

Q.1)

Consider the following function

```
foo (int p, int q)
{
    return ((p < q)?0:(p - q));
}
```

Which of the following calls finds the positive difference of p and q.  
(Assume p and q are two non-negative integers)

 A p+foo(p, q) B q+foor(p, q) C foo(p, q) + foo(q, p) Correct Option

Solution: (C)

 D foo(p, foo(p, q))

Q.2)

The following key values are inserted into a B+ tree, where order of the internal node is 5 and order of leaf node is 4. The order of the internal node is the maximum number of tree pointers in each node. The maximum number of times leaf nodes would get split up as a result if the insertion sequence is: 3, 10, 12, 14, 29, 38, 45, 55, 60

 A 5 B 3 Correct Option

Solution: (B)

Solution:

In order to get maximum number of split we need to fill right subtree full and split the node based on right biasing.

Note: Right biasing, when the node is full we select an element to split a node such that right sub-tree has more keys than right subtree. Similarly, for left biasing. But in practice we make use of right biasing rather than using left biasing.

On inserting 3, 10, 12, 14, 29 first split will be on 12 such that 12 will be the root and (3, 10) and (14, 29) will be the left and right child respectively. In order to get maximum number of splits we need to keep the right child always full (Right biasing) as inputs are in ascending order. On continuing insertion the next split will be due to 55 and 60. Thus, the total number of splits will be 3.

 C 7 D 8

Q.3)

A system uses 48 bit logical address and pages of size 16 KB. Multi-level paging is used. A page table entry is of 4 B. The total number of pages that are required to store the inner page table entries of a process in the outermost level of paging is \_\_\_\_\_

Subject: operating systems

Max Marks: 1

Correct Answer

Solution: (1)

Explanation:

Page size =  $2^{14}$  bytes. So, the number of page table entries =  $2^{48}/2^{14} = 2^{34}$ . Each page can store  $16\text{KB}/4 = 2^{12}$  page table entries. So, the number of innermost pages =  $2^{34}/2^{12} = 2^{22}$ .

Now, pointers to all these innermost pages must be stored in the next level of the page table, so the next level of the page table has  $2^{22}/2^{12} = 2^{10}$  pages. Finally, a single page can store all the  $2^{10}$  page table entries, so the outermost level has one page.

Q.4)

Which of the following statements are valid regarding the pointer arithmetic

Subject: C Programming

Max Marks: 1

 A S1:Addition of an integer to a pointer and increment operation B S2:Subtraction of an integer from a pointer and decrement operation

**c** Both S1 and S2 Correct Option

**Solution:** (c)

**d** Neither S1 nor S2

**Q.5)** For a group of order 110, there must be a cyclic subgroup of order Subject: Discrete Mathematics Max Marks: 1

**A** 3, 5 or 7

**B** 2, 7 or 9

**c** 2, 5 or 11 Correct Option

**Solution:** (c)

**Explanation:**

Let  $G$  be a group of order 110. Let  $x \in G, x \neq e$ . Then  $|x| \neq 1$  and divides  $110 = 2 \cdot 5 \cdot 11$ . It follows that  $|x|$  must be divisible by one of the primes 2, 5 or 11. If this prime is  $p$ , then the cyclic subgroup  $\langle x \rangle$  has a unique subgroup  $H$  of order  $p$ , which is also cyclic (by the Fundamental Theorem of Cyclic Groups). Since “being a subgroup of” is transitive,  $H$  is the cyclic subgroup of  $G$  we sought to prove existed.

**Another explanation:**

For a given group we can have a subgroup  $H = \langle a \rangle$  generated by element  $a \in G$  ( $a \neq e$ )

$H$  can have order 2, 5, 11, 10, 22, 55, or 110. (By langrange's theorem)

If  $H$  has order 2, 5, or 11. we are done.

If  $H$  has order 10 then consider subgroup of  $H$  generated by  $a^5 = \langle a^5 \rangle$ . Which will definitely have order 2. (because  $a^{10} = e \implies (a^5)^2 = e$  and if  $(a^5)^k = e$  for some  $k < 2$  then  $order(a) \neq 10$ )

Similar arguments can be given for case 22, 55, and 110.

**D** None of the above

**Q.6)** Consider a microprocessor with a 16 Kbyte L1 cache. The miss rate for this cache is 3% and the hit time is 2 CCs. The processor also has an 8 Mbyte, on-chip L2 cache and the hit time is 15CC. 95% of the time, data requests to the L2 cache are found. If data is not found in the L2 cache, a request is made to a 4 Gbyte main memory and the hit time is 200 CCs. The time to service a memory request is 100,000 CCs when there is a miss in Main memory. On average, it takes 3.5 CCs to process a memory request. How often is data found in main memory(Hit Rate in percentage) ? Subject: computer organization Max Marks: 1

**Correct Answer**

**Solution:** (99.5)

**Explanation:**

Average memory access time = Hit Time + (Miss Rate x Miss Penalty)

$$\begin{aligned} 3.5 &= 2 + 0.03 (15 + 0.05 (200 + X (100,000))) \\ \Rightarrow 3.5 &= 2 + 0.03 (15 + 10 + 5000X) \\ \Rightarrow 3.5 &= 2 + 0.03 (25 + 5000X) \\ \Rightarrow 3.5 &= 2 + 0.75 + 150X \\ \Rightarrow 3.5 &= 2.75 + 150X \\ \Rightarrow 0.75 &= 150X \\ \Rightarrow X &= .005 \end{aligned}$$

Thus, 99.5% of the time, we find the data we are looking for in main memory.

**Q.7)** Which of the following statements is incorrect about routing? Subject: Computer Networks Max Marks: 1

- I. The link-state routing and the distance vector routing both use the bellman ford algorithm.
- II. The update frequency of the distance vector routing is periodic and the link-state routing is triggered.
- III. In the distance vector routing and the link-state routing, nodes have the

hierarchical structure of the network topology.



A All are incorrect



B Only II is incorrect



C Only I and III are incorrect

Correct Option

**Solution:** (C)

**Explanation:**

Bellman-Ford algorithm is used for performing distance vector routing whereas Dijkstra is used for performing the link-state routing.

The frequency of updates in both routing technique is different distance-vector update periodically whereas link-state update employs triggered updates.

The distance vector doesn't have a hierarchical structure while in link-state routing the nodes can have a hierarchical structure.



D Only II and III are incorrect

Q.8)

Subject: C Programming

Max Marks: 1



Consider the following function

```
int foo(int n)
{
    if(n==0) return 0;
    int a = 0;
    while(n != 0)
    {
        n /= 2;
        a++;
    }
    return (1<<a);
}
```



A Find the position of rightmost set bit



B Find the most significant set bit of a number and which is in power of two

Correct Option

**Solution:** (B)

**Solution:**

The above code is find the most significant set bit of a number and which is in power of two.

The solution is to one by one divide n by 2 until it becomes 0 and increment a count while doing this. This count actually represents the position of MSB



C Find the Least significant set bit of a number and which is in power of two



D None of these

Q.9)

Subject: Computer Networks

Max Marks: 1



Map the following prefix of IPV6 addresses to their correct which designation?

1. fc00::/7      (i) Link local address
2. 2000::/3      (ii) Multicast
3. ff00::/8      (iii) Global unicast
4. fe80::/10      (iv) Unique local address
5. ::/128      (v) Unspecified
- (vi) Loopback



A 1-(iv), 2-(i), 3-(iii), 4-(ii), 5-(vi)



B 1-(iii), 2-(ii), 3-(i), 4-(ii), 5-(v)



C 1-(iv), 2-(iii), 3-(ii), 4-(i), 5-(v)

Correct Option

**Solution:** (C)

**Explanation:**

::/128 ----> Unspecified

This address may only be used as a source address by an initializing host before it has learned its own address.

**fc00::/7** ----> Unique Local Addresses (ULAs)

These addresses are reserved for local use in home and enterprise environments and are not public address space.

**2000::/3** ----> Global Unicast

IPv6 global unicast addresses are similar to IPv4 public addresses. A company that needs IPv6 addresses asks for a registered IPv6 address block, which is assigned as a global routing prefix. These addresses are routable on the Internet and only that company will use them.

**ff00::/8** ----> Multicast

These addresses are used to identify multicast groups. They should only be used as destination addresses, never as source addresses.

**fe80::/10** -----> Link-Local Addresses

These addresses are used on a single link or a non-routed common access network, such as an Ethernet LAN. They do not need to be unique outside of that link.

