

Q.1)

A Role of Employee has the privilege to select, insert, update and delete on all tables of a database. A new role Manager is created with the following statement

Subject: DBMS

Max Marks: 1

**Grant Manager to Employee;**

For the Manager for setting the access rights, which right/s will manager inherit?

A Only select

B Only select and delete

C Only delete, insert and update

D All rights- select, insert, update, delete

Correct Option

Solution: (D)

Explanation:

A manager must inherit all the rights in order to set the access rights.

Q.2)

Consider a hash table of size six, with starting index zero, and a hash function  $(2x+5) \bmod 6$ . Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 2, 4, 9, 10 is inserted into the table using closed hashing? Here “\_\_” denotes an empty location in the table.

Subject: Data Structures

Max Marks: 1



A \_\_\_, \_\_\_, 2, 9, 4, 10

B \_\_\_, 4, \_\_\_, 2, \_\_\_, 9

C \_\_\_, 4, 10, 2, \_\_\_, 9

Correct Option

Solution: (C)

Explanation:

Size of the Hash table is 6

Given sequence is 2,4,9,10

 $(2 \times 2 + 5) \bmod 6 = 9 \bmod 6 = 3$  $(4 \times 2 + 5) \bmod 6 = 13 \bmod 6 = 1$  $(9 \times 2 + 5) \bmod 6 = 23 \bmod 6 = 5$  $(10 \times 2 + 5) \bmod 6 = 25 \bmod 6 = 1$ 

Index	Key
0	-
1	4
2	10
3	2
4	-
5	9

D \_\_\_, 10, 4, 2, \_\_\_, 9

Q.3)

Number of states in a minimal DFA to recognize the following language, where  $\Sigma = \{a,b,c\}$

Subject: Theory of Computation, Compiler Design

Max Marks: 1



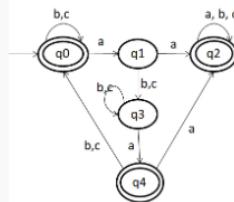
$L = \{w : w \text{ contains an even number of } a's \text{ or contains the pattern } 'aa'\}$

Correct Answer

Solution: (5)

Given language

$L = \{w : w \text{ contains an even number of } a's \text{ or contains the pattern 'aa'}\}$   
The strings that are in the language = {, b,c,bb,bc,bbcc, aa,aca,aba,abba,.....}  
aaa is also valid as it contains aa as a substring.



Q.4)

Consider the following C program.

```
#include <stdio.h>
int main()
{
    char p[]={‘h’,‘e’,‘y’};
    char q[ ]="Hey";
    printf("%lu %lu", sizeof(strlen("%s",p)), sizeof(strlen("%s",q)));
    return 0;
}
```

What will be the output for the following question.

A

4 4

Correct Option

Solution: (A)

Solution: 4 4

Here, when we go with code then we can get

```
char p[]={‘h’,‘e’,‘y’}; // this is character array, which is initialized with some
characters.
char q[ ]="Hey"; // this is character array which is initialized with a string.
printf("%lu %lu", sizeof(strlen("%s",p)), sizeof(strlen("%s",q))); // here we
are using printf inside sizeof and sizeof inside printf. So it will work as
printf(strlen("%lu %lu", sizeof("hey")), sizeof("Hey")); // it will print 4 4 as in
case sizeof operator it counts null character also.
```

So, the correct output is 4 4.

B

4 hey 4 Hey

C

hey Hey

D

Hey 4 Hey 4

Q.5)

For the given relation R(ABC)

Subject: DBMS

Max Marks: 1

A	B	C
5	1	1
3	2	4
3	3	4
3	4	1

Which of the following FD's are satisfied by the above instance of R(ABC)?

A

$AC \rightarrow B$  and  $B \rightarrow A$

B

$AB \rightarrow C$  and  $C \rightarrow B$

C

$BC \rightarrow A$  and  $A \rightarrow C$

D

$BC \rightarrow A$  and  $B \rightarrow C$

Correct Option

**Solution:** (D)

**Solution:**

Here, we can see that BC can uniquely determine A but neither AC nor AB could determine B and C uniquely. Similarly, B can uniquely determine C.

Q.6)

In order to switch from user mode to supervisor mode, consider the following:

S1 : A hardware exception doesn't work

S2 : A system call works

Which of the following options is/are correct ?



S1 only



S2 only

Correct Option

**Solution:** (B)

**Explanation:**

The three styles of switching from user mode to supervisor mode.

Interrupts, when a device sends an interrupt to the CPU.

When a program executes a system call, which is usually implemented by a trap instruction.

When a program performs an operation that causes a hardware exception, such as divide by zero, illegal memory access or execution of an illegal opcode.



Both S1 and S2



None of the above

Q.7)

If G is a cyclic group of order 217, the number of generators of the group G is \_\_\_\_

Subject: Discrete Mathematics

Max Marks: 1

Correct Answer

**Solution:** (180)

**Explanation :**

The number of generators of a cyclic group of order n is equal to the number of integers between 1 and n that are relatively prime to n.

Namely, the number of generators is equal to  $\phi(n)$ , where  $\phi$  is the Euler totient function.

By part (a), we know that G is a cyclic group of order 217.

Thus, the number of generators of G is :  $\phi(217) = \phi(7)*\phi(31) = 6*30 = 180$ .

Q.8)

Which of the following is/are undecidable

Subject: Theory of Computation,Compiler-Design

Max Marks: 1

- I.  $A_{TM} = \{ \langle M, w \rangle \mid M \text{ is a TM that accepts string } w \}$ .
- II.  $EQ_{TM} = \{ \langle M_1, M_2 \rangle \mid M_1, M_2 \text{ are TMs with } L(M_1) = L(M_2) \}$
- III.  $E_{TM} = \{ \langle M \rangle \mid M \text{ is a TM with } L(M) = \emptyset \}$



I and II Only



II and III Only



I and III Only



I,II and III Only

Correct Option

**Solution:** (D)

**Explanation:**

$A_{TM} = \{ \langle M, w \rangle \mid M \text{ is a TM that accepts string } w \}$ . Undecidable.

$EQ_{TM} = \{ \langle M_1, M_2 \rangle \mid M_1, M_2 \text{ are TMs with } L(M_1) = L(M_2) \}$

Undecidable.

$E_{TM} = \{ \langle M \rangle \mid M \text{ is a TM with } L(M) = \emptyset \}$  Undecidable.

Q.9)

Consider the relation R defined on the set Z of integers as:

$xRy$  if  $x - y$  is divisible by 3.

Subject: Discrete Mathematics

Max Marks: 1

Which of the following option is/are correct?

- A R is reflexive only
- B R is symmetric only
- C R is reflexive and symmetric but not transitive

- D None of the above

Correct Option

Solution: (D)

**Explanation:**

Reflexive:

$xRx$  means we can find an integer  $k$  such that  $x - x = 3k$ . Now,  $x - x = 0$  so this is true  $\forall x \in \mathbb{Z} (k = 0)$ .

Symmetric:

If  $x - y = 3k_1$  then  $y - x = -(x - y) = -(3k_1) = 3k_2$ . True  $\forall (x, y) \in \mathbb{Z}^2$ .

Transitive:

If  $x - y = 3k$  and  $y - z = 3k_2$  then  $(x - y) + (y - z) = 3k_1 + 3k_2$ . i.e.  $x - z = 3(k_1 + k_2) = 3k_3$ . True  $\forall (x, y, z) \in \mathbb{Z}^3$ .

$R$  is an equivalence relation.

Q.10)

Subject: computer organization

Max Marks: 1



A Computer system supports expanding opcode technique and has 32 two-address instructions and 512 one-address instructions. Assume that the computer uses the 16bit instruction format, the size of the address field is 5bits. The number of zero-address instructions it can support is \_\_\_\_\_

- A

Correct Answer

Solution: (16384)

**Explanation:**

Given that the computer system supports 16-bit instruction format.

Possible 2-Address Instructions if each Address requires 5 bits

16-bit Address		
Opcode(6)	Address-1 (5)	Address-2(5)

$2^6 = 64$  two address instructions are possible.

But we have 32 two address instructions only.

Number of one address instructions possible is

$64 - 32 = 32 \Rightarrow 32 * 2^5 \Rightarrow 1024$  One address instructions are supported by the given computer system.

We have only 512 One Address instructions are there.

