GATE

Subject : CS 2016_Set-1 - SOLUTIONS

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

1. $P \Rightarrow q$ will give {8, 9, 10, 12}

   $\neg r \vee \neg S$ will give {8, 10, 11, 12, 9}

   $(P \Rightarrow q) \wedge (\neg r \vee \neg S)$ will give {8, 9, 10, 12}

   and negation of above statement

   i.e. $\neg(P \Rightarrow q)(\neg r \vee \neg S)$ will give all numbers not in {8, 9, 10, 12} from the given set which is {11}.

   $\therefore$ Answer is 11

2. a_n is the number of n-bit strings that do not contain two consecutive 1s.

n	Strings	Number of strings
1	{0, 1}	2
2	{00, 01, 10}	3
3	{000, 001, 010, 100, 101}	5
4	{0000, 0001, 0010, 0100, 0101, 1000, 1001, 1010}	8

Thus, if we observe the patteren, we get

$a_1 = 2, \quad a_2 = 3$

$a_3 = 5$

$\therefore \quad a_3 = a_1 + a_2 = 2 + 3 = 5$

$a_4 = a_3 + a_2 = 5 + 3 = 8$

Similarly,

$a_n = a_{n-1} + a_{n-2}$

Thus, (B) is the correct option.

Alternative Solution :

Any n-digit binary sequence has to start with 0 or 1.

Consider two cases :

Case 1:

If it starts with 0 the rest will be same with a_{n-1}

Case 2:

If it starts with 1, then next number has to be 0, meaning it will exactly start with 10. So now, the rest will be a_{n-2}

The resulting solution will be a combination of both the cases.

$\therefore a_n = a_{n-1} + a_{n-2}$

3. $\lim_{x \to 4} \frac{\sin(x-4)}{x-4}$ ....(1)

Let $x - 4 = h$

$\therefore$ as $x \to 4$

$x - 4 \to 0$

$\therefore \quad h \to 0$

Thus, eqn (1) becomes

$\lim_{h \to 0} \frac{\sin(h)}{h}$ which we know is 1

$\because \left[\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1 \right]$

4. Pdf = $\frac{1}{x^2}$ on the interval [a, 1]

$\therefore p(x) = 0$ $x < a$

$= \frac{1}{x^2}$ $a \leq x \leq 1$

$= 0$ $x > 1$

We know that

$$\int_{\infty}^{\infty} P(x)dx = 1$$

$$\int_{-\infty}^{a} 0\,dx + \int_{a}^{1} \frac{1}{x^2}dx + \int_{1}^{\infty} 0\,dx = 1$$

$$\therefore 0 + \int_{a}^{1} \frac{1}{x^2}dx + 0 = 1$$

$\therefore \int_a^1 x^{-2}\,dx = 1$

$\therefore \left[\frac{x^{-2+1}}{-2+1}\right]_a^1 = 1$

$\therefore \left[\frac{x^{-1}}{-1}\right]_a^1 = 1$

$\therefore \left[\frac{-1}{x}\right]_a^1$

$\therefore \left(\frac{-1}{1}\right) - \left(\frac{-1}{a}\right) = 1$

$-1 + \frac{1}{a} = 1$

$\therefore \frac{1}{a} = 2$

$\therefore a = \frac{1}{2}$

$\therefore \boxed{a = 0.5}$

5. Since the matrix is a real matrix, its determinant has to be real. It can never be imaginary.
Also,
Determinant of a matrix = Product of its eigen values
$\therefore$ If one of the eigen value is complex, the other has to be its conjugate.
$\therefore$ Eigen values of the matrix are :

$3,\ 2 + \sqrt{-1}\ ,\ 2 - \sqrt{-1}$

i.e. $3,\ 2 + i,\ 2 - i$

$\therefore (2 + i)(2 - i).3 = (2^2 - i^2).3$

$= (4 + 1)\ 3$

$= 15$

$\therefore$ Value of determinant is 15

6. $x \# 0 = x$ ..... (given)

when $x = 0$, $0 \# 0 = 0$

when $x = 1$, $1 \# 0 = 1$

$x \# 1 = \overline{x}$ ..... (given)

when $x = 0$, $0 \# 1 = 1$

when $x = 1$, $1 \# 1 = 0$

$x \# 1 = \overline{x}$

i. e. $0 \# 1 = 1 \# 0 = 1$

If we observe, we can conclude that '#' is an XOR operator

$\therefore$ x # y will be

$x \oplus y = \overline{x}\, y + x\, \overline{y}$

Thus, (A) is the correct choice.

7. 16 bit 2's coplement of an integer is

11 11 1111 1111 0101

In 2's complement form,

Positive numbers are represented as it is.

But negative numbers are represented in complemented form.

As we can see the MSB is 1, i.e. the number is negative.