- D 1-(iv), 2-(iii), 3-(ii), 4-(i), 5-(vi)

Q.10)

Consider the following CFG, where the set of terminals is  $\Sigma = \{a, b, \#, \%, !\}$

$$S \rightarrow \%aT \mid U!$$

$$T \rightarrow aS \mid baT \mid \epsilon$$

$$U \rightarrow \#aTU \mid \epsilon$$

Then FOLLOW set for the nonterminal T is \_\_\_\_\_

- A  $\{!, \#\}$

- B  $\{\#, \$\}$

- C  $\{!, \#, \$\}$

Correct Option

Solution: (C)

Explanation:

$$\text{Follow}(T) = \text{First}(U) \cup \text{Follow}(S)$$

$$\text{Follow}(S) = \{\$\}$$

$$\text{First}(U) = \{\#, \epsilon\}$$

But Follow function does not  $\epsilon$ , Substitute  $\epsilon$  in place of U,  $\Rightarrow$

$$\text{Follow}(T) = \text{Follow}(U) = \{!\}$$

$$\Rightarrow \text{Follow}(T) = \{\#, !, \$\}$$

- D  $\{\%, !, \#, \$\}$

Q.11)

Let P(x) means "x is prime" and O(x) means "x is odd"

Subject: Discrete Mathematics

Max Marks: 1

Then which of the following is/are not incorrect to represent : x is both prime and odd?

- A  $P(O(x))$

- B  $\exists x P(O(x))$

- C  $P(x) \wedge O(x)$

Correct Option

Solution: (C)

Explanation:

Option A and B are incorrect ways of writing. We should not put predicates inside predicates.

The notation  $P(O(x))$  means that the assertion that x is odd is a prime number, and clearly an assertion is not any kind of number at all.

Functional notation has a wonderful internal beauty and consistency to it -- the thing inside the parenthesis has to be what the thing outside the parentheses applies to.

- D Both  $\exists x P(O(x))$  and  $P(x) \wedge O(x)$

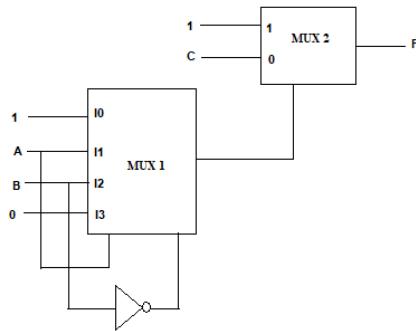
Q.12)

The number of minterms represented by the following function F(A, B, C) are

Subject: digital logic systems

Max Marks: 1

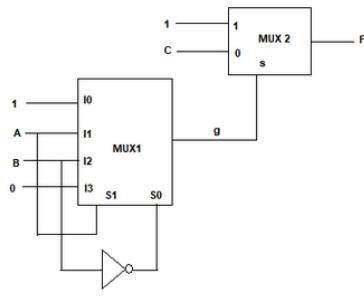
The number of minterms represented by the following function  $F(A, B, C)$  are \_\_\_\_\_



Correct Answer

**Solution:** (6)

**Solution:** 6  
For the given circuit:



Function g will be:

Here,  $S_1 = A, S_0 = B'$

Expression g will be given as:

$$\Rightarrow S_1'S_0' \cdot I_0 + S_1'S_0 \cdot I_1 + S_1S_0' \cdot I_2 + S_1S_0 \cdot I_3$$

$$\Rightarrow A'B \cdot I_1 + A'B' \cdot A + AB \cdot B + AB' \cdot 0$$

$$\Rightarrow A'B + AB$$

The function g is given as a select line in MUX 2. Note that here the select line will be implemented in inverted form as I0 is set as 1 and I1 is set as 0. So expression for function F will be given as:

$$\Rightarrow S \cdot I_0 + S' \cdot I_1$$

Here, S is nothing but g i.e.  $A'B + AB$

Therefore,

$$\Rightarrow (A'B + AB) \cdot 1 + (A'B + AB)' \cdot C$$

$$\Rightarrow A'B + AB + ((A'B)'(AB)) \cdot C$$

$$\Rightarrow A'B + AB + ((A + B)(A' + B')) \cdot C$$

$$\Rightarrow A'B + AB + (AB' + A'B' + B') \cdot C$$

On expanding every term and removing redundant terms in order to get total number of minterms, we will get:

$$\Rightarrow A'BC(M_1) + A'BC'(M_2) + ABC(M_3) + ABC'(M_4) + AB'C(M_5) + A'B'C(M_6)$$

Hence, total 6 minterms are present in the function F.

**Q.13)**

Which of the following properties are not preserved under the matrix transpose operation.

Subject: Engineering-Mathematics

Max Marks: 1

**A**

Determinant of the matrix.

**B**

Solution to the system of linear equations which is non-homogenous.

Correct Option

**Solution:** (B)

**Solution:**

Determinant, invertibility and eigenvalues do not change if we perform the matrix transpose, however if we perform the matrix transpose operation we not preserve the solution of linear equations.

**C**

Invertibility of the matrix.

**D**

Eigenvalues of the matrix.

**Q.14)**

For a system, the processes at any moment will be in either of three states:

Subject: operating systems

Max Marks: 1

Running, or

Ready, or

Blocked.

Following are the given sequences of these three states. Which of the following sequence of states is possible?

**A** Blocked, Ready, Running, Blocked

Correct Option

**Solution:** (A)

**Explanation:**

Blocked can only be followed by Ready, and Ready can only be followed by Running.

Thus, any sequence in which Blocked is followed immediately by Running is wrong, and so is any sequence where Ready is followed immediately by Blocked.

**B** Running, Read, Blocked, Running

**C** Running, Ready, Blocked, Ready

**D** Blocked, Running, Ready, Blocked

**Q.15)**

What will be the result of the following SQL query for the instance of the relation INVENTORY (stock, item) given in descending order.

Subject: DBMS

Max Marks: 1

```
SELECT item  
FROM INVENTORY I  
WHERE ( SELECT COUNT(*) FROM INVENTORY J WHERE J.stock > I.stock ) < 3;
```

**A** Bottom 3 items of the stock

**B** Bottom 2 items of the stock

**C** Top 3 items of the stock

Correct Option

**Solution:** (C)

**Solution:**

Let us consider an instance of the relation INVENTORY in order to get the solution.

Stock	Item
5	A
4	B
3	C
2	D
1	E

Now each row will be compared with every other row in the relation (including itself).

For example: For first tuple (5, A) FROM I, stock will be compared to every other stock values FROM J as follows:

$5 > 5 = \text{false}$

$4 > 5 = \text{false}$

$3 > 5 = \text{false}$

$2 > 5 = \text{false}$

$1 > 5 = \text{false}$

Therefore, COUNT(\*) will return 0 from the inner query. Since  $0 < 3 \Rightarrow$  conditions satisfied. Therefore, (5, A) FROM I will be there in result set.

Similarly if we check for every tuple, we will get (4, B) and (3, C) also present in the result set. Hence, the result will contain the top 3 items of the stock.

**D** Top 2 items of the stock

**Q.16)**

Which of the following can be used as an online sorting algorithm.

Subject: Algorithms

Max Marks: 1

**A** Selection sort

**B** Merge Sort

**C** Insertion Sort

Correct Option

**Solution:** (C)

**Solution:**

Out of the above options only insertion sort is an online sorting algorithm.

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Q.17)

Evaluate the following expression,

6 5 \* 7 3 - 4 8 + \* +

Which of the following cannot be an intermediate state of the given stack while evaluating the above expression?

 A

30 4 4 8

 B

30 7 4

Correct Option

**Solution:** (B)**Solution:** 30 7 4**Evaluation steps are as follows,**

6,  
6 5,  
30,  
30 7,  
30 7 3,  
30 4,  
30 4 4,  
30 4 4 8,  
30 4 12,  
30 48,  
78

 C

30 4 12

 D

30 48

Q.18)

Which of the following is/are True

Subject: Theory of Computation, Compiler Design

Max Marks: 1

- I.  $baa \in a^*b^*a^*b^*$
- II.  $b^*a^* \cap a^*b^* = a^* \cup b^*$
- III.  $a^*b^* \cap c^*d^* = \emptyset$

 A

I, II and III Only

 B

I and II Only

Correct Option

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

- I. True. Consider the defining regular expression:  $a^*b^*a^*b^*$ . To get baa, take no a's, then one b, then two a's then no b's.
- II.  $b^*a^* \cap a^*b^* \text{ True}$   
 $b^*a^* = \{\epsilon, b, ab, bb, aa, bba, bbaa, \dots\}$   
 $a^*b^* = \{\epsilon, a, b, aa, bb, ab, abb, aabb, \dots\}$   
 $b^*a^* \cap a^*b^* = \{\epsilon, a, b, aa, bb, aaa, bbb, \dots\} = a^* \cup b^*$
- III.  $a^*b^* \cap c^*d^* = \emptyset \text{ False}$   
 $a^*b^* \cap c^*d^* = \{\epsilon\}$

 C

II and III Only

 D

I and III Only

Q.19)

Consider the following sequence of instructions

Subject: computer organization

Max Marks: 1

1. LD.D F4, 16(R2)
2. LD.D F6, 48(R2)
3. MUL.D F10, F4, F8
4. ADD.D F8, F10, F6
5. SD F8, 0(R3)

The difference between the Data and Output dependencies are \_\_\_\_\_

Correct Answer

**Solution:** (5)**Data Dependencies: RAW+WAR+WAW****True dependence:**

Instruction 3 on instruction 1 in register F4  
Instruction 4 on instruction 3 in register F10  
Instruction 4 on instruction 2 in register F6  
Instruction 5 on instruction 4 on register F8

**Output dependence:**

None

**Anti-dependence:**

Instruction 4 on instruction 3 in register F8

Q.20)

Consider the following statements and assume that the most time-efficient implementation is used and that all keys are distinct. Use the N to represent the total number of elements. Bases of logarithms are assumed to be 2 unless otherwise specified.