$\Rightarrow 1024 - 512 = 512$

Number of Zero Address instructions that are supported by the given system is  $= 512 * 2^5 = 2^{14} = 16384$

Q.11)

Subject: Computer Networks

Max Marks: 1



Consider the network where A is connected to B with a link. The bandwidth of the link is R bits per second and the packets always come in the size of P bytes. The link speed is S meter per second and the length of the link is D meters. Acknowledgment is of K bits. Suppose the processing delay is negligible. Calculate the total delay required before sending the second packet in seconds.

- A  $P/R + 2(D/S) + K/R$
- B  $P/R + 2(D/S)$
- C  $8P/R + 2(D/S) + K/R$

Correct Option

Solution: (C)

**Explanation:**

Tt of packet =  $P/R * 8$

Tt of ACK =  $K/R$

RTT =  $2PT = 2 * D/S$

- D  $8P/R + 2(D/S) + K$

Q.12)

Subject: Computer Networks

Max Marks: 1

The following encoding is used in a data link protocol:

A: 01000011

B: 11000011

C: 10101111

FLAG: 01111110

ESC: 11100000

Show the bit sequence transmitted for the frame “C B FLAG” (FLAG is part of the frame).

What is the output of the framing method using character stuffing?

 A

011111101010111111000011111000000111111001111110

Correct Option

Solution: (A)

Explanation:

In the character stuffing if we want a flag in data then we have to put ESC before it and also starting and ending of the frame attached with the Flag.

Output frame is: FLAG C B ESC FLAG FLAG

Put all the value you will get the option A.

 B

0111111010101111110000110111111001111110

 C

01111110101011111100001111100000111000000111111001111110

 D

101011111100001101111110

Q.13)

Subject: Computer Networks

Max Marks: 1

You receive a call from a user who is complaining that they cannot get on the Internet. You have them verify their IP address, mask, and default gateway. The IP address is 10.0.37.144, with a subnet mask of 255.255.254.0. The default gateway is 10.0.38.1. What is the problem?

 A

Incorrect DNS server address

 B

Invalid subnet mask

 C

Incorrect gateway IP

Correct Option

Solution: (C)

Explanation:

Ip address = 10.0.37.144

Mask =23

So the range of addresses we have 10.0.36.0 to 10.0.37.255

Given default gateway is 10.0.38.1 which is outside the range of the network. The default gateway is generally the first or second address of the range.

A default gateway is a node in a computer network using the internet protocol suite that serves as the forwarding host (router) to other networks when no other route specification matches the destination IP address of a packet.

 D

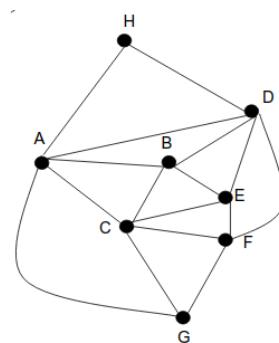
IP address and mask not compatible

Q.14)

Which of the following statements are true with respect to the following graph and its DFS traversal given below.

Subject: Algorithms

Max Marks: 1



DFS Traversal for the graph is given as H, A, C, G, F, E, B, D.

Statement I - The edge connecting A and G is both a back edge and a forward edge.

Statement II - The edge connecting C and E is a cross edge

 A

Only statement I is true

Correct Option

Solution: (A)

Solution:

According to the DFS traversal given AG acts as a back edge as this graph is an undirected graph, and forward edges are not possible in undirected graphs. Also, CE is not a cross edge because vertex C is the ancestor of vertex E in this DFS traversal.

- B Only statement II is true
- C Both statement I and statement II is true
- D Neither statement I nor statement II is true

Q.15)

Assuming the following line of code is inside the main( ) function, in which part of memory is the pointer variable **parray** allocated

```
int *parray = malloc(sizeof(int)*10);
```

Subject: C Programming

Max Marks: 1



A Stack

Correct Option

Solution: (A)

Solution: Stack

Parray is allocated in stack memory

B Heap

C Code

D Data

Q.16)

Subject: Algorithms

Max Marks: 1



Which of the following statements are TRUE

Statement I: Dijkstra's Algorithm behaves identical to BFS traversal in case of an undirected graph which has equal weights for each edge.

Statement II: Using Dijkstra's Algorithm we can detect negative weight cycles in an undirected graph.

A Only statement I is true.

Correct Option

Solution: (A)

Solution:

In case of a graph which has all vertices of equal weights then the Dijkstra's algorithm and BFS traversal are identical.

The negative weight cycles cannot be detected using Dijkstra's algorithm but they can be detected only using the Bellman-Ford algorithm.

B Only statement II is true.

C Neither statement I nor statement II is true.

D Both statement I and statement II are true.

Q.17)

Subject: Data Structures

Max Marks: 1



For what value of n, a complete binary tree can have a total number of nodes in multiple of three as the largest number and that number must be less than 100 is \_\_\_\_\_. (Assume n is the total number of nodes in complete binary tree)

Correct Answer

Solution: (99)

Explanation:

This is complete binary tree so last level can be partially filled

Level 0 -> root -> 1 node total nodes = 1

Level 1 -> 2 nodes total nodes = 3

Level 2 -> 4 nodes total nodes = 7

Level 3 -> 8 nodes total nodes = 15

Level 4 -> 16 nodes total nodes = 31

Level 5 -> 32 nodes total nodes = 63

Level 6 -> 64 nodes possible but we want total nodes less than 100

Total nodes = 99 is the answer which is less than 100 and multiple of 3 will take 7 levels.

Q.18)

How many 3 X 8 decoders are required to expand 7 X 128 decoder without using any other logic gate?

Subject: digital logic systems

Max Marks: 1



A 17

B 18

**Solution:** (c)**Solution:**

Since, M = 128

And N = 8

Therefore, number of levels =  $\text{Ceil}(\log_2 M / \log_2 N) = \text{Ceil}(\log_2 128 / \log_2 8) = \text{Ceil}(7/3) = \text{Ceil}(2.3) = 3$  levelsHence the number of decoder required are =  $\sum_{i=1 \text{ to } i=3} (M/N^i)$ 

$$\Rightarrow 128/8^1 + 128/8^2 + 128/8^3$$

$$\Rightarrow 16 + 2 + 1/4$$

Since, we cannot take  $1/4$  of a decoder we need to count it completely.Hence, the total number of 3 X 8 decoder required are  $16 + 2 + 1 = 19$ 

None of the above

Q.19)

Subject: computer organization

Max Marks: 1



Consider two different implementations, P1 and P2, of the same instruction set. There are five classes of instructions (A, B, C, D, and E) in the instruction set. The clock rate and CPI of each class is given below.

Machine	Clock rate	CPI A	CPI B	CPI C	CPI D	CPI E
P1	1.0 GHz	1	1	2	3	2
P2	1.5 GHz	1	2	3	4	3

If the number of instructions executed in a certain program is divided equally among the classes of instructions except for class A, which occurs twice as often as each of the others.

Which of the following is True

P1 is 1.072 times faster than P2.

P2 is 1.072 times faster than P1.

Correct Option

**Solution:** (B)**Explanation:**

$$P1 \text{ cycles: } 2 \times 1 + 1 + 2 + 3 + 2 = 10$$

$$\text{Execution time on P1: } \frac{10}{1} = 10 \text{ ns}$$

$$P2 \text{ cycles: } 2 \times 1 + 2 + 3 + 4 + 3 = 14$$

$$\text{Execution time on P2: } \frac{14}{1.5} = 9.33 \text{ ns}$$

$$\frac{P2 \text{ performance}}{P1 \text{ performance}} = \frac{P1 \text{ execution time}}{P2 \text{ execution time}} = \frac{10}{9.33} = 1.072$$

P2 is 1.072 times faster than P1.

P1 is 1.031 times faster than P2.

P2 is 1.031 times faster than P.

Q.20)

Subject: Theory of Computation, Compiler Design

Max Marks: 1



Consider the following CFG grammar over the non-terminals {X,Y,Z} and terminals {a,c,d} with the productions below and start symbol Z.