To obtain the original number, take its two's complement (i.e invert and add 1)

$\therefore$ 2's of given no. is

$$\begin{array}{rcccc} & 0000 & 0000 & 0000 & 1010 \\ + & 0000 & 0000 & 0000 & 0001 \\ \hline & 0000 & 0000 & 0000 & 1011 \end{array}$$

Decimal value of $(1011)_2$ is 11

$\therefore$ The number is –11

8. To design a counter that counts the sequence 0 – 1 – 0 – 2 – 0 – 3

As we can see these are three 0's in the sequence. Therefore to distinguish them, we need two bits as $\lceil \log_2 3 \rceil = 2$ and for the remaining sequence two more bits.

i.e. 2 + 2 = 4 bits needed

Note that it can't be done in 3 bits as the sequence has 4 distinct numbers which require two bits to count them. Now, we are left only with one bit which can take onlytwo distinct values. Thus the third 0 cannnot be uniquely identified. Hence we require one more bit. Thus we require 4 flipflops.

9. Maximum memory = 4GB = 2^{32} B

Since memory is word addressable and 1 word = 2 bytes

$\therefore$ x words = 2^{32} B

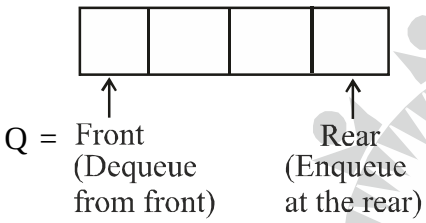
$$\therefore x = \frac{2^{32}}{2} = 2^{31} \text{ words}$$

Address bus has address lines which determine the capacity of the processor

$\therefore$ Address bus is 31 bits

As a side note, data lines determine the word length of the processor which in turn determines the performance of the processor.

10. Queue follows FIFO (First in First Out) policy



To implement a queue, we make use of two pointers front and rear.

We can add elements by incrementing the front.

But this may lead to problems such as front may point to the end of the array.

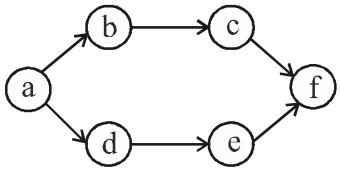
Thus, we need to test boundary conditions of front and rear and the solution to this problem is to use a 'CIRCULAR QUEUE'.

It increases front and rear in a circular manner not leading to overflow.

Thus, all the operations like enqueue(), dequeue(), isfull(), isEmpty(), getfront(), getRear () can be implemented in O(1) time.

Thus, the correct choice is (A).

11. Topological ordering of a directed graph is a linear ordering of its vertices such that for every Directed edge uv. from vertex u to vertex v, u comes before v in the ordering.



Thus the topological orderings are :

(i) a b c d e f

(ii) a b d c e f

(iii) a b d e c f

(iv) a d e b c f

(v) a d b c e f

(vi) a d b e c f

∴ There are 6 different topological orderings.

Answer is 6

12. i is an integar variable

S is a variable of type short

*P is value of pointer to short

Option (A) will give error because we are passing second argument as *S but S is not a pointer variable.

Option (B) is false because the function has no return type but still we are trying to store the value of f(i, s) in i. So it will give a type checking error.

Option (C) is false because of the same reason as option (A)

∴ (D) is the correct option. It won't result in a type checking errors.

13.

Sort type	Best case	Worst case	Average case
Insertion sort	O(n)	$O(n^2)$	$O(n^2)$
Merge sort	O(n logn)	O(n logn)	O(n logn)
Quick sort	O(n logn)	$O(n^2)$	O(n log n)

∴ Option (D) is the correct option

(i) Worst case of insertion sort occurs when input is reverse sorted. The recurrence relation is $T(n) = T(n - 1) + \theta(n)$

(ii) Worst case of quick sort occurs when input is sorted in ascending or descending order. Recurrenc relation is : $T(n) = T(n - 1) + \theta(n)$

(iii) Merge sort is not adaptable to the input. It takes O(n logn) time in all the cases.

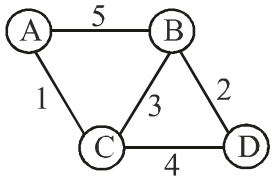
Recurrence relation is : $T(n) = 2T(n/2) + \theta(n)$

Note : Quick sort sorts faster than merge sort but there is no such theoretical proof.

14. If every edge weight is increased by same value and the graph has distinct positive edge weights, the minimum spanning tree won't change.

∴ Statement P is true.

To verify statement Q, consider the graph :



Shortest path between A and B is A – C – B of weight 4

Now, adding same weight to each of the edges say 5

$\therefore$ Path A – C – B has weight (1 + 5) + (3 + 5) = 14

and path AB has (5 + 5) = 10

Thus the shortest path may change

$\therefore$ Statement Q is false

Option (A) is the correct option.

15. Note that the mystery function doesn't swap values but it only changes pointers that are local to the function.

Thus, the value of a remains unchanged.

Answer is 2016.

16. $S \rightarrow$ as |bs| ε

The given grammar generates ε, a, b, aa, ab, ba, bb, bbb, abb, bab ....