- I. Insert an element into a hash table of table size N, containing N elements where separate chaining (each bucket points to an unsorted linked list) is used. Let its running time complexity be X.
- II. Finding the maximum value in a binary min heap (implemented using an array) containing N elements. Let its running time complexity be Y.

Considering the X and Y be least tightest bounds then which of the following holds TRUE?

A

X > Y

B

X < Y

Correct Option

Solution: (B)

Solution: X < Y

- I. Even if all the values are in one bucket, Insertion just requires doing the hash function to find the correct bucket which takes O(1) + inserting at the front of the unsorted list O(1). therefore X is 1. (Note: Find could take O(N) with this approach)
- II. Need to examine the values in the bottom row of the heap ( $= \sim N/2$  values). Even if we examine all the values in the heap still takes O(N). Therefore Y is N.

C

X = Y

D

Cannot be compared

Q.21)

Which of the following statement is false about the Network address translation?

Subject: Computer Networks

Max Marks: 1

A

NAT does not provide security to the internal network.

Correct Option

Solution: (A)

Explanation:

- a. Enhancing security for private networks by keeping internal addressing private from the external network.
- b. Yes true
- c. Connecting a large number of hosts to the global Internet using a smaller number of public (external) IP address, thereby conserving IP address space
- d. The private network organizations by using NAT can use the IP range of their choice for building up the internal network irrespective of the service provider of the public interface.

B

It provides the conversion of addresses from private to public and vice-versa.

C

It connects the large group of hosts by saving the public addresses to the internet.

D

It helps us to build the IP range of the choice of the private organization.

Q.22)

If a heuristic is available which can determine the minimum element from an array of n elements in logarithmic time. If selection sort is implemented using this heuristic then the worst case time complexity for such an implementation would be

Subject: Algorithms

Max Marks: 1

A

$O(n^2)$

Correct Option

Solution: (A)

Solution:

The time required to calculate the minimum in an array of n elements is

The time required to compare all elements is  $O(n)$  and however in the question it is given that using the new heuristic we can determine the minimum in  $O(\log n)$  time and now let us analyse this case.

1. When we have  $n$  elements in the unsorted list time taken is  $O(\log n)$  + time taken to swap  $O(1)$ .
2. Now  $n-1$  elements in the unsorted list then the time taken is  $O(\log(n-1))$
3. Now  $n-2$  elements in the unsorted list then the time taken is  $O(\log(n-2))$
- ...

So on upto 1.

Therefore the total time taken =  $\log n + \log(n-1) + \log(n-2) + \dots + \log(1)$   
=  $\log(n!)$

using stirling's approximation

$$n! \sim \sqrt{2\pi n} \left(\frac{n}{e}\right)^n$$

=  $\log(k \cdot n^n)$  where  $k$  is a constant.  
=  $O(n \log n)$ .

We do not have  $O(n \log n)$  in the options but as  $n \log n$  grows slower than  $n^2$  we can also write it as  $O(n^2)$ .

A  $O(n)$

C  $O(\log n)$

D None of the above

Q.23)

Which of the following statements are correct?

- I. The function  $F(a,b,c) = 1$ , have no maxterms.  
II. The dual of Exclusive-OR (EX-OR) is equivalent to its complement.

Subject: digital logic systems

Max Marks: 1

A Only I

B Only II

C Both I and II

Correct Option

Solution: (C)

Solution:

- I. The sum of all literals/variables will be equal to 1 only when all the terms are minterms i.e.  $\Sigma(0,1,2,3,4,5,6,7)$  and  $\pi( )$ . Hence, there will be no maxterms
- II. Let  $F = A \text{ XOR } B = A'B + AB'$ . Its dual will be  $(A' + B)(A + B')$ . This is equivalent of writing  $AB + A'B' = F'$ . Hence, it is true.

Thus, both the statements are correct.

D Neither I nor II

Q.24)

We shall compare different memory organizations based on the following assumptions:

- all transfers are multiple of word (1 word = 4 bytes);
- 1 clock cycle to send the address;
- 10 clock cycles for the access time;
- 1 clock cycle for a bus transfer of the accessed item.

The simple and cheap approach for memory organization is to have

transfers, between all levels of the memory hierarchy. Compute the memory bandwidth for a word organized memory system. The cache block size is 8 words (32 bytes).

Correct Answer

Solution: (0.33)

Answer: 0.33

Explanation:

For each word in the block the address must be transmitted (1 clock cycle), a fixed amount of time has to be spent waiting (10 clock cycles), and each word has to be transferred into the cache (1 clock cycle); therefore the miss

penalty is:

$$\text{miss\_penalty} = 8 * (1 + 10 + 1) = 96 \text{ clock cycles}$$

The memory bandwidth is:

$$\text{memory\_bandwidth} = \text{bytes\_transferred} / \text{clock\_cycles} = 32 / 96 = 0.33$$

Bytes/Clock Cycle.

Q.25)

Which of the following is/are False.

- I. If a language L can be described by a regular expression, we can be sure it is a context-free language.
- II. If a language L cannot be described by a regular expression, we can be sure it is not a context-free language.
- III. If L is generated by a context-free grammar, then L cannot be regular.

A

I and II only

B

II and III only

Correct Option

Solution: (B)

Explanation:

True, since all regular languages are context-free.

False, there exist languages that are context-free but not regular.

False, All regular languages are also context-free and thus are generated by context-free grammars.

C

I and III only

D

I,II and III only

Q.26)

The number of key comparisons in the worst case for Merge Sort is given by

Subject: Algorithms

Max Marks: 2

A

$O(n \log n)$

B

$O(n)$

C

$O(n \log n)$

Correct Option

Solution: (C)

Solution:

The worst case i.e. the number of maximum of comparisons when merging two sorted lists ( $n-1$ ).

The recurrence relation for this is given by

$$T(n)=2T(n/2)+n-1 \text{ or } T(n)=2T(n/2)+O(n)$$

This is identical to the recurrence relation of merge sort it is given by  $O(n \log n)$ .

D

Cannot be determined.

Q.27)

In the new congestion control scheme, In the slow start, we increase the current window by the multiple of two with the previous window and in the congestion avoidance phase, we increase the current window by 1 MSS of the previous window like that we continue alternatively. We are increasing the sender window size alternatively, for  $i^{\text{th}}$  transmission slow start phase and for  $(i+1)^{\text{th}}$  transmission congestion avoidance phase. After a timeout, we are repeating the same procedure again. After the threshold, we follow the congestion avoidance phase. The initial threshold is set to 24 KB. The slow start phase starts with 2KB which is equal to the maximum segment size. What will be the sender window size in Kilobytes at the twelfth transmission if a timeout occurs on every ninth transmission? [Note the very first transmission starts with a slow start and for second transmission we apply the congestion avoidance phase like this we continue alternatively].

Subject: Computer Networks

Max Marks: 2

A

4 KB

B

6 KB

C

8 KB

Correct Option

**Solution:** (c)

**Explanation:**

First transmission: 2KB [Slow start phase]

Second transmission: 4KB [congestion avoidance]

Third transmission: 8KB [Slow start phase]

Fourth transmission: 10KB[congestion avoidance]

Fifth transmission: 20KB[Slow start phase]

Sixth transmission: 22KB[congestion avoidance]

Seventh transmission: 24 KB [Threshold reached]

Eighth transmission: 26 KB [Congestion avoidance]

Ninth transmission:28KB[Congestion avoidance, Timeout occurs, New Threshold = 28/2=14KB]

Tenth transmission: 2KB [Slow start phase]

Eleventh Transmission: 4KB[ Congestion avoidance]

Twelfth transmission: 8KB[Slow start phase]

10 KB

**Q.28)**

Consider the following grammar

$X \rightarrow Ma$

$X \rightarrow bMc$

$X \rightarrow dc$

$X \rightarrow bda$

$M \rightarrow d$

The given grammar is

Subject: Theory of Computation,Compiler Design

Max Marks: 2

A

Both SLR(1) and LALR(1)

B

Not SLR(1) but LALR(1)

Correct Option

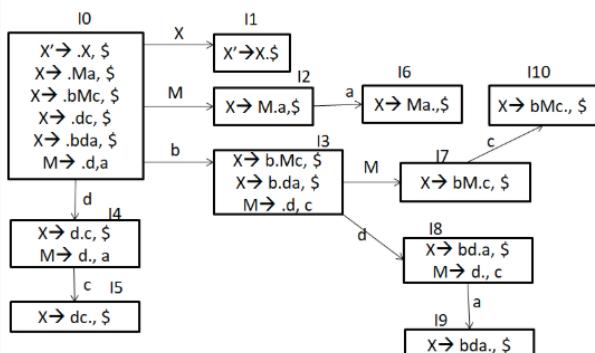
**Solution:** (B)

**Explanation:**

State I4 contains Shift and Reduce Operations

$\{c\} \cap \text{Follow}(M) = \{c\} \cap \{a,c\} \neq \emptyset$

S/R Conflict. Hence the grammar is not SLR(1)



C Neither SLR(1) nor LALR(1)

D Not LR(0) but SLR(1)

**Q.29)**

Station A is connected to station B directly via the link, Station B also connected to stations C, D, E, F directly via link. What will be

the total time required if station A sends the packet of 2000 bits to station E and receives the Acknowledgement, the propagation delay of every individual link is 1 ms and also bandwidth is 1 Mbps. Station B uses flooding for transferring data and Acknowledgement which takes additional 2ms for processing and (TT/K) for transmitting simultaneously on every link(TT=transfer time, K= no of links it will transfer, size of ACK is negligible).