 $X \rightarrow a$  $X \rightarrow Y$  $Z \rightarrow d$  $Z \rightarrow X Y Z$  $Y \rightarrow c$  $Y \rightarrow \epsilon$ 

First(Z) is

{a}

{a,d}

**c** {a,c,d}

**Solution:** (c)

**FIRST(X) =**{a} **u FIRST(Y) =**{ a, c, ε }  
**FIRST(Y) =**{ c, ε }  
**FIRST(Z) = FIRST(X) u {d} =**{ a, c, d }

Correct Option

**D** {a,c,d,ε}

**Q.21)**

Consider the following code snippet:

```
main()
{
    val = 5;
    if(fork())
        wait(&val);
    val++;
    printf("%d\n", val);
    return val;
}
```

Subject: operating systems

Max Marks: 1



The output of the following program is \_\_\_\_.

Note: Marks will be given to all who attempted this question as there is ambiguity in question about whether the val is from parent or the child.

**Solution:** (?)

The parent process creates a child and then waits for the child to exit (through the system call "wait"). The child executes and prints out the value of val, which is "6" after the v++ statement. The child then returns the value of val to the parent, which receives it in the argument to "wait" (& val). The parent then prints out the value of val, which is now 7. Note that the parent and child have separate copies of the variable "val".

Correct Answer

**Q.22)**

Subject: Engineering-Mathematics

Max Marks: 1



Two cards are drawn from the pack of 52 cards. Find the probability that both are diamonds or both are kings \_\_\_\_\_. (Round your answer correct to two places after the decimal point 12.249=>12.25)

Correct Answer

**Solution:** (0.06)

**Solution:** 0.06

Total no. of ways =  $52C2$

Case I: Both are diamonds =  $13C2$

Case II: Both are kings =  $4C2$

P (both are diamonds or both are kings) =  $(13C2 + 4C2) / 52C2$

Solve the problems  $(78+6)/1326=0.063=0.06$

**Q.23)**

Subject: digital logic systems

Max Marks: 1



Which of the following corresponds to the IEEE double precision floating point representation of 0x7FF000...00 ?

**A** Not a Number

**B** +∞

**Solution:** (B)

**Solution:**

On expanding the hexadecimal number, we will get:  
 $0x7FF000...00 \Rightarrow 0111\ 1111\ 1111\ 0000\ 0000\ 0000...0000\ 0000 \Rightarrow 0\ 11111111\ 0000...00$  (total 64 bits, 1 for sign bit, 11 for exponent and 52 for mantissa)  
Since all exponent bits are 1 and mantissa bits are zero, therefore, it will result in +∞.

Correct Option

**C** -∞

**D** None of the above

Q.24)

A Computer system uses a 8-way associative cache of size 64KB, The cache block size is 16 bytes. Assume that the main memory is byte addressable and uses a 32-bit address. Then the size of the TAG memory in Bytes is\_\_\_\_\_

Subject: computer organization

Max Marks: 1

Correct Answer

**Solution:** (9728)**Explanation:**

Given that the cache size = 64KB

Each cache block/line size is =16B

Number of cache lines = 64KB/16B = 4K

Number of sets are = 4K/8 = 512

TAG	Set Number	Offset
19	9	4

TAG is associated with each cache line

The Size of the cache memory is =  $19 * 2^9 * 8$ (each set contains 8 blocks) = $19 * 512B = 9728B$ 

Q.25)

Consider the following code segment.

p=a+b

q=p-c

p=q\*d

p=e-p

q=p+q

The minimum number of variables required to convert the above code segment to static single assignment form is

Subject: Theory of Computation,Compiler-Design

Max Marks: 1

Correct Answer

**Solution:** (10)**Explanation:**

Static Single Assignment form for the given code is

 $p_1 = a + b$  $q_1 = p_1 - c$  $p_2 = q_1 * d$  $p_3 = e - p_2$  $q_2 = p_3 + q_1$ Total number of variables are  $\{p_1, q_1, p_2, p_3, q_2, a, b, c, d, e\}$ 

Q.26)

**S1 :** If G is a graph with  $|V(G)| = n \geq k+1$  and  $\delta(G) \geq (n+k-2)/2$ , then G is k-connected.

Subject: Discrete Mathematics

Max Marks: 2

**S2 :** Let G be a connected graph with all degrees even. It is not possible to show that G is 2-edge-connected

Which of the above statements are True?



S1 only

Correct Option

**Solution:** (A)**Explanation:****S1:**

**Solution:** We prove that any two non-adjacent vertices  $u, v \in V(G)$  have at least  $k$  common neighbor vertices. Then one can easily see that after removing any  $k-1$  vertices from  $G$ , if  $u$  and  $v$  are adjacent, we are done, otherwise they still have at least one common neighbor, so the graph remains connected. Denote the set of neighbor vertices of  $u, v$  by  $N(u), N(v)$ , respectively. Since we have  $|N(u) \cup N(v)| \leq n-2$ , we get

$$n-2 \geq |N(u)| + |N(v)| - |N(u) \cap N(v)| \geq 2 \cdot \frac{n+k-2}{2} - |N(u) \cap N(v)| = n+k-2 - |N(u) \cap N(v)|.$$

Therefore, we have  $k \leq |N(u) \cap N(v)|$ .**S2:**

As G is connected with all degrees even, it has an Euler tour. Deleting any edge from an Euler tour results in an Euler trail. So  $G-e$  has an Euler trail and all its vertices have positive degree, so it is connected. As this is true for any edge  $e$ , G

is a 2-edge-connected graph.

B S2 only

C Both S1 and S2

D None of the above

Q.27)

A full adder is implemented using EX-OR, AND, OR gates. The propagation delay of AND and OR gates are half of that of EX-OR gate.

The propagation delay of EX-OR is given as 2ms. A 4-bit ripple carry adder is implemented using 4 full adders. The total propagation delay of the 4-bit ripple carry adder will be

Note: The input given to gates used for construction of full adder is not restricted to 2. The gates have fan-in more than 2.

Subject: digital logic systems

Max Marks: 2



**Solution:** (8)

**Solution:** 8ms

In order to compute the sum we need one 3-input EX-OR gate which will take 2ms. While for computing the carry the circuit will have 2 level AND, OR gates, thus the time taken to compute a carry in single full adder will be 2ms.

Since, we need to find the delay for 4-bit ripple carry adder, the total delay will be:

$$3 * \text{Carry delay} + \text{Sum delay} = 3 * 2 + 2 = 8\text{ms}$$

Correct Answer

Q.28)

Which of the following languages is/are Regular

- I. Let  $B = \{a^k \mid \text{Where } k \text{ is a multiple of } n\}$
- II. Let  $C = \{x \mid x \text{ is a binary number which is a multiple of } n\}$

A I Only

B II Only

C Both I and II

Correct Option

**Solution:** (c)

**Explanation:**

- I. Let  $B = \{a^k \mid \text{Where } k \text{ is a multiple of } n\}$   
Let  $n=2$ , then multiples of 2 are  $\{0, 2, 4, 6, \dots\}$   
The strings in the language are  $\{\epsilon, aa, aaaa, aaaaaa, \dots\}$   
Series in the arithmetic progression and one input symbol. The given language is a Regular.
- II.  $C = \{x \mid x \text{ is a binary number which is a multiple of } n\}$   
Let  $n=3$  then the multiples of 3 are  $\{0, 3, 6, \dots\}$   
Binary representation of the strings are  $\{0000, 011, 110, 1001, \dots\}$   
The Transition diagram for the given problem is

	0	1
$\rightarrow *q_0$	$q_0$	$q_1$
$q_1$	$q_2$	$q_0$
$q_2$	$q_1$	$q_2$

C is also Regular language.