$\therefore$ Language generated is (a + b)*

(D) is the correct option

17. I is decidable

II is decidable (Membership problem is decidable for all languages except for REL)

III is undecidable

Given 2 CFGS G_1 and G_2, it is undecidable whether

$L(G_1) = L(G_2)$

$L(G_1) \subseteq L(G_2)$

$L(G_1) \cap L(G_2) = \phi$

IV is undecidable as well as non-recurssively enumerable

whereas given a TM M, is $L(M) \neq \phi$ is undecidable and recursively enumerable

$\therefore$ (C) is the correct option

18. (A) Represents strings which have 0011 or 1100 as substring

(C) Represents strings which have 00 or 11 as substring

(D) Represents strings starting with 00 and ending with 11 or strings starting with 11 and ending with 00.

(B) is the correct option

19. In static single assignment, each variable which is used to assign values shoud be specified with distincit names.

The given code has two assignments to x and 3 assignment to y.

We use variables x, x^1 to distinguish x assignment and y, y^1, y^{11} to distinguish y assignment

$\therefore$ $x = u - t$

$y = x * V$

$x_1 = y + w$

$y_1 = t - z$

$y_{11} = x_1 * y_1$

$\therefore$ Variables required are x, u, t, y, v, x^1, w, y^1, y^{11}, z

$\therefore$ Total 10 variables, Answer is 10

20. Turn around time is the time difference between completion of the process and start of the process.

Among all CPU algorithms, SJF gives minimum turn around time and waiting time. SRTF is preemptive SJF.

$\therefore$ correct option is (A)

21. Remember these two important points

(i) Candidate key is the minimal of super key. If a proper subset of a super key is also a super key, then that proper subset is a candidate key.

(ii) If none of the proper subsets of a super key is a super key then that key is a candidate key as well as superkey

Also, any superset of superkey is also a superkey

Primary key is one of the candiadate keys. The remaining candidate keys, if any other than primary key are known as alternate keys.

Correct answer is option (B) since it does not contain the attribute Y from the primary key VY. Hence it is not a superkey.

22. 'D' in ACID properties stands for Durability. The other three are correct

$\therefore$ Correct option is option (D)

23. Let V – Volume, N – Number, S – Start page, E – End page, Title – T, Y – year, P – Price
Primary key – VNSE

FDs

{ VNSE $\rightarrow$ T

VN $\rightarrow$ Y

VNSE $\rightarrow$ P}

VN $\rightarrow$ Y is a partial dependency

i.e. Proper subset of candidate key $\rightarrow$ Non key attribute

$\therefore$ The relation is not in 2NF

New database is

R_1(VN SE TP)

R_2 (V N Y)

Same FDs as for old database

No partial dependencies in R_1 and R_2 $\therefore$ 2NF

Also $R_1 \cap R_2$ = VN

$(VN)^+$ = VNY which is superkey of R_2

No transitive dependencies in R_1 and R_2 $\therefore$ 3NF

$\therefore$ The weakest normal form that new database satisfies but the old one doesn't is 2NF

Option (B) is the correct option.

24. DNS is used to translate human friendly domain names to numerical IP addresses. ARP is used to translate IP addresses to MAC addresses.

RARP is used to translate MAC addresses to IP addresses.

DHCP dynamically allocates IP addresses.

It does not convert one form of address to another

Hence correct option is option (C)

25. The essence of stateless protocols is that all the requests over the same connection (in case of HTTP) or multiple connections, the server does not associate any special meaning to their arriving over same or different sockets. All the requests are treated as independent requests.

Egs. of stateless protocols are IP and HTTP.

FTP is a stateful protocol

POP3 is a stateful protocol

TCP is a stateful protocol but it is a transport layer protocol

The question asks for stateful application layer protocols, which are FTP and POP3.

$\therefore$ (C) is the correct option.

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

26. $S = (x^3 + x^4 + x^5 + x^6 + \ldots\ldots)^3$

$S = (x^3(1 + x + x^2 + x^3 + \ldots\ldots)^3$

$S = \underbrace{x^9\ (1 + x + x^2 + x^3 + \ldots\ldots)^3}_{\text{Infinite GP}}$

$1 + x + x^2 + x^3 + \ldots\ldots = \dfrac{1}{1-x} = (1 - x)^{-1}$

$\therefore\ S = x^9\ \left((1-x)^{-1}\right)^3$

So we need coefficient of x^3 from $(1 - x)^{-3}$ and x^9. $x^3 = x^{12}$ will give the coefficient of x^{12}
Coefficient of x^3 using binomial expansion,

$$(1 - x)^{-3} = 1 - (-3)\ x + \frac{(-3)(-4)}{2!}(-x)^2 + \frac{(-3)(-4)(-5)(-x)^3}{3!}$$

$\therefore$ Coefficient of $x^3 = \dfrac{-(-3)(-4)(-5)}{3!} = 10$

$\therefore$ 10 is the correct answer

27. $a_1 = 8$

$a_n = 6n^2 + 2n + a_{n-1}$

$a_n = 6(n^2 + (n - 1)^2) + 2\ (n + (n - 1) + a_{n-2}$

$a_n = 6(n^2 + (n - 1)^2 + (n - 2)^2\ ) + 2\ (n + (n - 1) + (n - 2) + a_{n-3}$

$\therefore\ a_n = 6(n^2 + (n - 1)^2 + (n - 2)^2 + \ldots\ldots 2^2 + 1^2) + 2\ (n + (n - 1)\ (n - 2\ ) + \ldots. 2 + 1)$