A 8.5 ms

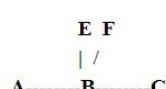
B 10 ms

C 10.5 ms

Correct Option

**Solution:** (C)

**Explanation:**



D

For sending A to B = TT(data) + PT

For sending B to E using flooding= Processing delay(PD) + TT(data)/k + PT (k=4)  
because in flooding we send the data accept to the point of origin)

For sending E to B= TT(ACK) + PT

For sending B to A= processing delay + TT(ACK)/4 + PT

TT(ACK)=0, TT(data)= 2000/1 Mbps= 2ms, PD=2ms

Total time = TT(data) + 4 PT + 2 PD + TT(data)/4= 10.5ms

D

6 ms

Q.30)

Which of the following option represent the number (0.53125)<sub>10</sub> in IEEE 754 and single precision format ?

Subject: digital logic systems

Max Marks: 2

A

1	0001000...0	01111110
<-----sign	bit(1)	>-----Mantissa
bit(23)-><-----Exponent bit(8)----->		

B

0	001000...0	01111110
<-----sign	bit(1)	>-----Mantissa
bit(23)-><-----Exponent bit(8)----->		

C

0	0001000...0	1000000
<-----sign	bit(1)	>-----Mantissa
bit(23)-><-----Exponent bit(8)----->		

D

0	0001000...0	01111110
<-----sign	bit(1)	>-----Mantissa
bit(23)-><-----Exponent bit(8)----->		

Correct Option

Solution: (D)

??????

Since the number is positive, therefore, sign bit should be 0. Therefore, we can discard the first option.

For binary equivalent of 0.53125 is 0.10001. Thus while writing in the mantissa format M should be 1.0001, therefore, we can discard second option also.

In order to get 0.10001, the exponent should be -1. Since, the normalised format of IEEE single precision is (-1)s X (1.M) X 2^E - 127

The value of the exponent should be 126 in order to get 2-1. For E = 126 => 01111110. Thus, the correct option is (iv) as on expanding it we will get:

$$(-1)^0 \times (1.0001) \times (2^{-1}) = 0.10001 = 0.53125_{base10}$$

Q.31)

Let  $\Sigma = \{a, b\}$ . Let  $L_1 = \{x \in \Sigma^*: |x| < 4\}$  and  $L_2 = \{aa, aaa, aaaa\}$ .

Then the number of strings in the language  $L_3 = L_1 - L_2$  is \_\_\_\_\_

Subject: Theory of Computation,Compiler Design

Max Marks: 2

Correct Answer

Solution: (13)

Answer:13

Explanation:

$L_1 = \{\epsilon, a, b, aa, ab, ba, bb, aaa, aab, aba, abb, baa, bab, bba, bbb\}$ .

$L_2 = \{aa, aaa, aaaa\}$

$L_1 - L_2 = \{\epsilon, a, b, ab, ba, bb, aab, aba, abb, baa, bab, bba, bbb\}$

Q.32)

What is the time complexity of the following snippet of code

```

for(i=n;i>=1;
{
    for(j=1;j<=i;j*=2)
    {
        for(k=1;k<n;k++)
        {
            printf("All the best");
        }
    }
}

```

Subject: Algorithms

Max Marks: 2

```

        }
        i=2;
    }
}

```

**A** O(nlogn)

**B** O(nlog<sup>2</sup>n)

Correct Option

**Solution:** (B)

**Solution:**  
The inner most loop with k as the counter will run n time lets keep this factor aside and multiply it will the final outcome of the outer two loops.  
Let us analyse the outer two loops now.  
for i=n the inner loop will execute log n times.  
Next i=n/2 , the inner loop will execute log n/2 times.  
Next i=n/4 , the inner loop will execute log n/4 times.  
Next i=n/8 , the inner loop will execute log n/8 times.  
...  
i=2 the inner loop will execute log 2 times.  
Upto i=1 the inner loop will execute log 1 times.

Total number of times the inner loop( loop with index j) will execute is  
=Log n +log n/2+log n/4+log n/8+...log1  
=Log n +log n/2+log n/4+log n/8+...log (n/2<sup>k</sup>)

Where k is floor(log n)

The number of terms in the above expression is k

$$\begin{aligned}
&= \log(n^k / 2^{0+1+2+\dots+k}) \\
&= \log(n^k) - \log(2^{k(k+1)/2}) \\
&= k \log(n) - k(k+1)/2 \\
&\text{As } k = \log(n) \\
&= \log(n) * \log(n) - (\log^2(n) - \log(n))/2 \\
&= 1/2 * ((\log^2(n)) - \log(n)) \\
&= O(\log^2 n)
\end{aligned}$$

Multiplying it with n (because of the inner most loop)

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

**C** O(nlogn)

**D** None of the above

**Q.33**

Which statement is true about a B-tree having order  $\geq t$  with height  $h$  and  $n$  nodes, assuming that each node takes exactly 1 disk operation to read?

Subject: DBMS

Max Marks: 2

- I. Finding a node in T cannot require more than  $O(h)$  disk operation in other words,  $O(h)$  time, if only disk reads and writes are counted.
- II. If each node in T is augmented with an integer showing the size of that node's subtree, then n additional nodes can be inserted into T in a total of  $O(n \times h)$  CPU operations.

**A** Only I

**B** Only II

**C** Both I and II

Correct Option

**Solution:** (C)

**Solution:**

Statement I is True. Let each node has a minimum of 't' children. Then searching for a node takes more time than reading down the tree in  $O(h)$  steps and reading across each node in  $O(t)$  steps for a total of  $O(t * h)$  CPU operations and  $O(h)$  disk operations, where t is a constant.

Statement II is true. Even though the tree may grow due to splits during insertion, and insertion still takes no more than  $O(t * h)$  CPU operations, so inserting n nodes takes  $O(n * t * h) = O(n * h)$  CPU operations.

**D** Neither I nor II

Q.34)

Subject: Theory of Computation, Compiler Design

Max Marks: 2

Which of the following is/are CFLs

- I.  $L = \{a^n b^m c^k : n \neq m \text{ or } m \neq k\}$
- II.  $L = \{w_1 c a^n b^m a^j b^j w_2 : w_1, w_2 \in \{a,b\}^*, \text{length}(w_1) = \text{length}(w_2), j=2i, n \leq m\}$
- III.  $L = \{w_1 c w_2 : w_1, w_2 \in \{a,b\}^*, \text{length}(w_1) = \text{length}(w_2)\}$

 A I, II and III

Correct Option

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

$$\text{I. } L = \{a^n b^m c^k : n \neq m \text{ or } m \neq k\} \text{ CFL}$$

There are four 'cases' to consider:

1. More a's than b's (w/ any number of c's).
2. More b's than a's (w/ any number of c's).
3. More b's than c's (w/ any number of a's).
4. More c's than b's (w/ any number of a's).

Production Rules

$$S \rightarrow S_1 S_3 | S_2 S_3 | S_4 S_5 | S_4 S_6$$

Each of the four 'cases' are accounted for (from left to right in the above production).

$$S_1 \rightarrow a S_1 b | a S_1 | a$$

$$S_2 \rightarrow a S_2 b | S_2 b | b$$

$$S_3 \rightarrow S_3 c | \epsilon$$

$$S_4 \rightarrow a S_4 | \epsilon$$

$$S_5 \rightarrow b S_5 c | b S_5 | b$$

$$S_6 \rightarrow b S_6 c | S_6 c | c$$

- II.  $L = \{w_1 c a^n b^m a^j b^j w_2 : w_1, w_2 \in \{a,b\}^*, \text{length}(w_1) = \text{length}(w_2), j=2i, n \leq m\} \text{ CFL}$

The CFG for the given language is

$$S \rightarrow a S b | a S a | b S a | b S b | S_1$$

$$S_1 \rightarrow c S_2 S_3$$

$$S_2 \rightarrow a S_2 b | S_2 b | \epsilon$$

$$S_3 \rightarrow a S_3 b b | \epsilon$$

- III.  $L = \{w_1 c w_2 : w_1, w_2 \in \{a,b\}^*, \text{length}(w_1) = \text{length}(w_2)\} \text{ CFL}$

$$S \rightarrow a S b | a S a | b S a | b S b | c$$

 B I and II only

 C II and III only

 D I and III only

Q.35)

Subject: Engineering-Mathematics

Max Marks: 2

$$\lim_{x \rightarrow 0} \frac{\left[ \int_0^x \sin^2 t \cos t dt \right]}{x^3} =$$

 A 1

 B  $\frac{1}{3}$ 

Correct Option

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

$$\begin{aligned} & \lim_{x \rightarrow 0} \frac{\left[ \int_0^x \sin^2 t \cos t dt \right]}{x^3} \\ &= \lim_{x \rightarrow 0} \frac{\left[ \frac{1}{3} \sin^3 t \Big|_0^x \right]}{x^3} \\ &= \lim_{x \rightarrow 0} \frac{\left[ \frac{1}{3} \sin^3 x \right]}{x^3} \quad (\text{as } \lim_{x \rightarrow 0} \frac{\sin x}{x} = 1) \\ &= \frac{1}{3}. \end{aligned}$$

 C -1

 D  $\infty$ 

Q.36)

Subject: Theory of Computation, Compiler Design

Max Marks: 2

The language generated by the given regular expression is

The language generated by the given regular expression is

$$L( (((a^*b^*)^*ab) \cup ((a^*b^*)^*ba))(b \cup a)^* )$$

A

Set of all strings of a's and b's

B

Any string of a's and/or b's with at least one occurrence of ab or ba.