D Neither I nor II

Q.29)

There are two nodes on a network C and S. C is the client and S is the server. C wants to connect to S and send a message that is 35

kilobytes long using TCP. Assume that a single packet can hold up to 2 kilobytes of data and the headers are negligibly small. Processing time at both ends of the connection is negligible, but the propagation time between node C and node S is 5 ms. The link transmission rate is 10 Megabits per second. consider all kinds of delays SYN, ACK is negligible. Also, assume that the connection starts off in the slow start stage and that there is no packet loss. How much time it will take to send 36 KB data in millisec [ Take the sealed value if the answer is in decimal]

Subject: Computer Networks

Max Marks: 2



Correct Answer

**Solution:** (54)

**Explanation:**

First transmission 1 packet :  $T_t = 2KB / 10 Mbps + Pt$

Second transmission 2 packet :  $T_t = 4KB / 10 Mbps + Pt$

Third transmission 4 packet:  $T_t = 8 KB / 10 Mbps + Pt$

Forth transmission 8 packet:  $T_t = 16 KB / 10 Mbps + Pt$

Fifth transmission only 3 packets left:  $T_t = 6 KB / 10 Mbps + Pt$

In total =  $36KB / 10Mbps + 5 Pt$

Total time = 28.8 mili sec + 25 mili sec = 53.8 mili sec

**Q.30)**

Subject: DBMS

Max Marks: 2



Let the order of B-tree is 30 and the B-tree is 65% full. The number of entries the 2<sup>nd</sup> level of B-tree holds is

Note: An entry in B-tree corresponds to <key, data pointer>

**A**

8000

**B**

7999

**C**

8420

**D**

None of the above

Correct Option

**Solution:** (D)

**Solution:**

The order given = 30 and the B-tree node is 65% full. Therefore, order of B-tree according to the utilization will be  $0.65 * 30 = 19.5 = 20$

So, at level 0 (Root): 19 keys

At level 1:  $20 * 19$  keys = 380 keys

At level 2:  $20 * 20 * 19$  keys = 7600 keys

Hence, total keys =  $19 + 380 + 7600 = 7999$  keys

**Q.31)**

Subject: Discrete Mathematics

Max Marks: 2



**S1 :** Every cyclic group is not abelian.

**S2 :** Let G be an abelian group and let H be the subset of G consisting of all elements of G of finite order.

That is,

$H = \{a \in G \mid \text{the order of } a \text{ is finite}\}$ .

Then H is a subgroup of G.

Which of the above statements are True?

**A**

S1 only

**B**

S2 only

Correct Option

**Solution:** (B)

**Explanation:**

**S1 :**

Let  $G$  be a cyclic group with a generator  $g \in G$ .

Namely, we have  $G = \langle g \rangle$  (every element in  $G$  is some power of  $g$ .)

Let  $a$  and  $b$  be arbitrary elements in  $G$ .

Then there exists  $n, m \in \mathbb{Z}$  such that  $a = g^n$  and  $b = g^m$ .

It follows that

$$ab = g^n g^m = g^{n+m} = g^m g^n = ba.$$

Hence we obtain  $ab = ba$  for arbitrary  $a, b \in G$ .

Thus  $G$  is an abelian group.

S2:

Note that the identity element  $e$  of  $G$  has order 1, hence  $e \in H$  and  $H$  is not an empty set.

To show that  $H$  is a subgroup of  $G$ , we need to show that  $H$  is closed under multiplications and inverses.

Let  $a, b \in H$ .

By definition of  $H$ , the orders of  $a, b$  are finite.

So let  $m, n \in \mathbb{N}$  be the orders of  $a, b$ , respectively:

We have

$$a^m = e \text{ and } b^n = e.$$

Then we have

$$\begin{aligned} (ab)^{mn} &= a^{mn}b^{mn} && \text{since } G \text{ is abelian} \\ &= (a^m)^n(b^n)^m \\ &= e^n e^m = e. \end{aligned}$$

This implies that the order of  $ab$  is at most  $mn$ , hence the order of  $ab$  is finite.

Thus  $ab \in H$  for any  $a, b \in H$ .

Next, consider any  $a \in H$ . We want to show that the inverse  $a^{-1}$  also lies in  $H$ .

Let  $m \in \mathbb{N}$  be the order of  $a$ .

Then we have

$$(a^{-1})^m = (a^m)^{-1} = e^{-1} = e.$$

This implies that the order of  $a^{-1}$  is also finite, and hence  $a^{-1} \in H$ .

Therefore we have proved that  $H$  is closed under multiplications and inverses.

Hence  $H$  is a subgroup of  $G$ .

Both S1 and S2

None of the above

Q.32)

Subject: DBMS

Max Marks: 2



Suppose we have an Employee relation with attributes(id, name, dept) which represent employee id, employee name and department id respectively. Consider another relation Department with attributes (dept, name) corresponding to department id and department name. If we want to join the relation based on dept attribute (of Employee relation) and dept attribute (of Department relation) and project the department id's, such that the resultant table does not contain duplicate column names then which of the following relational operators are needed?

$\rho, \pi$

$\rho, \sigma$

$\bowtie$

$\rho, \bowtie, \pi$

Correct Option

Solution: (D)

Solution:

In order to project only the department id of both the relation we need projection operation which is performed over the result of Employee NATURAL JOIN Department.

Since both the columns have same name, therefore, in order to distinguish them we will rename it using rename operation.

Hence, (iv) option is correct.

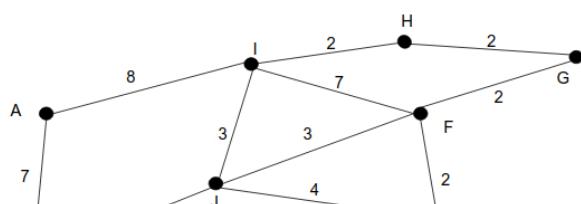
Q.33)

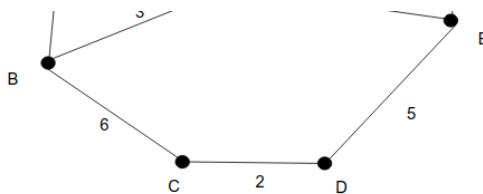
Subject: Algorithms

Max Marks: 2



The cost the MST represented by the graph below is \_\_\_\_\_



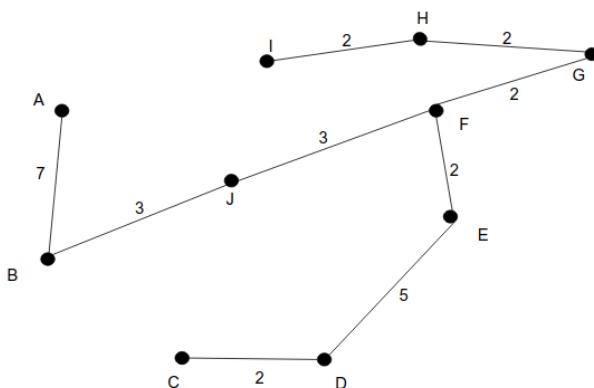


Correct Answer

**Solution:** (28)

**Solution:** 28

Applying Kruskal's algorithm we get the following minimal spanning tree.



Cost of MST = 2 + 5 + 2 + 2 + 2 + 3 + 3 + 7 = 28.

Q.34)

The solution for the recurrence relation

$$T(n) = \sqrt{3}T(n/2) + O(\sqrt{n} \log n)$$

A

$$O(\log n)$$

B

$$O(\log^2 n)$$

C

$$O(n)$$

Correct Option

**Solution:** (C)

**Solution:**

$$a = \sqrt{3}, b = 2, k = 1/2, p = 1$$

Applying Masters Theorem we get

$$T(n) = \Theta(n^{\log_2 \sqrt{3}}) = \Theta(n^{0.79})$$

Option A  $\log n$  grows slower than  $n^{0.79}$ , therefore, it is not appropriate.

Option B  $\log^2 n$  also grows slower than  $n^{0.79}$ , therefore, it is not appropriate.

Option C  $n$  also grows faster than  $n^{0.79}$ , therefore, it is appropriate.

D

None of the above

Q.35)

Given below are two statements:

S1 : Consider the environment where many user-level threads are mapped to a single kernel thread (i.e., the many-to-one model). Sometimes, it is possible for the one-to-one model to outperform this model.

S2 : A page cannot be in two working sets at the same time.

Which of the following option(s) is/are correct?

A

S1 only

Correct Option

**Solution:** (A)

**Explanation:**

S1 : The chief benefit of the one-to-one model over the many-to-one model is that it allows for more concurrency within a program. In the many-to-one model, if a thread makes a blocking system call, all the threads of that process have to wait to be scheduled again.

Clearly, any environment where threads make frequent system calls is one where the one-to-one model outperforms many-to-one. Therefore, S1 is true.

S2 : If pages can be shared, yes it is possible.

For example, if two users of a timesharing system are running the same editor at the same time, and the program text is shared rather than copied, some of those pages may be in each user's working set at the same time.

Therefore, S2 is false.