$= 6\ (n^2 + (n - 1)^2 + (n - 2)^2 + \ldots. + 2^2) + 6 + 2\ (n + (n - 1) + (n - 2) + \ldots. 2) + 2$

$= 6\ (n^2 + (n - 1)^2 + \ldots\ldots 2^2) + 2(n + (n - 1) + \ldots\ldots 2) + 8$

$\therefore\ a_n = \Sigma\ n^2 + 2\ \Sigma\ n$

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

$= n(n + 1)\ (2n + 1) + n(n + 1)$

$= n(n + 1)\ [2n + 1 + 1]$

$= n(n + 1)\ (2n + 2)$

$a_n = 2n\ (n + 1)^2$

$\therefore\ a_{99} = 2(99)\ (100)^2 = 198 \times 10^4$

$\therefore\ K = 198$

28. $f : N^+ \rightarrow N^+$

$f(n) = f(n/2)$ if n is even

$f(n) = f(n/5)$ if n is odd

Let n = 4

$f(4) = f(4/2) = f(2) = f(2/2) = f(1)$

Let n = 3

$f(3) = f(3 + 5) = f(8) = f(8 / 2) = f(4)$ and we know $f(4)$ is $f(1)$

Let n = 10

$f(10) = f(5) = f(10) = f(5)$

For n = 5

$f(5) = f(10)$

$\therefore$ $f(5)$ and $f(10)$ give the same value and $f(1)$ gives different value

$\therefore$ Two distinct values

2 is the correct answer

29. A fair coin when flipped twice has outcomes as {HH, HT, TH, TT}

$P(TH) = \frac{1}{4} = P(H\ H) = P(H\ T) = P(TT)$

It leads to an infinite series

Step 2 + step 4 step 2 + step 4 step 4 step 2 +.....

$= \frac{1}{4} + \frac{1}{4} \cdot \frac{1}{4} + \frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$

It is an infinite GP where a is 1/4 and r is 1/4.

$\therefore$ Sum $= \frac{a}{1-r}$

$= \frac{1/4}{1-1/4}$

$= 1/3$

$\therefore$ S $= 0.33$

0.33 is the correct answer.

30. Output F1 of MUX 1 is

$F1 = \bar{P}\,0 + P\,R$

$F1 = PR$

Output X of MUX 2 is

$X = \bar{Q}\,\bar{R} + Q.\ F1$

$X = \bar{Q}\,\bar{R} + QPR$

$\therefore$ (D) is the correct choice

31. Size of data count register = 16 bits

$\therefore$ Data transferred in 1 time = 2^{16}B

= 64 KB

$\therefore$ To transfer 29154 KB of data, DMA needs to get the control of system bus

$\frac{29154\,KB}{64\,KB} = 455.53$

$\therefore$ Atleast 456 times

456 is the correct answer

32. Performanc of pipeline $\propto \frac{1}{\text{Execution Time}}$

For 4-stage pipeline P,

Max stage delay t_p = 800 picoseconds

$\therefore$ P1 = $\frac{K.1}{800}$

New pipeline P1 has stage delays

600, 350, 500, 400, 300 and five stages

$\therefore$ P1 = $\frac{K\cdot}{600}$ as 600 is max stage delay

$\therefore$ % increase in through put $= \frac{P2 - P1}{P1} \times 100$

$$= \frac{\frac{K}{600} - \frac{K}{800}}{\frac{K}{800}} \times 100$$

$$= \frac{1}{3} \times 100$$

= 33.33%

$\therefore$ Range of correct answer is [33 – 34]

33. For a carry lookahead adder, the expression for carry out from a stage is :

$G_i + 1 = G_i + C_iP_i$

where

$G_i = A_i . B_i$ is the generals function to indicate if that stage causes a carry out signal and

$P_i = A_i + B_i$ is the propagate function whether the carry in to the stage is passed to the carry out for next stage.

$\therefore\ G_{i+1} = G_i + C_i\ P_i$

$G_{i+1} = G_i + P_i\ (G_{i-1}) + G_i - 1\ P_{i-1})$

$= G_i + P_i\ G_i - 1 + P_i\ P_i - 1\ (G_i - 2 + G_i - 2.\ P_i - 2)$

$G_{i+1} = G_i + P_i\ G_i - 1 + P_i\ P_i - 1\ G_i - 2 + P_i\ P_i - 1\ P_i - 2$

$= GI - 3 + ... Pi\ Pi - 1 ..... Pi - k\ P1\ P0\ Co$

Note that it does not require the carry out signals from previous stages, so we don't have to wait for changes to ripple through the circuit.