Correct Option

Solution: (B)

Answer:

Explanation:

Given RE is  $L( (((a^*b^*)^*ab) \cup ((a^*b^*)^*ba))(b \cup a)^* )$

$$(a^*b^*)^* \Rightarrow (a \cup b)^*$$

$$\Rightarrow (((a \cup b)^* ab \cup (a \cup b)^* ba))(b \cup a)^*$$

$\Rightarrow$  Every string contains either ab or ba or both at least once.

C

Any string of a's and/or b's with at exactly equal occurrence of ab or ba.

D

Any string of a's and/or b's where every string ends with ab or ba.

Q.37)

Subject: Computer Networks

Max Marks: 2



We are using the selective repeat ARQ for sending the file from point A to point B. The file size is bigger than 500 KB, therefore, we are transmitting the file according to window size. The window size is the combination of frames. The frame size is 20 bytes. The bandwidth of the link is 1 Mbps and one-way latency is 5ms. The efficiency of the channel noticed is 100%. After how many windows the whole file will be transmitted and assume there is no loss of data in between? [Take the sealed value if the window size is in decimal and take the sealed value if the answer is in decimal]

A

Correct Answer

Solution: (400)

Ans 391

Explanation:

In the selective repeat ARQ

$$T_t = \text{Frame size} / \text{Bandwidth} = 20 \times 2^3 \text{ bits} / 10^6 \text{ bits} = 0.16 \text{ ms}$$

$$T_p = 5 \text{ ms}$$

$$a = T_p/T_t = 31.25$$

$$\text{Efficiency} = WS / (1 + 2a)$$

$$1 = WS/63.5$$

WS = 63.5 = 64 seal value we will take

The size of one window =  $64 \times 20 \text{ B} = 1280 \text{ B}$

The size of file =  $500\text{KB} / 1280\text{B} = (500 \times 1024\text{B}) / 1280\text{B} = 400 \text{ windows}$  [ Considering file that's why k value = 1024B]

Q.38)

Subject: Engineering Mathematics

Max Marks: 2



A room is of the shape of a hexagon and 6 robots are present in each corner of the room they randomly choose to move along the wall given that they do not have working sensors to detect if the other robot is also moving towards them, what is the probability that at least one pair of robots collide.

A

1/32

B

1/64

C

31/32

Correct Option

Solution: (C)

Solution:

There are only two cases when a collision will not occur in which all the robots are moving in either clockwise or anticlockwise direction.

Total number of ways in which each robot can move is 2, therefore the total number of unique moves are  $2^6$ .

$$P(\text{No collision}) = 2/2^6 = 1/2^5 = 1/32$$

$$P(\text{At least one collision}) = 1 - P(\text{No collision}) = 1 - 1/32 = 31/32$$

D

1/2

Q.39)

The maximum possible number of candidate keys for given 10 distinct attributes are \_\_\_\_\_

Subject: DBMS

Max Marks: 2



Solution: (252)

Solution: 252

The maximum number of candidate keys of size r for given n attributes is  ${}^n C_r$ .

Correct Answer

While, in general, the maximum number of candidate keys for  $n$  attributes is given as  ${}^nC_{\text{floor}(n/2)}$ . This is because candidate key is the minimal super key.

Thus, maximum number of candidate keys for given 10 attributes is  $= {}^{10}C_{(10/2)} = {}^{10}C_5 = 10!/(5! * 5!) = 252$  keys.

Q.40)

Subject: operating systems

Max Marks: 2



Given that S and T are two binary semaphores, and X, Y, Z are three processes. Let X and Y be identical processes and consist of the following four statements:

P(S);

P(T);

CS

V(T);

V(S);

And let process Z consists of the following statements:

P(T);

P(S);

CS

V(S);

V(T);

Which of the following options is guaranteed to not result in a deadlock for the system?

Note : Initially  $T = S = 1$ .



A Run process X and process Y together, followed by Z



B Run process X and process Z together, followed by Y



C Run process Y and process Z together, followed by X



D None of the given options is a safe choice

Correct Option

Solution: (D)

If X and Y runs together, since they request resources in the same order, therefore, one of them will be able to perform P(S) and proceed towards its C.S.

If X and Z runs together then, there is a possibility of deadlock when X executes P(S) and Z executes P(T). Now, X waits for Z to do V(T) and Z waits for X to do V(S)

Similar case may arise when Y and Z are executed together, there is a possibility of deadlock.

So, out of X and Y, say X was able to execute and completes. Then Y executes P(S) and now at the same time if Z executes P(T), then Y and Z will get stuck in a deadlock in their next lines.

Thus, for all the given orders of execution in the given options, there is a possibility of occurrence of a deadlock. Therefore, option D is correct.

**Note :** Say X executes and completes and then Y gets unblocked and starts executing. At the same Z begins its execution, in that case, there is a possibility of a deadlock. Please note that if

we can prove in any way that the given order of execution could lead to a deadlock, then the order is not a safe order of execution. We have to consider all the possibilities since we are not given exact timestamps of order of execution.

Q.41)

Subject: Discrete Mathematics

Max Marks: 2



Let  $A$  be a finite set with  $n \geq 1$  elements  $A = \{A_1, A_2, \dots, A_n\}$ , where each  $A_i$  is itself a set, such that for any  $i, j$  we have  $A_i \subseteq A_j$  or  $A_j \subseteq A_i$ .

Consider the following statements:

**S1 :**  $A$  contains an element  $A_k$ , such that  $A_k$  is not a subset of any other element in  $A$

**S2 :**  $A_k$  is a superset of every element of  $A$

Which of the above statements are False?



A S1 only



B S2 only



C Both S1 and S2



D None of these

Correct Option

**Solution:** (d)

**Explanation:**

**S1:**

Assume for contradiction that no such element  $A_k$  exists. Then, any  $A_i$  is such that it has a *proper* superset  $A_j$  for some choice of  $j \neq i$ . Thus,  $A_1 \subset A_{i_1}$  for some  $i_1 \neq 1$ . But then, also  $A_{i_1} \subset A_{i_2}$ , for some  $i_2$  which is distinct from 1 and  $i_1$ . By iterating this idea, we get:

$$A_1 \subset A_{i_1} \subset A_{i_2} \subset \dots \subset A_{i_n}$$

where all of the indices are distinct. However, this sequence contains  $n + 1$  different elements of  $A$  which is a contradiction, because  $A$  has only  $n$  elements.

**S2:**

Choose an arbitrary  $i \in \{1, 2, \dots, n\}$ . If  $i = k$ , then clearly  $A_k = A_i \subseteq A_k$ . Otherwise,  $i \neq k$  and thus it must be the case  $A_i \neq A_k$ . The premise of the problem gives us:

$$A_i \subseteq A_k \text{ or } A_k \subseteq A_i$$

But, from part (a), we know that the latter is not true. Therefore, it must be the case that  $A_i \subset A_k$ . Because we have chosen the index  $i$  arbitrarily, we conclude that  $A_k$  is a superset of all elements in  $A$ .

**Q.42)**

**Subject: operating systems**

**Max Marks: 2**



We are given 4 systems. We need to compare the price-performance ratio of these systems. Price-performance ratio has been defined as the product of the total cost of a system with its effective memory access time. The total cost has to be calculated using the cost of RAM and the cost of the disk drive. System A has a 1 GB RAM which costs rupees 2000. The main memory access time is 0.1 ms. The disk drive in this system configuration costs rupees 6000 and the page fault service time is 2 ms.

System B has a 0.5 RAM which costs rupees 1500. The main memory access time is 0.075 ms. The disk drive in this system configuration costs rupees 10000 and the page fault service time is 1.5 ms.

System C has a 2 RAM which costs rupees 2500. The main memory access time is 0.1 ms. The disk drive in this system configuration costs rupees 10000 and the page fault service time is 1.5 ms.

System D has a 2 GB RAM which costs rupees 2000. The main memory access time is 0.2 ms. The disk drive in this system configuration costs rupees 10000 and the page fault service time is 1 ms.