- B S2 only
- C Both S1 and S2
- D None of the above

Q.36)

The solution for the system of linear equations is  $x_1, x_2, x_3$  then the value of  $x_1x_2 + x_2x_3 + x_3x_1 = \underline{\hspace{2cm}}$ .

$$2x_1 + 3x_2 + 4x_3 = 38$$

$$x_1 + x_2 + x_3 = 14$$

$$10x_1 + 12x_2 + x_3 = 121$$

Subject: Engineering-Mathematics

Max Marks: 2

Correct Answer

Solution: (61)

**Solution : 61**

Solving the matrix by Gauss Elimination method.

$$\left( \begin{array}{ccc|c} 2 & 3 & 4 & 38 \\ 1 & 1 & 1 & 14 \\ 10 & 12 & 1 & 121 \end{array} \right) \xrightarrow{\text{R}_2 - \frac{1}{2}\text{R}_1} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 38 \\ 0 & \frac{-1}{2} & -1 & -5 \\ 10 & 12 & 1 & 121 \end{array} \right) \xrightarrow{\times(-5)} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 38 \\ 0 & \frac{-1}{2} & -1 & -5 \\ 0 & -5 & 1 & 69 \end{array} \right) \xrightarrow{\text{R}_3 - 5 \times \text{R}_1} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 38 \\ 0 & \frac{-1}{2} & -1 & -5 \\ 0 & -3 & -4 & 69 \end{array} \right) \xrightarrow{\times(-6)} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 38 \\ 0 & \frac{-1}{2} & -1 & -5 \\ 0 & 1 & 8 & -41 \end{array} \right) \xrightarrow{\text{R}_2 - \frac{1}{2}\text{R}_1} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 38 \\ 0 & 0 & 7 & -46 \\ 0 & 1 & 8 & -41 \end{array} \right)$$

Find the variable  $x_3$  from the equation 3 of the system (1):

$$-13x_3 = -39$$

$$x_3 = 3$$

Find the variable  $x_2$  from the equation 2 of the system (1):

$$\frac{-1}{2}x_2 - 5 + x_3 = -5 + 3 = -2$$

$$x_2 = 4$$

Find the variable  $x_1$  from the equation 1 of the system (1):

$$2x_1 - 38 - 3x_2 - 4x_3 = 38 - 3 \times 4 - 4 \times 3 = 14$$

$$x_1 = 7$$

$x_1 = 7, x_2 = 4, x_3 = 3$ . The required sum =  $7*4 + 4*3 + 3*7 = 61$ .

Q.37)

**Consider the following two statements:**

**S1 :** An ancient Sicilian legend says that the barber in a remote town who can be reached only by traveling a dangerous mountain road shaves those people, and only those people, who do not shave themselves. Such a barber exists.

**S2:**  $(p \rightarrow q) \vee (p \rightarrow r)$  and  $(p \rightarrow (q \vee r))$  are logically Equivalent.

Which of the above statements are True?

Subject: Discrete Mathematics

Max Marks: 2

- A S1 only
- B S2 only

Correct Option

Solution: (B)

**Explanation:**

Converting the paradox into a logical sentence,

$N(y) : y$  do not shave by himself.

$S(x, y) : x$  shaves  $y$ .

$\exists x (\forall y (N(y) \leftrightarrow S(x, y)))$

If UOD is set of all human beings, a female barber  $x$  exists and truth value is TRUE.

If UOD is set of all males and they shaves, then who will shave the barber. If he shaves himself, then sufficiency is violated. If  $x$  do not shave himself, then barber will shave him. This violates necessity and hence such a barber cannot exist.

$$\text{L.H.S} : (p \rightarrow q) \vee (p \rightarrow r)$$

$$\leftrightarrow (\neg p \vee q) \vee (\neg p \vee r)$$

$\leftrightarrow (\neg p \vee \neg p) \vee (q \vee r)$  (By Associativity property)

$\leftrightarrow \neg p \vee (q \vee r)$  (by the property  $(p \vee p \rightarrow p)$ )

$$\leftrightarrow (p \rightarrow (q \vee r))$$

Hence proved.

- C Both S1 and S2
- D None of the above

Q.38)

Subject: Theory of Computation, Compiler Design

Max Marks: 2

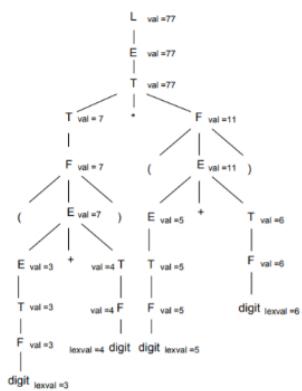
Given the Syntax-Directed Definition below with the synthesized attribute val,

$L \rightarrow E$	$L.val = E.val$
$E \rightarrow T$	$E.val = T.val$
$E \rightarrow E_1 + T$	$E.val = E_1.val + T.val$
$T \rightarrow F$	$T.val = F.val$
$T \rightarrow T_1 * F$	$T.val = T_1.val * F.val$
$F \rightarrow ( E )$	$F.val = E.val$
$F \rightarrow \text{digit}$	$F.val = \text{digit}.lexval$

The output produced by the given SSD for the expression  $(3+4) * (5+6)$  is \_\_\_\_\_

Correct Answer

Solution: (77)

**Explanation:**

Q.39)

Subject: operating systems

Max Marks: 2

Consider the following set of processes each with a specified CPU burst and fixed priority:

Process	CPU Burst (in units)	Priority
P1	3	4
P2	5	2
P3	2	5
P4	1	3
P5	4	1

Assume that the processes arrive in the order P1, P2, P3, P4, and P5 all at time 0.

The difference in the average waiting time when one scheduler implements an SJF and the other implements non-preemptive priority algorithm is \_\_\_\_\_ units.

**NOTE:** 1 > 2 > 3 > 4 > 5 is the order of priority.

Correct Answer

Solution: (3.2)

**Explanation:**

SJF



The waiting time (in units) for P1 = 3, P2 = 10, P3 = 1, P4 = 0, P5 = 6.

The average waiting time is :

$$(3 + 10 + 1 + 0 + 6) / 5 = 4 \text{ units}$$

**nonpreemptive priority**

P5	P2	P4	P1	P3
0	4	9	10	13

The waiting time (in units) for P1 = 10, P2 = 4, P3 = 13, P4 = 9, P5 = 0.

The average waiting time is :  
 $(10 + 4 + 13 + 9 + 0) / 5 = 7.2$  units

Therefore, the difference between the average waiting time between non-preemptive priority and SJF is  $(7.2 - 4) = 3.2$  units

Q.40)

Subject: C Programming

Max Marks: 2

Match the following cases on how many bytes of memory are allocated for each of the following variables? Assume that a character takes 1 byte, integer takes 2 bytes, and floating point number takes 4 bytes.

- |                                       |       |
|---------------------------------------|-------|
| 1. float a[ ] = {4.7};                | a. 40 |
| 2. char a[ ] = "4.7";                 | b. 4  |
| 3. union { int x, float y}<br>number; | c. 3  |
| 4. Int c[10] = { 1, 2, 3};            | d. 6  |
|                                       | e. 1  |

A

1-b, 2-e, 3-d, 4-d

B

1-b, 2-c, 3-b, 4-d

C

1-b, 2-c, 3-b, 4-b

D

None of these

Correct Option

**Solution:** (D)**Solution:** None of these

1-b, 2-b, 3-b, 4-a

[1] float a[] = {4.7};

Answer: 4 (one float)

[2] char a[] = "4.7";

Answer: 1\*4=4 (four characters including '\0')

[3] char animals[] [10] = {"lion", "elephant", "tiger", "cat"};

Answer: 1\*10\*4=40 (four arrays containing 10 characters)

[4] union {int x; float y} number;

Answer: 4 (size of largest type = float)

[5] int c[10] = {1,2,3};

Answer: 10\*4=40 (ten integers)

Q.41)

Subject: Engineering-Mathematics

Max Marks: 2

There are 7 students in a class and 7 separate tables for each of them and they have their places allocated according to their roll number, however during the examination time the places of the students have to be changed such that none of the students can take their original place. In how many ways can the examiner arrange the students on an exam day.

A

5039

B

1854

Correct Option

**Solution:** (B)**Solution:**

The number of ways the 7 students can be arranged such that none of them are

in their original place is given by the number of derangements i.e.  $!7$  which is given by

$$!n = n (!!(n - 1)) + (-1)^n$$

Substituting the value of  $n=7$  we get  $!7=1854$ .