Two number can hence be added in constant time O(1), of just 6 gate delays; which is independent of 'n' if no. of inputs = fan in

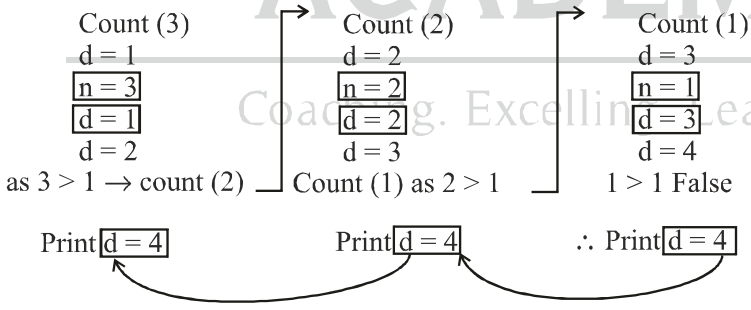
However if logic gates are available with a limited no. of inputs, trees will be constructed to compute and time will be 0(log n)

$\therefore$ B is the correct choice.

34. The condition that satisfies the while loop is a ! = b or b ! = a

$\therefore$ Option (D) seems to be the corrrect choice

35.



$\therefore$ Output : 3 1 2 2 1 3 4 4 4

(A) is the correct choice

36. With dynamic scoping, a global identifier refers to the identifier associated with the most recent environment i.e. the execution context or the calling context.

So dynamic scoping means that 'x' refers to the 'x' declared in the most recent frame of the call-stack if it has one.

a = 3

main ( )

{ m (a); || since there is no local a, global value of a is passed ∴ m(3)

void m(y)

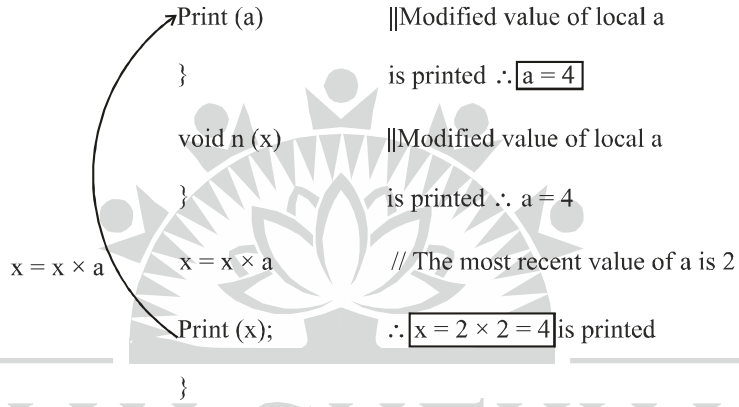
{

a = 1, || A local a is created

a = y – a || a = 3 – 1 = 2

n (a);

∴ Local a with value 2 is passed to n



∴ Output is 4, 4

Correct option is (D)

37. For a heap,

depth is always O (log n) as heaps are stored in complete binary trees where 'n' is the no. of elements forming a heap.

To insert an element in a heap

= O(1) + O(log n) [to heapify]

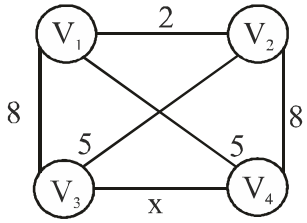
To delete an element from a heap

O(1) + O(log n) [to reverse heapify]

∴ Reverse heapify takes O(log n) which is O(d)

∴ (B) is the correct option.

38. Let V_1, V_2, V_3, V_4 be the vertices of the graph. Edge V_3 to V_4 has the weight 'x'



Consider paths from V_3 to V_4

$V_3 - V_1 - V_2 - V_4$ has weight $(8 + 8 + 2) = 18$

$V_3 - V_2 - V_4$ has weight $(8 + 5) = 13$

Shortest path should include 'x'

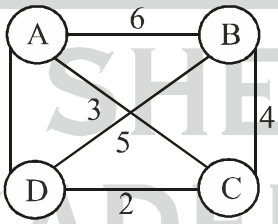
$\therefore$ Largest value of x must be 12

as V_3 directly connects V_4 via 'x'.

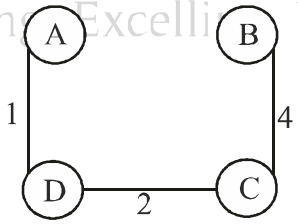
$\therefore$ $\boxed{x = 12}$

39. The maximum possible weight of a MST will be when all its minimum edge weights form a cycle

Consider the graph



MST will be



We cannot include edge AC in MST as it forms a cycle

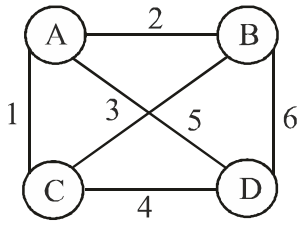
$\therefore$ Maximum possible weight of MST is

$4 + 2 + 1 = 7$

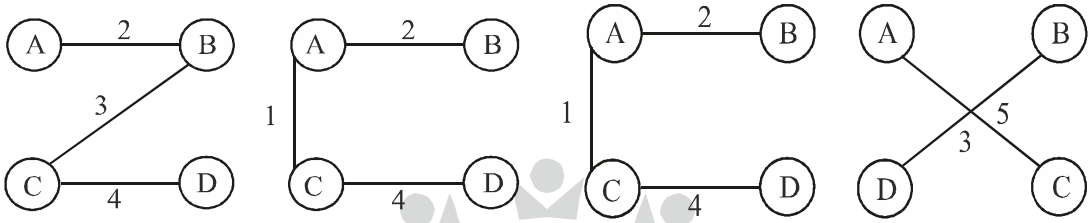
$\therefore$ 7 is the answer

40. Statement I is not true

Consider a complete graph of 4 vertices



It will have various MSTS



∴ Not every MST includes the edge weight 1

II is true. Consider any cycle of MST. It will always exclude heaviest edge e as addition of any edge into MST will create a cycle.