The page fault rate(in %) in the above 4 systems are 10, 15, 7.5 and 7.5 respectively.

Which of the following option(s) is/are correct given the above 4 systems?

Note: There is an ambiguity created due to the usage of the word "Best" in the options, whether it means lower is better or higher is better. Therefore, marks will be given to those who have attempted this question.



A has the best price-performance ratio



C has the best price-performance ratio



B has the best price-performance ratio

Correct Option

**Solution:** (c)

**Explanation:**

In order to compare the system configuration with respect to their price-performance ratios, we need to compute the effective memory access time for each one.

The effective memory access time in A is  $0.90 * 0.1 + 0.10 * 2 = 0.09 + 0.2 = 0.29$  ms.

The effective memory access time in B is  $0.85 * 0.075 + 0.15 * 1.5 = 0.06375 + 0.225 = 0.28875$  ms.

The effective memory access time in C is  $0.925 * 0.1 + 0.075 * 1.5 = 0.0925 + 0.1125 = 0.205$  ms.

The effective memory access time in D is  $0.925 * 0.2 + 0.075 * 1 = 0.185 + 0.075 = 0.26$  ms.

Total cost of system A = 2000 + 6000 = Rs 8000

Total cost of system B = 1500 + 10000 = Rs 11500

Total cost of system C = 2500 + 10000 = Rs 12500

Total cost of system D = 2000 + 10000 = Rs 12000

The price performance ratios for the various systems can now be obtained by multiplying their effective memory access times and the total cost of the system configuration.

Therefore,

best price-performance ratio for system A =  $0.29 * 8000 = 2320$

best price-performance ratio for system B =  $0.28875 * 11500 = 3320.625$

best price-performance ratio for system C =  $0.205 * 12500 = 2562.5$

best price-performance ratio for system D =  $0.26 * 12000 = 3120$

So the system configuration with the best price-performance ratio is system B, followed by system D, system C and finally system A.



D has the best price-performance ratio

**Q.43)**

**Subject: Engineering-Mathematics**

**Max Marks: 2**



If c is randomly chosen from the set {0,1,2,3,4,5,6,7,8,9} then the probability that the following equation has at least one imaginary/complex root.

$$x^3 + 3x^2 + cx = 0$$



3/10



7/10

Correct Option

**Solution:** (B)

Solution:

$x=0$  is a root of the equation, the other part of the equation is  $x^2+3x+c=0$ ,  
the roots of the equation are given by  $\frac{-b \pm \sqrt{b^2-4ac}}{2}$  if the roots are complex  
then the roots should be  
 $\sqrt{9-4c}$  should be imaginary or  $9-4c < 0$  or  $c > (9/4) = c > 2.25$  for  $c$  should  
be 3,4,5,6,7,8 or 9. Therefore the probability of 7/10.

C 4/10

D None of the above

Q.44)

Let  $Q(A)$  represent the power set of a set  $A$ . For the given lattice  $(Q(B), \leq)$ ,  
where  $B$  is another set, what is its dual?

Subject: Discrete Mathematics

Max Marks: 2

A  $(Q(B), \leq)$

B  $(Q(B), \geq)$

Correct Option

Solution: (B)

Explanation:

Let  $B = \{1,2\}$

$Q(B) = \{\text{Phi}, \{1\}, \{2\}, \{1,2\}\}$

For lattice  $(Q(B), \leq)$ , the dual would be  $(Q(B), \geq)$ .

Every partially ordered set  $P$  gives rise to a dual (or opposite) partially ordered set which is often denoted by  $P^d$ .

This dual order  $P^d$  is defined to be the same set, but with the inverse order. It is easy to see that this construction, which can be depicted by flipping the Hasse diagram for  $P$  upside down, will indeed yield a partially ordered set.

C  $(B, \geq)$

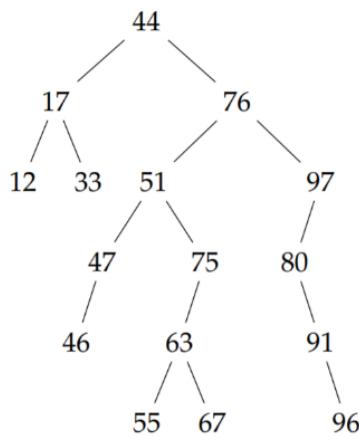
D None of the above

Q.45)

If you are given the following binary search tree,

Subject: Data Structures

Max Marks: 2



In which order could the elements 17, 33, 47, 63, 67 and 76 have been added to the tree?

- I. 17, 33, 47, 63, 67, 76
- II. 17, 76, 33, 63, 47, 67
- III. 17, 76, 47, 33, 67, 63
- IV. 76, 63, 67, 47, 17, 33
- V. 76, 67, 17, 33, 47, 63

A I, II, III and IV

B II and IV

Correct Option

Solution: (B)

**Solution:**

II and IV

The idea is: if node x is an ancestor of node y, then node x must have been added before y. In A, 67 is added before 76, but 76 is an ancestor of 67. In C and E, 67 is added before 63, but 63 is an ancestor of 67.

C II, III and V

D II and V

Q.46)

Given that R is the set of real numbers.

For a given function f from R to R, for all x,  $f(x) = 10x - 30$ .

Which of the following are correct about function f?

A f is only one-to-one

B f is only onto

C f is both one-to-one and onto

Correct Option

**Solution:** (C)

**Explanation:**

$f$  is one-to-one: Need to prove that  $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$ .

$$10x_1 - 30 = 10x_2 - 30 \Rightarrow 10x_1 = 10x_2 \Rightarrow x_1 = x_2$$

(adding 30 on both sides and then dividing by 10 on both sides)

$\therefore f$  is one-to-one

$f$  is onto : we need to prove that,

$\forall y \in R, \exists x \in R, \text{ such that } f(x) = y$ .

Let  $y \in R$ .

$x = \frac{y+30}{10}$ , which is a real number.

$$f(x) = 10x - 30 = 10 \frac{y+30}{10} - 30 = y + 30 - 30 = y$$

$\therefore f$  is onto.

D None of the above

Q.47)

Which of the following minimal boolean expression represent the 3-input majority gate?

NOTE: A majority gate is a digital circuit whose output is 1 if the majority of the inputs are 1, else the output is zero.

A  $AB' + BC + A'C$

B  $AB + AC + BC$

Correct Option

**Solution:**

**Solution:**

The truth table for 3-input majority gate will be:

A	B	C	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

The expression formed will be:

$$\Rightarrow A'BC + AB'C + ABC' + ABC$$

$$\Rightarrow A'BC + AB'C + AB$$

$\Rightarrow A'BC + A(B'C + B)$   
 $\Rightarrow A'BC + A( (B' + B)(B + C))$   
 $\Rightarrow A'BC + A(B + C)$   
 $\Rightarrow A'BC + AB + AC$   
 $\Rightarrow AB + C(A'B + A)$   
 $\Rightarrow AB + C( (A' + A)(A + B))$   
 $\Rightarrow AB + C(A + B)$   
 $\Rightarrow AB + AC + BC$

C  $AB + A'C + BC$

D None of the above

Q.48)

Which of the following statement is True?

- I. Create table is a good example for valid triggering event.
- II. If a database has two tables T1, and T2 and both of these tables have a same column C, then C is a foreign key.

Subject: DBMS

Max Marks: 2

A Only I

Correct Option

Solution: (A)

Solution:

A trigger is a special type of stored procedure that automatically runs when an event occurs in the database server. CREATE falls under DDL, and DDL triggers run in response to a variety of data definition language (DDL) events.

Just having a same column does not make it a foreign key. It needs to be a primary key for one table, and then it is called foreign key for the other table.

Thus, only statement I is correct.

B Only II

C Both I and II

D Neither I nor II

Q.49)

If you were given the job to write a hash function for storing names(strings), which one of the following hash functions is the BEST

Subject: Data Structures

Max Marks: 2

A multiply the integer value of each character in the string by their respective index in the string and return the sum of these products

Correct Option

Solution: (A)

SOLUTION:

is the best solution, since it best spreads out the hash keys.

takes only as many values as there are characters in the alphabet, so there are many collisions and only the first elements of the array will be used independent of the overall array size.

Not bad, but spreads hashkeys over a smaller interval than (a).

(d) is not deterministic.

B return the int value of the middle character of the string

C sum up the integer value of each character in the string

D return the value of Math.Random (i.e. a random number) rounded to the closest integer

Q.50)

Which of the following is/are True

- I. Every subset of a regular language is regular.
- II. Let  $L' = L_1 \cap L_2$ . If  $L'$  is regular and  $L_2$  is regular,  $L_1$  must be regular.

Subject: Theory of Computation,Compiler Design

Max Marks: 2

A I and II

B I only

C II only

D Neither I nor II

Correct Option

Solution: (D)

Explanation:

- I. Every subset of a regular language is regular. FALSE.  
Often the easiest way to show that a universally quantified

statement such as this is false by showing a counterexample. So consider  $L = a^*$ .  $L$  is clearly regular, since we have just shown a regular expression for it. Now consider  $L' = a^i : i$  is prime.  $L' \subseteq L$ . But we showed in class that  $L'$  is not regular.