C 3186

D None of the Above

Q.42)

Consider the following fragment of code.

```
int main()
{
    int sum=0,sum2=0,sum1=0;
    for(i=0;i<=5*n;i+=(n))
    {
        for(j=0;j<=n;j++)
            sum+=1;
        for(j=0;j<=n;j++)
            sum1+=n;
        for(j=1;j<=n;j=j*2)
            sum2+=n;
    }
    sum=sum+sum1+sum2;
}
```

Which of the following values accurately describes the value stored in the variable sum.

A  $O(n)$

B  $O(n \log n)$

C  $O(n^2)$

Correct Option

Solution: (c)

**Solution:**

Here the outer loop will execute only 5 times.

Inside this loop, we have 3 loops

1. The first loop will execute  $n$  times and each time 1 is added to sum this comes to  $n$ .
2. In the second loop will execute  $n$  times and each time  $n$  is added to sum this totals to  $n^2$ .
3. In the third loop will execute  $\log n$  times and each time  $n$  is added to sum, this totals up to  $n \log n$ .

The total after 5 iterations the total adds up to  $5*(n+n^2+n \log n)$ , in terms of asymptotic notation it comes to  $O(n^2)$ .

D None of the above

Q.43)

Consider a sliding window flow control protocol between hosts A and B. Suppose a link propagation delay is a 1-time unit, and the window size is 3. Assume the link drops every third data packet, i.e., the link drops the 1st, 4th, 7th, ... data packets. (Note that here "kth packet" means the kth packet transmitted on the link and not the sequence number of the packet.) How long does it take to transmit 6 packets between A and B?

(Note: Ignore the transmission times and the queueing delay, and assume that no acknowledgments are lost. When a packet is lost will resend the lost packet only)

Solution: (5)

Explanation:

Initially, we send three packets 1,2,3 which will take a 1-time unit

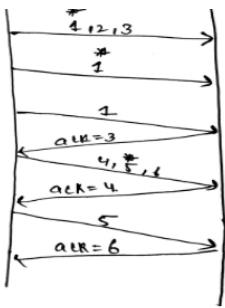
Packet 1 is lost we retransmit it will take the 1-time unit.

Again packet 1 is lost it will take the 1-time unit.

Now we send three packets 4,5,6 which will take the 1-time unit.

Packet 5 is lost we retransmit it will take a 1-time unit

Correct Answer



Q.44)

Consider the following schedule with two transaction T1 and T2 along with their timeline:

Subject: DBMS

Max Marks: 2

	1	2	3	4	5	6	7	8	9
T1	R(A)			W(B)				R(B)	C1
T2		R(A)	W(A)		R(B)	W(B)	C2		

Which of the following statements is true about the above transaction?

A

Deletion of R1(B) at timestamp 8 will lead to a conflict serializable and cascadeless schedule.

B

Deletion of R2(B) at timestamp 5 will lead to a conflict serializable and cascadeless schedule.

C

Deletion of R2(B) at timestamp 5 will lead to a non-conflict serializable and cascadeless schedule.

Correct Option

Solution: (C)

**Solution:**

- I. Deletion of R1(B) at timestamp 8:

It will lead to a conflict serializable schedule  $T1 \rightarrow T2$ , but it will not give a cascadeless schedule as there is a presence of dirty/uncommitted read R2(B) at time stamp 5.

- II. Deletion of R2(B) at time stamp 5:

It will lead to a non conflict serializable schedule as  $T1 \rightarrow T2$  and  $T2 \rightarrow T1$  (due to  $W2(B) \rightarrow R1(B)$ ). But it will be cascadeless as there will be no uncommitted reads if we remove R1(B) at timestamp 5.

D

Deletion of R1(B) at timestamp 8 will lead to a non-conflict serializable and non-cascadeless schedule.

Q.45)

The solution for the given system of linear equations is not unique then the sum of all the possible values of  $k = \underline{\hspace{2cm}}$ .

$$kx + 2y + 3z = 0$$

$$6x + ky + 3z = 0$$

$$9x + 5y + kz = 0$$

Subject: Engineering-Mathematics

Max Marks: 2

Solution: 0

**Solution:** 0

If the system of linear equations does not have a unique solution then the determinant of the coefficient matrix is equal to 0.

$$\begin{vmatrix} k & 2 & 3 \\ 6 & k & 3 \\ 9 & 5 & k \end{vmatrix} = 0$$

Correct Answer | Attempted

On simplification it gives  $k^2 - 54k + 90 = 0$

The sum of the roots of the equation  $ax^3 + bx^2 + cx + d = 0$  is given by  $-b/a$ , therefore the sum of the possible values of  $k=0$ .

Q.46)

Consider the following code fragment:

Loop: LD R2,4(R1) ; load R2 from address 4+R1

LD R3,0(R2) ; load R3 from address 0+R2

DADD R3,R1,R2 ; R3=R1+R2

BNEZ R3,Loop ; branch to loop if R3 != 0

Use the classic MIPS five-stage integer pipeline. Assume all memory

accesses take 1 clock cycle, conditional branch is handled by predicted to be taken, and a register may be read and written in the same clock cycle.

Calculate the number of clock cycles required for the completion of one iteration. Assume normal forwarding and bypassing hardware

Subject: computer organization

Max Marks: 2



Correct Answer

Solution: (10)

	1	2	3	4	5	6	7	8	9	10
LD	IF	ID	EX	M	WB					
LD		IF	ID	—	EX	M	WB			
DADD			IF	—	ID	—	EX	M	WB	
BNEZ					IF	—	ID	EX	M	WB

Instruction 2 is dependent instruction on I1. At clock cycle 4 I1 is accessing the memory, we need to stall for the result, before starting execution of I2.

Q.47)

Given a function  $F(A, B, C, D) = C' + A'D' + BD'$ , which of the following is the correct number of functions covering F?

Subject: digital logic systems

Max Marks: 2



16



30



64



32

Correct Option

Solution: (D)

**Solution:**

On expanding the given function F we will get:

$$\Rightarrow C'(A + A')(B + B')(D + D') + A'D'(B + B')(C + C') + BD'(A + A')(C + C')$$

On expanding this we will get:

$$\Rightarrow A'B'C'D' (M_0) + A'B'C'D(M_1) + A'BC'D'(M_4) + A'BC'D(M_5) + ABC'D'(M_{12}) + ABC'D(M_{13}) + AB'C'D'(M_8) + AB'C'D(M_9) + A'B'CD'(M_2) + A'BCD'(M_6) + ABCD'(M_{14})$$

Since, there are total 11 minterms covered by F. Total number of minterms with 4 binary variables are  $2^4 = 16$ . Therefore, the remaining minterms which should be covered by covering function are  $= 16 - 11 = 5$

Hence, the total number of functions which covers F are  $= 2^5 = 32$ .

Q.48)

Given that  $L_1$  is a Regular language,  $L_2$  is Context free language and  $L_3$  is a Recursive language.

Subject: Theory of Computation,Compiler-Design

Max Marks: 2

Which of the following is/are True

- I.  $L_1 \cap L_2$  is Regular
- II.  $L_1^* \cap L_3$  is Regular
- III.  $L_1^* \cap L_3$  is Recursive
- IV.  $L_2 \cap L_1$  is CFL



I and II Only



II and III Only

**Solution:** (c)**Explanation:**L<sub>1</sub> is a Regular languageL<sub>2</sub> is Context free languageL<sub>3</sub> is a Recursive language

- i. L<sub>1</sub> ∩ L<sub>2</sub> is Regular      False

CFLs are closed under intersection operation with regular languages. Result is CFL but not Regular.

- ii. L<sub>1</sub> ∩ L<sub>3</sub> is Regular False

L<sub>3</sub> is Recursive language and closed under complement operation.

Let L<sub>1</sub> = (a+b+c)\* then L<sub>1</sub>\* = (a+b+c)\* and L<sub>3</sub> = {a<sup>n</sup>b<sup>n</sup>c<sup>n</sup> | n ≥ 0} ⇒ L<sub>1</sub>\* ∩ L<sub>3</sub> = L<sub>3</sub>

Which is Recursive.

- iii. L<sub>1</sub> ∩ L<sub>3</sub> is Recursive True.

- iv. L<sub>2</sub> ∩ L<sub>1</sub> is CFL True.

CFLs are closed under intersection operation with regular languages. Result is CFL but not Regular.