Suppose we add an edge e' to the spanning tree which created cycle. We can reduce the cost of MST if we choose an edge other than e from cycle which implies that e must not be in MST and we get a contradiction.

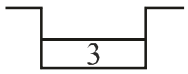
∴ II is true.

Option (B) is the correct answer.

41. Maximum possible itertions will take place in the worst case when queue is reverse sorted.

Q : [3][2][1] S : empty

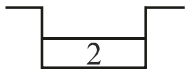
I1 : dequeue Push (3)

∴Q : [2][1] S: 

I2 : POP dequeue Push (2)

∴Q : [2][1][3] S: 

I3 : dequeue Push (2)

∴Q : [1][3] S: 

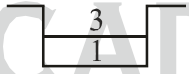
I4 : POP( ) Enqueue (2)

∴Q : [1][3][2] S: 

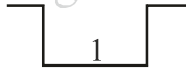
I5 : dequeue( ) Push (1)

∴Q : [3][2] S: 

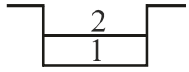
I6 : dequeue Push (2)

∴Q : [2] S: 

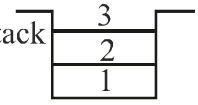
I7 : POP( ) enqueue (3)

∴Q : [2][3] S: 

I8 : dequeue( ) enqueue (3)

∴Q : [3] S: 

I9 : dequeue( ) Push (3)

∴Q : emphy Stack 

For 3 elements, there are 9 iterations. So for n element, it will take n^2 iteratons in worst case.

∴ For n = 16, iterations = 256

42. L(G1) = {b, bb, ab, aab, aabb, bbb, ... }
i.e. atleast one 'b'
L(G 2) = {a, b, aa, ab, aab, ... }
i.e. atleast one 'a' or one 'b'
$\therefore$ (D) is the correct option

43. The given PDA accepts
$\{a^n \mid n \geq 0\}$ Using start state as final state
and also
$\{a^n b^n \mid n \geq 0\}$ Using another final state and it is a DCFL
$\therefore$ (D) is the correct choice

44. If A is mapping reducible to B, $A \leq m\ B$ and
(i) If A is undecidable then B is undecidable
(ii) If B is decidable then A is decidable
X – Recursive
Y – REL but not recussive
$\overline{Y} \leq m\, W$ _____ given
$\overline{Y}$ is non REL as RELs are not closed under complementation
$\therefore$ W is non REL
$Z \leq m\, \overline{X}$ _____ given
$\overline{X}$ is recussive as X is recussive and all recussive languages are decidable
$\therefore$ Z is decidable and recussive
(c) is the correct choice

45. E = 2 – 5 + 1 × 3 ($\because$ + has highest precedence)
= 2 – 6 – 7 × 3 (– has right associativity)
= 2 – (–1) × 3
= 3 × 3
= 9
$\therefore$ 9 is correct answer

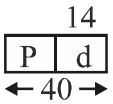
46. w = a a b
= a S b {S → a} print 2
= a A {A → Sb} print 3
= S {S → aA} print 1

The process of buttom up passes is to reduce the given string to start symbol

∴ (c) is the correct choice.

47. LA = 40 bit

Page size = 16 kB = $2^4 \cdot 2^{10}$

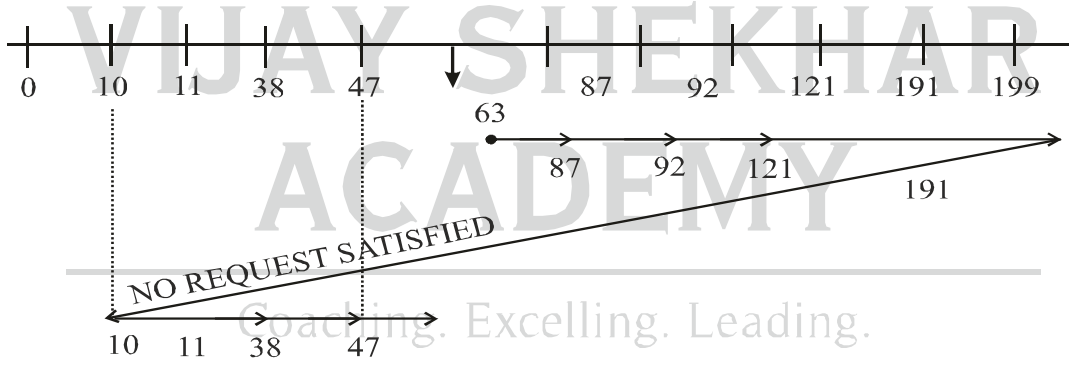


d = 14 ∴ P = 40 – 14 = 26

PTE = 48 bits = $\frac{48}{8}$B = 6 bytes

Size of paper tables = # pages × PTE size
= 2^{26} × 6 B
= $2^6 \times 6 \times 2^{20}$ B
= 384 MB

48.