- II. Let  $L' = L_1 \cap L_2$ . If  $L'$  is regular and  $L_2$  is regular,  $L_1$  must be regular. FALSE.  
 Let  $L' = \emptyset$ . Let  $L_2 = \emptyset$ . So  $L'$  and  $L_2$  are regular.  
 Now let  $L_1 = \{a^i : i$  is prime $\}$ .  $L_1$  is not regular. Yet  $L' = L_1 \cap L_2$ .

**Q.51)**

Subject: operating systems

Max Marks: 2

We are supposed to use overlays technique that allows programs to be larger than the computer's main memory. At a time, process P can use a total main memory of 512KB. Also, let P be structured as overlay A and overlay B. Say, the overlay A has code of size of 180 KB and overlay B has data of size of 40KB. And the common data between A and B has a size of 80KB. If the size of the code common to A and B is X, B's code size is Y and A's data size is Z, then out of the given options below, which (X,Y,Z) triples will allow the process P's execution in the system?

A (220KB, 140KB, 40KB)

B (220KB, 180KB, 10KB)

C (160KB, 240KB, 60KB)

D (160KB, 220KB, 80KB)

Correct Option

**Solution:** (D)

**Explanation:**

The total size of overlay A is

$$X + 80\text{KB} + 180\text{KB} + Z = X + Z + 260\text{KB}$$

The total size of overlay B is

$$X + 80\text{KB} + Y + 40\text{KB} = X + Y + 120\text{KB}$$

Given that process P is restricted to a main memory size of 512KB, the total main memory required for each overlay of process P must be at most 512KB. Therefore, each correct answer choice needs to satisfy the two inequalities:  $X+Z \leq 252\text{KB}$  and  $X+Y \leq 392\text{KB}$ .

**Q.52)**

Subject: computer organization

Max Marks: 2

For a direct-mapped cache design with a 16-bit address, the following bits of the address are used to access the cache.

Tag	Index	Offset
15-10	9-4	3-0

What is the ratio between total bits required for such a cache implementation over the data storage bits including one valid bit. (Evaluate the answer upto two decimal places).

Correct Answer

**Solution:** (1.05)

**Answer:** 1.05

**Explanation:**

Since the offset is 3-0, that is 4 bits, it implies  $2^4$  bytes = 16 bytes = 4 words.

Index bits are 4-9  $\Rightarrow$  6 bits

Number of cache lines =  $2^6 = 64$

Total bits =  $64 \text{ entries} \times (1 \text{ valid bit} + 6 \text{ tag bits} + 16 \times 8 \text{ data bits}) = 64 \times 135$ .

Data bits =  $64 \text{ entries} \times 16 \times 8 \text{ data bits} = 64 \times 128$ .

Ratio =  $64 \times 135 / (64 \times 128) = 1.05$

**Q.53)**

Subject: computer organization

Max Marks: 2

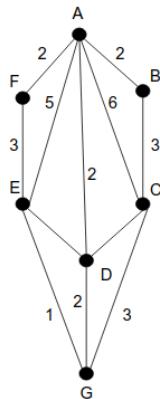
Consider a non-pipelined processor using the 5-stage datapath with 1 ns clock cycle. Assume that due to clock skew and pipeline registers, pipelining the processor adds 0.2 ns of overhead to the clock speed. How much speedup can we expect to gain from pipelining? Assume a balanced pipeline and ignore the pipeline fill and drain overheads (Evaluate the answer upto two decimal places).

**Solution:** (4.16)**Answer: 4.16****Explanation:**

Without pipelining: Clock period = 1 ns, CPI = 5

With pipelining: Clock period =  $1 + 0.2 = 1.2$  ns, CPI = 1Speedup from pipelining =  $(1 \text{ ns} * 5) / (1.2 \text{ ns} * 1) = 5 / 1.2 = 4.16$ **Q.54**

Which of the following is not a possible order or removal of nodes for the given graph from the min heap in case Dijkstra's single source shortest path algorithm is applied with the source at vertex A.



Note: Since the edge weights, ED and DC are not mentioned, all those who have attempted this question will be given marks.

**A**

A, B, F, D, E, C, G.

**B**

A, F, B, D, E, C, G.

**C**

A, D, F, B, C, E, G.

**D**

None of the above.

Correct Option

**Solution:** (D)**Solution:**

1. If we start with A it is removed from the min heap.

A. Vertices F, B, E, C and D are relaxed.

B. F.d=2, B.d=2, D.d=2 E.d=5 C.d=6

2. Now let's choose B

A. Vertex C is relaxed, C.d=5

3. Now let's choose F

No vertex is relaxed.

4. Now let's choose D

A. Vertex G is relaxed.

B. G.d=4.

5. Now let's choose E

No vertex is relaxed.

6. Now C has to be chosen

No vertex is relaxed.

7. Finally vertex G is relaxed.

If we observe vertices F, B and D can be chosen in any order as they are at the same distance from the source and if we work out we will get the cost of E and C to be (after removing F, B and D they both will get reduced to 3) therefore they can also be removed in any order and this should be followed by G as it is at maximum distance from the source.

**Q.55**

**Statement I:** The Floyd Warshall's Algorithm can be used to also detect negative weight cycles in a graph.

**Statement II:** The Bellman Ford Algorithm can be modified to detect all pairs shortest paths.

**A**

Statement I is true only.

**B**

Statement II is true only.

**C**

Both Statement I and II are true.

Subject: Algorithms

Max Marks: 2

**Solution:** (C)**Solution:**

Floyd Warshall's algorithm can be used to detect negative weight cycle if at the end of the Floyd Warshall's algorithm we have distance from a vertex to itself as negative we can conclude that the graph contains a negative weight cycle.

If we run the Bellman Ford's algorithm with multiple times with each vertex as the source each time then we can determine the all pairs shortest path for a given graph.

Therefore both statement I and statement II are true.

Correct Option

**D** Neither Statement I or Statement II is true.

**Q.1)**

Subject: General Aptitude

Max Marks: 1

Applied Course offers their GATE CS Blended Course at a discount of 22% to all the students. They also give a special offer to their AI students that if they take the GATE CS Blended Course then they get 10% cashback by applying the promotional code at the time of purchase. So what will be the net discount (in percentage) for the AI students for the GATE CS Blended Course?

Note: There was a mistake in the calculation, which is updated now and answer and option is updated accordingly.

**A** 29.8%

Correct Option

**Solution:** (A)

**Solution:** Let the original selling price of the course be ₹ 100.

Then the amount at which all the students can purchase the course

$$= 100 - (100 * \frac{22}{100}) = 100 - 22 = ₹ 78.$$

The amount at which AI students can purchase the course

$$= 78 - (78 * \frac{10}{100}) = 78 - 7.8 = ₹ 70.2$$

Therefore, the total discount for the AI student = ₹ 100 - ₹ 70.2 = ₹ 29.8

$$\text{Discount (in percentage)} = \frac{29.8}{100} * 100 = 29.8\%$$

**B** 32%

**C** 20.8%

**D** Cannot be determined

**Q.2)**

Subject: General Aptitude

Max Marks: 1

Select the most correct sentences out of the given options.

Sagar noticed the cat's soft hair, sharp paws, and a keen sense of hearing.

**A** Sagar noticed the cat's soft hair, sharp paws, and a keen sense of hearing.

Correct Option

**Solution:** (A)

**Solution:** The given sentence is correct so the answer is an option (a). The given phrases are all parallel and hence no error.

**B** Sagar noticed the cat's soft hair, sharp paws, and that his sense of hearing was keen.

**C** Sagar noticed the cat's soft hair, that he had sharp paws, and a very keen sense of hearing.

**D** Sagar noticed the cat's soft hair, keen sense of hearing and also that it had sharp paws.

**Q.3)**

Subject: General Aptitude

Max Marks: 1

Select the correct alternative for the underlined sentence below having the same meaning.

With great difficulty, he was able to carve out a niche for himself.

**A** became a sculptor

**B** did the best he could do

**C** destroyed his career

**D** developed a specific position for himself

Correct Option

**Solution:** (D)

**Solution:** "to carve out a niche" it means that to establish a unique role (for oneself), usually by excelling in a very specific area. Hence the option (d) is correct.

**Q.4)**

Subject: General Aptitude

Max Marks: 1

Find the correct alternative having the same meaning for the sentence given below

He says that he is very sorry.

**A** He said. 'He is very sorry'

**B** He told me. 'I felt sorry'

**C** He says, 'I am very sorry'

Correct Option

**Solution:** (C)

**Solution:** The given sentence is in the form of indirect speech, the answer to it is in the form of direct speech and both have the same meaning. The rest of the other sentence does not follow the rules of the direct/indirect speech and hence is wrong.

D He said. 'He was very sorry'

Q.5)

The smallest square number, which is exactly divisible by 2, 3, 4, -9, 6, 18, 30 and 60, is

Subject: General Aptitude

Max Marks: 1

A 900

Correct Option

**Solution:** (A)

**Solution:** LCM of the given numbers is 180.

Hence, all the multiples of 180 will be divisible by all of these numbers.

We will check with the multiples of 180 and check the smallest square number.

