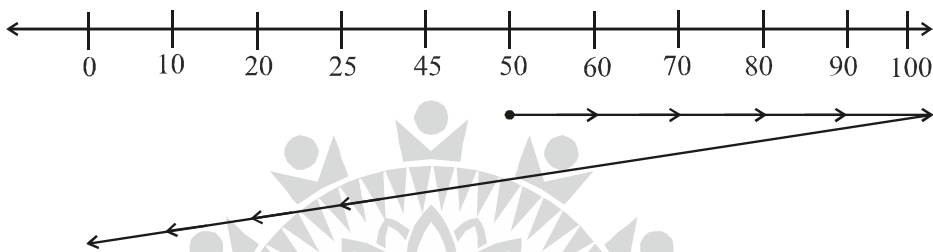
46. Using SSTF



$$\therefore \text{Distance travelled} = |145 - 50| + |90 - 45| + |90 - 10|$$

$$= 5 + 45 + 80 = 130$$

Using SCAN,



$$\therefore \text{Distance travelled} = |50 - 100| + |100 - 10|$$

$$= 50 + 90 = 140$$

Additional distance travessed by R/W head

$$= |140 - 130|$$

$$= 10$$

\therefore 10 is the correct answer

47. Using FIFO,

3	8	2	3	9	1	6	3	8	9	3	6	2	1	3
3	3	3	3	9	9	9	3	3	3	3	6	6	6	3
	8	8	8	8	1	1	1	8	8	8	8	2	2	2
		2	2	2	2	6	6	6	9	9	9	9	1	1
			H							H				

\therefore # Page faults = 13

Using LRU,

3	8	2	3	9	1	6	3	8	9	3	6	2	1	3
3	3	3	3	3	3	6	6	6	9	9	9	2	2	2
	8	8	8	9	9	9	3	3	3	3	3	3	1	1
		2	2	2	1	1	1	8	8	8	6	6	6	3
			H							H				

\therefore # page faults = 13

\therefore (A) is the correct option

$$48. \int_{\frac{1}{\pi}}^{\frac{2}{\pi}} \frac{\cos\left(\frac{1}{x}\right)}{x^2} dx$$

$$\text{Let } \frac{1}{x} = t$$

$$\therefore \frac{-1}{x^2} dx = dt$$

$$\text{when } x = \frac{2}{\pi}, t = \frac{\pi}{2}$$

$$\text{when } x = \frac{1}{\pi}, t = \pi$$

$$\therefore \int_{\pi}^{\pi/2} -\cos t dt$$

$$= \int_{\pi/2}^{\pi} \cos t dt$$

$$= [\sin t]_{\pi/2}^{\pi}$$

$$= [0 - 1]$$

$$= -1$$

$$= -1 \text{ is the answer}$$



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$$49. A = \begin{pmatrix} 1 & 4 \\ b & a \end{pmatrix} \text{ Eigen values are } -1 \text{ and } 7$$

trace of A = \sum eigen values

$$1 + a = -1 + 7$$

$$\therefore 1 + a = 6$$

$$\therefore a = 5$$

only option (D) has a = 5

\therefore (D) is the correct option

To find value of b, use

$$\det(A) = \pi \text{ (eigen values)}$$

50. Since the maximum no. of operations to be performed are insert operations i.e. $O(N)$ insert operations, so we have to check the complexity of insert operation.

- (i) For unsorted array, T.C. to insert an element is $O(1)$
 - (ii) For minimum heap, T.C. of insertion is $O(\log N)$
 - (iii) For sorted array, insertion will take time $O(N)$ in worst case as we will have to shift the elements
 - (iv) For sorted doubly linked list, T.C. to insert is $O(N)$ to find position of element to be inserted
- \therefore unsorted array is the correct choice
(A) is the answer

51. The given SQL query gives output as:

S.student name	Sum (P. marks)
Raj	310
Rohit	140

Group by S.student_Name will group the table in only two rows as we have only 2 student names.

\therefore 2 rows will be returned.

52. Base address of $x = 2000$

$$\therefore x + 3 = 2000 + 3 \times 3 \times 4 = 2036$$

as 4 bytes are required by an integer

$(x + 3)$ will point to '10'

\therefore address of 10

$*(x + 3)$ and $*(x + 2) + 3$ both give the same value as $(x + 3)$

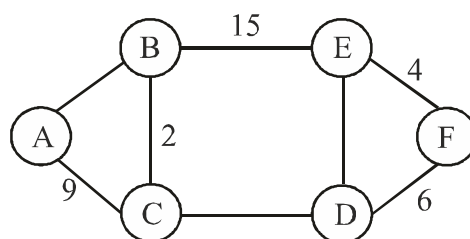
$$*(x + 2) + 3 = 2000 + 2 \times 3 \times 4 + 3 \times 4$$

$$= 2000 + 24 + 12$$

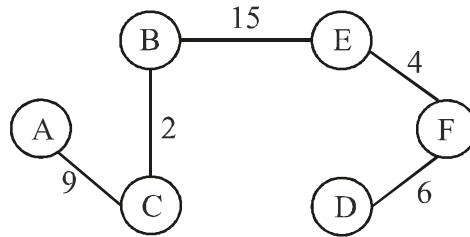
$$= 2036$$

\therefore (A) is the correct option.