∴ Head movement = |191 – 63| + |191 – 10| + |10 – 47| = 346

In clook, head does not satisfy any request while from last request of one side to the first request of another. But head movement will be considered.

49. In last in first out, first 10 will incur page faults (a_1 to a_{10}). From (a_{11} – a_{20}) another 10 page faults but 10th physical frame will be replaced every time. Now (a_1 – a_9) 9 hits and the remaining 11 will be faults

∴ using LIFO, total page faults = 10 + 10 + 11
= 31

Now, in optimal (a_1 to a_{10}) will be placed,

∴ For (a_{11} to a_{20}) another 10 page faults for (a_1 – a_9) 9 hits and now when a10 comes, we'll

replace a_1, for a_{11}, we'll replace a_2 and so on up to a 9

$\therefore$ (a_{10} – a_{19}) 10 faults. a_{20} will be a hit using optimal page replacement policy,

No. of page faults = 10 + 10 + 10 = 30

$\therefore$ Difference in page faults = |30 – 31| = 1

1 is the correct answer.

50. The solution ensures mutual exclusion

Let i = 1

$\therefore$ for P_1

C[1] = 1

t[1] Pmax (t [0], ... t[n – 1] + 1 = 0 + 1 = 1, c[1] = 0

For j ≠ l (0 to n – 1)

$$\text{False}\begin{bmatrix}\text{while}(c[2]);\text{Taking } j=2\\ \text{while}(t[2]!0\&\&[2]<=t[1]);\end{bmatrix}$$

$\therefore$ $\boxed{P_1 \text{ in CS}}$

Now consider i = 3 $\therefore$ for P_3

C[3] = 1, t[3] = 1

for every j ≠ 3 (0 to n – 1)

while (C [1]); false

while (t [1] ! = 0 & & t [1] < t [3]) ; true $\therefore$ loop in while

$\therefore$ only one process in CS at a time

$\therefore$ (A) is the correct answer.

51. The locking described in the question is that of conservative 2 PL

In conservative 2 PL, there is no possibility of deadlock and it ensures serializability.

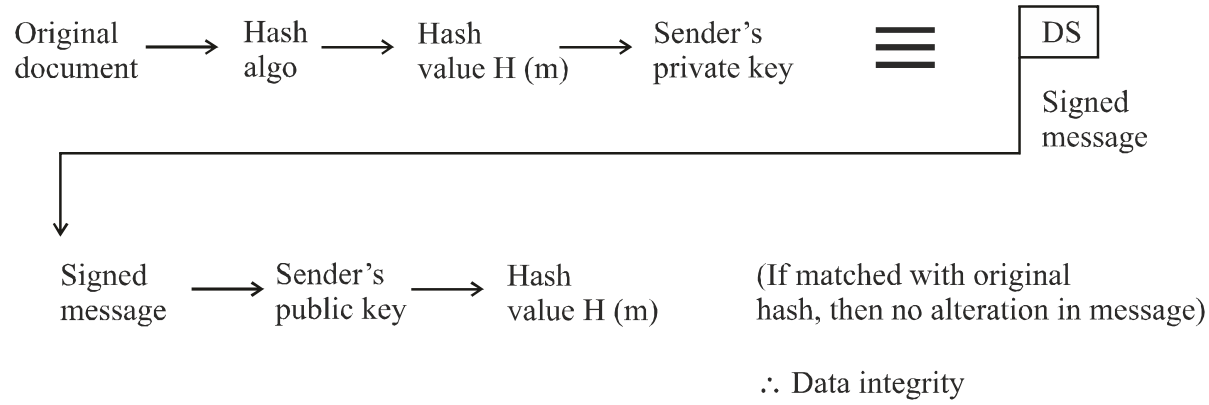
The disadvantages of conservative 2PL are

(1) low resource utilization as it acquires resources before transaction begins.

(2) Less throughput and possibility of stavation.

$\therefore$ (A) is the correct choice.

52. Digital signature is based on public key assymetric cryptography



Thus if B wants to send a message to A that is digitally signed, it should encrypt the hash value with its own private key

$\therefore \{m, K_B(H-(m))\}$

i.e. (B) is the correct choice.

53. Size of IP data gram = 1000 B

MTU = 100 B

IP header = 20 B

$\therefore$ Data in MTU = 100 – 20 = 80 B

$\therefore$ No. of fragment = $\left\lceil \frac{100}{80} \right\rceil = \lceil 12.5 \rceil = \underline{13}$

13 is the correct answer

54. O/P rate M = 20 MBPS

Arrival rate = 10 MBPS

$\therefore$ 20 – R = 10

R = input rate = 10 MBPS

$\therefore$ I/P rate = 10 MBPS

when we begin transfer the tokens present in the token bucket, they are transmitted at once to the network

i.e. if initially capacity of token bucket is 'C', then 'C' tokens will be instantly.

present in the network.