**Q.49**

Consider the following program

Subject: C Programming

Max Marks: 2

```
int ABC(unsigned int X, unsigned int Y)
{
    If (X-Y>0)
        return 1;
    else
        return 0;
}
```

Which is best suitable choice that explains the behaviour of this program?

Returns 1 if X is greater than Y

Returns 1 if X is less than Y

Returns 0 if X is divisible by Y

None of these

Correct Option

**Solution:** (D)**Solution:** None of these**Q.50**

Subject: computer organization

Max Marks: 2

A byte-addressable computer has a small data cache capable of holding eight 32-bit words. Each cache block consists of one 32-bit word. When a given program is executed, the processor reads data from the following sequence of hexadecimal addresses: 200, 204, 208, 20C, 2F4, 2F0, 200, 204, 218, 21C, 24C, 2F4.

If the pattern is repeated for two times then the total number of misses are\_\_\_\_

Assume that all the cache blocks are initially empty.

Correct Answer

**Solution:** (11)**Explanation:**

Each cache block consists of 32-bit word ⇒ 1 word = 4B

Number of cache blocks/lines = 8\*32/32 = 8

Number of bits to represent the Byte in the word = 2

Number of bits for the cache line=3

Address bits are =32

TAG	Cache Line	Offset
27	3	2

Given addresses are 200, 204, 208, 20C, 2F4, 2F0, 200, 204, 218, 21C, 24C, 2F4.

200 ⇒ 0010 000 (0 00) (00) First Two bits will represent the Byte in the

block and the next three bits will represent the block number and the remaining are TAG bits.

In the first iteration number of hits are 200, 204, 2F4

$24C \Rightarrow 0010\ 010(0\ 11)(00) \Rightarrow$  will refer the third block need to replace with 24C

200	204	208	20C	2F4	2F0	200	204	218	21C	24C	2F4
Mis s	Mis s	Mis s	Mis s	Mis s	Mis s	Hit	Hit	Mis s	Mis s	Mis s and repl ce 20C	Hit

For the second iteration the number of hits are

200	204	208	20C	2F4	2F0	200	204	218	21C	24C	2F4
Hit	Hit	Hit	Mis s and repl ce	Hit	Hit	Hit	Hit	Hit	Hit	Mis s and Rep lace	Hit

Total number of hits are  $3+10 = 13$

Total number of Misses are  $9+2 = 11$

Q.51)

Which of the following languages are CFLs

- I.  $L_1 = \{a^i b^{2i} a^i \mid i \geq 0\}$
- II.  $L_2 = \{ww^R w \mid w \in \{a, b\}^*\}$

A Both I and II

B I only

C II only

D Neither I nor II

Subject: Theory of Computation, Compiler-Design

Max Marks: 2

Correct Option

Solution: (D)

**Explanation:**

$$L_1 = \{a^i b^{2i} a^i \mid i \geq 0\}$$

Assume that language  $L = \{a^i b^{2i} a^i \mid i \geq 0\}$  is context-free. By the pumping lemma, there is a number  $k$  such that every string in  $L$  with length  $k$  or more can be written  $uvwxy$  where

- (i)  $\text{length}(vwx) \leq k$
- (ii)  $v$  and  $x$  are not both null
- (iii)  $uv^iwx^iy \in L$  for all  $i \geq 0$ .

The string  $z = a^k b^{2k} a^k$  must have a decomposition  $uvwxy$  that satisfies the preceding conditions. Consider the string  $uv^2wx^2y$  obtained by pumping  $uvwxy$ . Since by assumption  $uv^2wx^2y \in L$ , we must have that the union of  $v$  and  $x$  contains both a type  $a$  and a type  $b$  of terminals. Otherwise it only increases one type of terminal while keeping the other the same, thereby no longer in  $L$ . Furthermore, condition (i) requires the length of  $vwx$  to be at most  $k$ . This implies that the substring  $vwx$  of  $z$  cannot contain  $a$ 's from both sides of the  $b$ 's substring. Therefore  $uv^2wx^2y$  only increases the number of  $a$ 's either preceding or after  $b$ 's, but not both. Hence  $uv^2wx^2y \notin L$ , and consequently,  $L$  is not context-free.

$$\text{II. } L_2 = \{ww^R w \mid w \in \{a,b\}^*\}$$

Non-CFL, require more than one stack to check the equality between  $WW^R$  and  $W^R W$  and  $WW$ .

Q.52)

Consider a memory-management system based on paging. Let the total size of the physical memory be 2GB laid out over pages of size 4KB. Let the logical address space of each process be limited to 128MB.

The size of each page table entry is \_\_\_\_\_ bits

Subject: operating systems

Max Marks: 2

Correct Answer

**Solution:** (19)

**Explanation :**

The total physical memory size is 2GB, so each physical address requires 31 bits. The page size is 4KB, requiring 12 bits of displacement in each address. Thus, the physical address layout is 31 bits, including 19 bits for the page frame number and 12 bits of displacement.

Note that there are 512K page frames in the system. The logical address space for each process is 128MB, requiring a total of 27 bits. The page size is the same as that of the physical pages (i.e., 4KB).

Therefore the logical address layout is 27 bits, with 15 bits for page number and 12 bits for displacement. Note that there are 32K pages in the address space of each process.

Each page table should contain as many entries as there are logical pages in the address space of each process. Therefore, there are 32K entries in each page table.

Since the page frame number has 19 bits, the length of each entry in the page table is 19 bits. Since nothing else is mentioned, we don't consider valid/invalid bits etc.

**Q.53)**

The sum of the lengths of all the longest common subsequences for the given pair of strings is \_\_\_\_.

Subject: Algorithms

Max Marks: 2

"ationrili"

"nanatrlil"

Correct Answer

**Solution:** (16)

**Solution:** 16

The DP Matrix for the longest common subsequence for the two strings are given below

	0	a	t	i	o	n	r	i	l
0	0	0	0	0	0	0	0	0	0
n	0	0	0	0	0	1	1	1	1
a	0	1	1	1	1	1	1	1	1
n	0	1	1	1	1	2	2	2	2
a	0	1	1	1	1	2	2	2	2
t	0	1	2	2	2	2	2	2	2
r	0	1	2	2	2	2	3	3	3
i	0	1	2	2	2	2	3	3	4
i	0	1	2	3	3	3	3	4	4

From the above table, we can infer that the longest common subsequences are

anri

anrl

atri

atrl

Length of each is 4 characters, the sum of the lengths is  $4*4=16$  characters.

**Q.54)**

Which of the following conditions must a public key cryptosystem meet?

Subject: Computer Networks

Max Marks: 2

A

It must be computationally infeasible to derive the private key from the (respective) public key.

Correct Option

**Solution:** (A)

**Explanation:**

Yes true, because the private key is used for decryption which should only known to the receiver and by using the public key it should not be possible to derive the private key.

False, because ciphertext was obtained from the public key, not the private key.

If it is infeasible to extract plain text from the private key then it is not the public key cryptography.

B

It must be computationally infeasible to extract the plaintext by using the public key from the ciphertext was obtained using the private key.

C

It must be computationally infeasible to extract the plaintext by using the private key from the ciphertext was obtained using the public key.

D

None of the above

**Q.55)**

If we are making tree such that right child of every node is pointing to its in-order successor then what will be the advantages of doing this.

Subject: Data Structures

Max Marks: 2

A

Making tree with less space complexity.

B

use of stack and recursion will be easy.

C

Pre-order traversal will be faster.

D

In-order traversal will be faster.

Correct Option

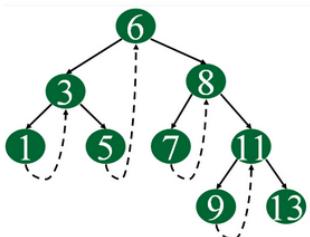
Solution: (D)

Solution: (a)

Explanation:

In-order traversal will be faster.

Inorder traversal of a Binary tree can either be done using recursion or with the use of an auxiliary stack. The idea of threaded binary trees is to make inorder traversal faster and do it without stack and without recursion. A binary tree is made threaded by making all right child pointers that would normally be NULL point to the inorder successor of the node (if it exists).



Q.1)

Identify the error in the sentence given below.

Subject: General Aptitude

Max Marks: 1

A The games scheduled to be held in the State

B have been plunged into crisis just two months prior the

Correct Option

Solution: (B)

Solution:

The preposition 'to' is missing in the second part of the sentence. It should be '..just two months prior to the.' and not '.. just two months prior the..?'