53. Given graph G is



MST has edges as follows



and weight of MST = 36

AB = 10 as it is not included in MST

Similarly minimum values of foll. edges will be

CD = 16

and ED = 7

∴ Minimum possible sum of edges of the graph is 36 + 10 + 16 + 7 = 69

∴ 69 is the answer.

54. The first for loop will run 'n' times. The second for loop will run for log n times. The third for loop runs $\theta(\log p)$ times and we know that $p = \theta(\log n)$ (from second loop)

∴ Total T.C. of fun1() will be $O(n \log (\log n))$

∴ (D) is the correct choice.

55. Let $x = 10, Y = 3$

$q = 0$

$r = x = 10$

$10 \geq 3$ true

∴ $r = r - y$

$r = 10 - 3 = 7$ ∴ $r = 7, q = 1$

$7 \geq 3$ true

∴ $r = r - y$

$r = 7 - 3 = 4$ ∴ $r = 4, q = 2$

$4 \geq 3$ True

∴ $r = r - y$

$r = 4 - 3$ ∴ $r = 1, q = 3$

$1 \geq 3$ false ∴ stop

∴ $x = qy + r$

and $r < y$

(B) is the correct answer

GENERAL APTITUDE SECTION

1. (A) is correct
2. enjoyed herself immensely – had a terrific time
∴ (c)

3. Acquiescence – compliance, submissive
wheedle – to persuade, coax
flippancy – frivolity, lightness, not serious
profligate – recklessly extravagant
(B) is the correct choice

4. (I) one step _____ $\frac{3}{4}$ foot
x steps _____ 9 feet

$$\therefore \frac{3}{4}x = 9$$

$$\therefore x = \frac{36}{3} = 12$$

(II) doesn't make sense

∴ (A) is correct

5. $A = \{2, 3, 4, 5\}$ Coaching. Excelling. Leading.

$B = \{11, 12, 13, 14, 15\}$

$$16 = 2 + 14 = 3 + 13 = 4 + 12 = 5 + 11$$

4 cases are favourable

$$\text{Total combinations} = {}^4C_1 \times {}^5C_1 = 20$$

$$\therefore \text{Probability} = \frac{4}{20} = \frac{1}{5} = 0.2$$

(A) is correct

6. Took to their heels = ran away = fled
only (C) matches ∴ (C)

7. (I) follows
 (II) also follows
 (III) does not seem to be an appropriate action
 \therefore (A) is correct

8. Male : Female = 5 : 4 (for each department)
 for electrical, males = 40

$$\therefore \frac{40}{F} = \frac{5}{4}$$

$$\therefore F = 32$$

$$\text{Total students} = M + F = 72$$

$$\therefore 72 = 20\% \text{ of total}$$

$$\therefore \text{Total} = 360$$

$$\text{Students in mechanical} = 10\% \text{ of } 360 = 36$$

$$\text{Females in mechanical} = \frac{4}{9} \times 36 = 16$$

$$\text{Students in civil} = 30\% \text{ of } 360 = 108$$

$$\text{Females in civil} = \frac{4}{9} \times 108 = 48$$

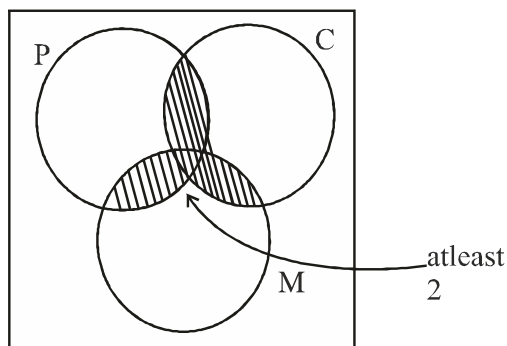
Difference b/w females in mechanical and civil

$$= 48 - 16 = 32$$

\therefore 32 is the answer

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- 9.



$$P(P \cup C \cup M) = P(\text{atleast one subject is cleared}) \\ = 0.75$$

$$P(\text{passing in atleast two}) = 0.5$$

$$P(\text{passing in exactly two}) = 0.4$$

$$\begin{aligned} P(\text{passing in exactly 3}) &= P(\text{passing in atleast two}) - P(\text{passing in exactly two}) \\ &= 0.5 - 0.4 \\ &= 0.1 \end{aligned}$$

$$\therefore P(P \cap C \cap M) = 0.1$$

$$\begin{aligned} P(P \cup C \cup M) &= p + c + m - P(P \cap C) - P(C \cap M) - P(P \cap M) + P(P \cap M \cap C) \\ 0.75 &= P + C + M - 0.4 + 3 \times 0.1 + 0.1 \end{aligned}$$

$$\therefore p + c + m = \frac{27}{20} = 1.35$$

\therefore (I) is true

(III) is false as $P(P \cap M \cap C) = 0.1$

and p, m, c are not independent probabilities

\therefore (A) is correct

$$\begin{aligned} 10. \text{ Average of marks} &= \frac{21 \times 2 + 15 \times 3 + 11 \times 1 + 23 \times 2 + 31 \times 5}{44} \\ &= 6.795 \end{aligned}$$

No. of students = 44

\therefore (C) is the correct

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