Time to empty the token bucket-

R – every sec, we are getting R tokens

M – every sec, M tokens are produced

C – initial capacity of the bucket

$\therefore$ Input rate = output rate

$C + RT = Mt$

$$\therefore t = \frac{C}{M - R}$$

$$= \frac{1MB}{(20-10)MBPS}$$

$$\boxed{t = 0.1 \text{ sec}}$$

$\therefore$ To send 12 MB of data, 1 MB is initally present in the bucket. So it is instantly transferred

$\therefore$ Total time is (12 – 1) * 0.1 = 11 × 0.1 = 1.1 sec

56. L = 1000 B

BW = 80 Kbps

$$\therefore Tt = \frac{L}{BW} = \frac{1000B}{80\,kbps}$$

$$Tt = \frac{1000 \times 8b}{80 \times 10^3\,bps} = 0.1 \text{ sec}$$

For ACk,

L_{ack} = 100 B

Tr rate at receivers = 8 kbps

$$\therefore T_{tack} = \frac{100B}{8kbps} = \frac{8 \times 10^2 b}{8 \times 10^3\,bps} = 0.1 \text{ sec}$$

P_t = 100 milliseconds = 0.1 sec

$\therefore$ Total time $= T_t + T_{tack} + 2p_t$

$= 0.1 + 0.1 + 2 \times 0.1$ sec

$= 0.4$ sec

57. Throughput $= \frac{Tt}{Total\,time} \times BW$

$$= \frac{L/BW}{0.4\,sec} \times BW$$

$$= \frac{1000B}{0.4\,sec}$$

Throughput = 2500 Bytes/second

General Aptitude Section

1. (D) is the correct answer.

   Until itself comes with not and since the minister is a singular subject, we use a singular verb 'meets'.

2. (A) is the correct answer.

   Paraphrase is a statement that says something that another person has said or written in a different way.

   Paradox is a contradictory statement or opposed to common sense and is perhaps true paradigm is way of thinking & paraffin is an inflammable substance.

3. (A) is the correct answer.

   The given statement is a figurative statement

4. (C) is the correct answer

   relftaga – carefree

   otaga – careful

   fertaga – careless Fer ≡ Less

   ∴ taga ≡ care

   Also second half of the code word represents the first half of actual word

   ∴ aftercare – tagazen

   as tagafer can't be used because fer ≡ less

   So, we are left with only one option i.e. (C)

5. Volume of a cube = 64 cube units

   ∴ $(\text{side})^3 = 64$ cube units

   ∴ side = 4 units

   Even after removing one cube block from every corners, the surface area would not be changed as it would still create 3 open faces of the unit cube.

   ∴ Total surface area of the cube $= 6 \times (\text{side})^2$

   $= 6 \times 4^2$

   $= 96$

   ∴ (D) is the correct answer.

6. Revenue of elegance = (27300 + 25222 + 28976 + 21012) + 48
= ` 4920480
Revenue of smooth = (20009 + 19392 + 22429 + 18229) + 63
= ` 5043717
Revenue of soft = (17602 + 18445 + 19544 + 16595) + 78
= ` 5630508
Revenue of executive = (9999 + 8942 + 10234 + 10109) + 173
= ` 6796132
As we can see revenue of executive is maximum and hence its fraction of revenue will be maximum.

7. The given sentences emphasize more on the nation's diversity.
(A) and (C) are ruled out first as they don't make any sense
(B) is incorrect as linguistic pluralism is not the 'only' indicator of a nations's diversity
(D) is logically valid and strenthens the given sentences.
∴ (D) is correct.

8.

P	Q	R	S
always beats Q		always beats S always loses to Q	loses to P sometimes

(i) is invalid as S loses to P only 'sometimes'
∴ S wins with P most of the times
(ii) is also invalid because of the same reason as (i) is invalid
∴ (D) is correct.

9. $f(x) = 2x^7 + 3x - 5$

1	2	0	0	0	0	0	3	–5
		– 2	2	2	2	2	2	5
	2	2	2	2	2	2	5	0

∴ $(x - 1)$ is a factor of $f(x)$
∴ (B) is the correct choice

10. $F \propto a^l$ F – Faihure, l – load

$F = K.a^l$

$l = 80, F = 100$

$l = 40, F = 10000$

For $l = 80, F = 100$

For $l = 40, F = 10000$

$\therefore 10000 = K \cdot a^{40}$ ..... (1)

$100 = K .a^{80}$ ..... (2)

$\therefore (1) \div (2)$

$$\frac{10000}{100} = \frac{K a^{40}}{K a^{80}}$$

$10^2 = a^{-40}$

$2 \log_{10}{}^{10} = -40 \log_{10} a$

$$\therefore \frac{-1}{20} = \log_{10} a$$

$$\therefore \boxed{a = (10)^{-1/20}}$$

$\therefore$ For F = 5000 cycles l = ?

$\therefore 100 = K \cdot a^{80}$

$100 = K. (10)^{\frac{-1}{20} \times 80}$

$100 = K. 10^{-4}$

$$\therefore \boxed{K = 10^6}$$

$\therefore 5000 = 10^6 . a^l$

$5000 = 10^6 \left[(10)^{-1/20}\right]^l$

Substitite values of l from options

For option (B) i.e. $l = 46.02$, we get F = 5000.345

$\therefore$ (B) is correct.