C shoddy workmanship and delays in handing over venues

D No error

Q.2)

I am an entertainer. (.....), I have to keep smiling because, in my heart, laughter and sorrow have an affinity.

From among the answer choices given, select the sentence that can fill the blank to form a coherent paragraph.

Subject: General Aptitude

Max Marks: 1

A While entertaining people

B Even though I am depressed inside.

C Even if I have tears in my eyes.

Correct Option

Solution: (C)

Solution:

The key to this question is the phrase 'I have to keep smiling'. Obviously, before this phrase, we require something that conveys the opposite meaning and lends a sense of completion to the sentence. We find this is option C.

D In the entertainment business.

Q.3)

H and M started a business investing amounts in the ratio of 2:3 respectively. If H had invested an additional amount of Rs. 10000, the ratio of investment would have been 3:2. What was the amount invested by H?

Subject: General Aptitude

Max Marks: 1

A 18000

B 12000

C 8000

Correct Option

Solution: (C)

**Solution:** Let the initial investment done by H and M be  $2x$  and  $3x$  respectively.

So as per the question, we can say that,

$$\frac{2x+10000}{3x} = \frac{3}{2}$$

$$\Rightarrow 4x + 20000 = 9x$$

$$\Rightarrow 5x = 20000$$

$$\Rightarrow x = 4000$$

H had invested  $2x$ , i.e.,  $2 * 4000 = ₹ 8000$

D None of these

Q.4)

Subject: General Aptitude

Max Marks: 1

Select an appropriate antonym for **Austere**.

**A** Lavish

Correct Option

**Solution:** (A)

**Solution:**

Austere means simple and unadorned while lavish means produced or expended in abundance. Option A is thus the right choice.

**B** unfavorable

**C** light

**D** devout

**Q.5)**

Find the compound interest at the rate of 10% for 3 years on that principal which in 3 years at the rate of 10% per annum gives Rs. 300 as simple interest.

Subject: General Aptitude

Max Marks: 1

**A** 331

Correct Option

**Solution:** (A)

**Solution:** Simple Interest = (Principle \* Time \* Rate)/100

$$300 = \frac{P \times 3 \times 10}{100}$$

$$\Rightarrow P = \text{₹} 1000$$

$$\text{Amount} = P[1 + \frac{r}{100}]^n$$

$$= 1000[1 + \frac{10}{100}]^3$$

$$= 1000[1 + .1]^3$$

$$= 1000 * 1.331$$

$$= \text{₹} 1331$$

$$\text{Compound Interest} = A - P$$

$$= 1331 - 1000 = \text{₹} 331$$

**B** 330

**C** 333

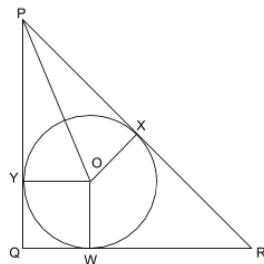
**D** 310

**Q.6)**

In the given diagram PQR is an isosceles right angle triangle with the center O touches the side QR at W, PR at X and PQ at Y. If  $PR = 3\sqrt{2} \text{ cm}$ , then what is the area of quadrilateral PYOX?

Subject: General Aptitude

Max Marks: 2



**A**  $9(\sqrt{2} + 1) \text{ cm}^2$

**B**  $9(\sqrt{2} - 1) \text{ cm}^2$

**C**  $\frac{9}{2}(\sqrt{2} + 1) \text{ cm}^2$

**D**  $\frac{9}{2}(\sqrt{2} - 1) \text{ cm}^2$

Correct Option

**Solution:** (D)

**Solution:**  $PR = 3\sqrt{2} \text{ cm}$

$PQ = QR = 3 \text{ cm}$

In-circle of an isosceles right angle triangle touches the hypotenuse at its midpoint.

So,  $PX = XR = \frac{3}{2}\sqrt{2} \text{ cm}$

And  $WR = XR = \frac{3}{2}\sqrt{2} \text{ cm}$

$QW = QR - WR = (3 - \frac{3}{2}\sqrt{2}) \text{ cm}$

$\text{Area of } PYOX = \text{area of } \triangle PYQ + \text{area of } \triangle XOQ = 2 \text{ area of } \triangle PYQ$

$$= \frac{1}{2} * [3 - \frac{3}{2}\sqrt{2}] * \frac{3}{2}\sqrt{2} * 2$$

$$\begin{aligned}
 &= \frac{8}{2} \sqrt{2} - \frac{8}{4} * 2 \\
 &= \frac{8}{2} \sqrt{2} - \frac{8}{2} \\
 &= \frac{8}{2} (\sqrt{2} - 1) \text{ cm}^2
 \end{aligned}$$

Q.7)

Subject: General Aptitude

Max Marks: 2

$(\frac{a}{b})^{x-2} = (\frac{b}{a})^{x-7}$ . What is the value of  $x$ ?

- A 3
- B 3.5
- C 4
- D 4.5

Correct Option

**Solution:** (D)

**Solution:**  $a^n = \frac{1}{a^{-n}}$

$$\begin{aligned}
 (\frac{a}{b})^{x-2} &= (\frac{b}{a})^{x-7} \\
 \Rightarrow (\frac{a}{b})^{x-2} &= (\frac{a}{b})^{-(x-7)} \\
 \Rightarrow x-2 &= -(x-7) \\
 \Rightarrow x-2 &= -x+7 \\
 \Rightarrow 2x &= 9 \\
 \Rightarrow x &= 4.5
 \end{aligned}$$

Q.8)

Subject: General Aptitude

Max Marks: 2

The question contains four arguments of three sentences each. Choose the set in which the third statement is a logically derived conclusion of the first two.

- A All earthquakes cause havoc. Some landslides cause havoc. Some earthquakes are landslides.
- B All glass things are transparent. Some curios are glass things. Some curios are transparent.
- C All clay objects are brittle. All XY are clay objects. Some brittle are XY.
- D No criminal is a patriot. Ram is not a patriot. Ram is a criminal.

- A Only
- B Only
- C and B

Correct Option

**Solution:** (C)

**Solution:** C and B is the right choice. Statement A is invalid as it alone as four different terms. B is valid as some curios which are glass things are also transparent. And as all-glass things are transparent, those curios that are glass things are definitely transparent. D is invalid as no valid conclusion can be drawn from the statements.

- D Only

Q.9)

Subject: General Aptitude

Max Marks: 2

The petrol prices shot up by 7% as a result of the hike in the price of the crudes. The price of petrol before the hike was ₹ 28 per litre.

Vikram travels 2400 kms every month and his car gives a mileage of 18 kms to a litre. Find the increase in the expenditure that Vikram has to incur due to the increase in the price of petrol (to the nearest rupee)?

- A 270
- B 262

Correct Option

**Solution:** (B)

**Solution:** Traveling for 2400 kms at 18 km per litre, Vikram will use  $\frac{2400}{18} = 133.33$  litres of petrol per month. The increase in the expenditure for Vikram will be  $133.33 * 28 * \frac{7}{100} = ₹ 261.333 = ₹ 262$  (approx).

- C 276
- D 272

Q.10)

Subject: General Aptitude

Max Marks: 2

A dishonest dealer marks up the price of his goods by 20% and gives a discount of 10% to the customer. Besides, he also cheats both his supplier and his buyer by 100 grams while buying or selling 1 kg. Find the percentage profit earned by the shopkeeper.

- A 20%

25%

c

32%

Correct Option

**Solution:** (c)

**Solution:** While buying he buys 1100 grams instead of 1000 grams (due to his cheating)

Suppose he bought 1100 grams for ₹ 1000

While selling, he sells only 900 grams when he takes the money for 1 kg.

Now according to the question he sells at a 8% profit (20% markup and 10% discount)

Hence the selling price is ₹ 1080 for 900 grams.

Now to calculate the profit, either equate the goods or the money.

In this case, the money is being equated:

Bought 1100 grams for ₹ 1000

Hence  $\frac{1100}{1000} * 1080 = 1188$  grams for ₹ 1080

Sold 900 grams for ₹ 1080

Hence Profit (%) =  $\frac{\text{Goods Left}}{\text{Goods Sold}} * 100$

$$= \frac{1188 - 900}{900} * 100$$

$$= \frac{288}{900} * 100$$

$$= 32\%$$

D

27.5%

close