The multiples of 180 are: 360, 540, 720, 900.

900 is the smallest square number which is exactly divisible by the given numbers.

B 1600

C 3600

D None of these

Q.6)

Tushar invests his money for 3 years under a policy where the interest is compounded annually and the money invested by him grows to  $\frac{729}{512}$  times. In how many years the same amount of money will get 4 times the amount invested by Tushar under the simple interest policy where the rate of interest remains the same as per the earlier policy?

Subject: General Aptitude

Max Marks: 2

A 21 years

B 20 years

C 22 years

D 24 years

Correct Option

**Solution:** (D)

**Solution:** Let the money invested by Tushar be ₹ x.

As per the compound interest policy the amount after 3 years will be ₹  $\frac{729}{512}x$ .

The formula to calculate the amount as per compound interest is

$A = P(1 + \frac{r}{100})^n$ , A = amount, P = principal, r = rate of interest, n = number of years.

Therefore we can say that,

$$\begin{aligned}\frac{729}{512}x &= x(1 + \frac{r}{100})^3 \\ \Rightarrow \frac{729}{512} &= (1 + \frac{r}{100})^3 \\ \Rightarrow 1 + \frac{r}{100} &= \frac{9}{8} \\ \Rightarrow \frac{r}{100} &= \frac{1}{8} \\ \Rightarrow r &= \frac{100}{8}\% \end{aligned}$$

Now we need to find the number of years using the simple interest policy.

As per the question the Amount will be ₹ 4x, if Principal is ₹ x.

Then Simple Interest (SI) =  $A - P = 4x - x = ₹ 3x$ .

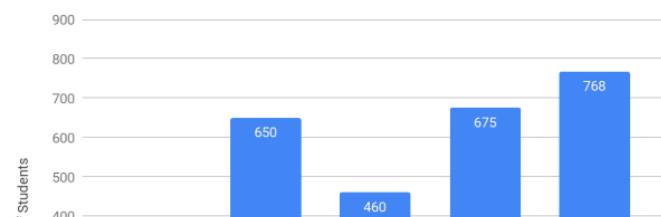
$$\begin{aligned}SI &= \frac{Pnr}{100} \\ \Rightarrow 3x &= \frac{x \cdot n \cdot 100}{8 \cdot 100} \\ \Rightarrow 3 &= \frac{n}{8} \\ \Rightarrow n &= 24 \text{ years.} \end{aligned}$$

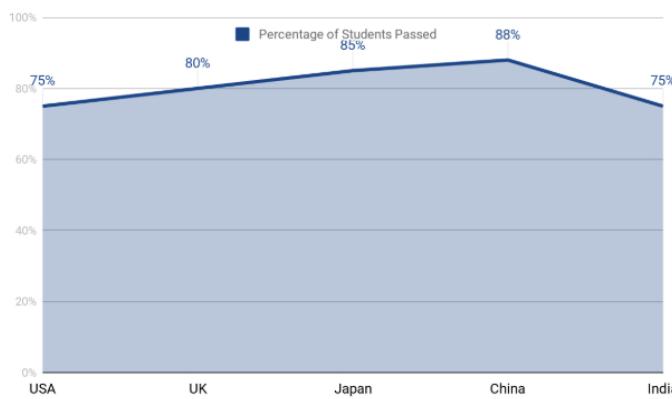
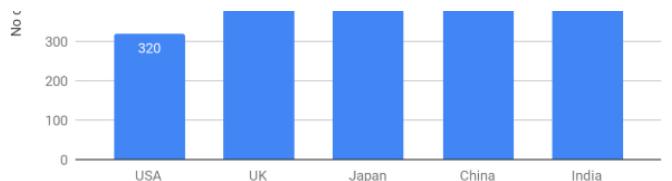
Q.7)

Below is a column graph showing the number of students appeared for the International Mathematical Olympiad from 5 different countries. The line graph below shows the pass percentage of the students from the 5 different countries. Find the ratio of number of girls passed in China to number of boys failed in China, if the ratio of boys and girls are given as 14:13?

Subject: General Aptitude

Max Marks: 2





A 21:143

B 21:121

**C 143:21**

Correct Option

**Solution:** (C)

**Solution:** Number of Students appeared for the exam in China = 675  
 Number of students passed in China =  $675 * \frac{88}{100} = 594$   
 Number of Girls passed in China =  $594 * \frac{13}{27} = 286$   
 Therefore, number of students failed in China =  $675 - 594 = 81$   
 Number of Boys failed in China =  $81 * \frac{14}{27} = 42$   
 Hence, the ratio of number of girls passed in China to number of boys failed in China =  $286 : 42 = 143 : 21$

D 143:121

**Q.8)**

Mr. X purchased 2 varieties of pulses, costing ₹ 5 per kg and ₹ 6 per kg each. These two pulses were mixed in some ratio. The mixture was sold at ₹ 7 per kg by making a profit of 20%. Find the ratio of the mixtures.

Subject: General Aptitude

Max Marks: 2



**A 1:5**

Correct Option

**Solution:** (A)

**Solution:** Let the ratio of the mixtures be  $1 : k$   
 Then we can say that  $(1+k)$  kg of mixture will be equal to 1 kg of pulses of one type and  $k$  kgs of pulses of the other.  
 As per the given cost the cost of  $(1+k)$  kg of mixture will be  
 $\Rightarrow (5 * 1) + (k * 6) = 5 + 6k$   
 Hence the equation will be as follows if  $(1+k)$  kg of mixture is sold for ₹ 7 per kg at a profit of 20%.  
 $7(1+k) = (5 + 6k) + \{20\% of (5 + 6k)\}$   
 $\Rightarrow 7 + 7k = 5 + 6k + \{\frac{20}{100}(5 + 6k)\}$   
 $\Rightarrow 2 + k = \frac{5+6k}{5}$   
 $\Rightarrow 10 + 5k = 5 + 6k$   
 $\Rightarrow k = 5$   
 Hence the ratio of the mixture is  $1 : 5$

B 3:8

C 2:7

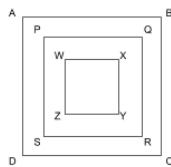
D 1:10

Q.9)

Subject: General Aptitude

Max Marks: 2

A series of infinite concentric squares are drawn as shown below. Starting with the first square  $WXYZ$ , subsequent squares drawn are  $PQRS$ ,  $ABCD$  and so on as shown in the diagram. If areas of the squares  $WXYZ$ ,  $PQRS$ ,  $ABCD$ , ..... are  $1$ ,  $\frac{3}{2}$ ,  $\frac{7}{4}$ ,  $\frac{15}{8}$ , ..... and so on, then find the area of the diagram when the infinite number square is drawn.

 A

1

 B

2

Correct Option

**Solution:** (B)**Solution:** Area of  $\square WXYZ = 1$ 

$$\text{Area of portion between } WXYZ \text{ and } PQRS = \frac{3}{2} - 1 = \frac{1}{2}$$

$$\text{Area of the next portion between } PQRS \text{ and } ABCD = \frac{7}{4} - \frac{3}{2} = \frac{1}{4}$$

So the required area is the sum of the following infinite series  $1 + \frac{1}{2} + \frac{1}{4} + \dots$

So from the series we can see the common ratio is  $\frac{1}{2}$ . Hence we need to calculate the sum of infinite Geometric Progression

$$S_{\infty} = \frac{a}{1-r}, \text{ where } a = 1 \text{ and } r = \frac{1}{2}$$

$$\text{Therefore the required area} = \frac{1}{1-\frac{1}{2}} = 2$$

 C

3

 D

0

Q.10)

Subject: General Aptitude

Max Marks: 2

The first and the last sentence of the paragraph is given, arrange the remaining sentence which forms a meaningful paragraph.  
Rahul Sharma, clearly no admirer of long engagements, got married abruptly for the second time in three years.

- A. The latest wedding took place in a secret midnight ceremony in Sydney, Australia.
- B. It is also the second marriage for the new missus, about whom little is known.
- C. The wedding was attended by the groom's entourage and staff, according to Sharma's publicist.
- D. The bride, 37-year-old Debbie Rowe, who is carrying Sharma's baby, wore white.

All that is known is that she is a nurse for Sharma's dermatologist.

 A

CBAD

 B

BDCA

 C

DCBA

 D

ACDB

Correct Option

**Solution:** (D)

**Solution:** The paragraph is about Rahul Sharma's recent marriage. The opening statement mentions that Sharma got married for the second time in three years, so the next sentence, abiding by the sequential order, would inform about this new wedding. Sentence A states that this latest wedding took place in a secret midnight ceremony in Sydney, now if there is a sentence which describes or gives more information about this wedding, then it would come next. Hence, C is our third sentence as it informs who attended this wedding. Now, the remaining sentences are about Rahul Sharma's wife, so we will look for a sentence that best introduces her. It is evident that sentence D, with the appositive phrase, introduces or describes his wife. Now, the only remaining spot for B is fourth, but it can be verified as it makes a perfect link with the closing sentence: sentence B says that not much known about her, and sentence 6 continues this thought by saying that all that is known is that she is a nurse of Sharma's dermatologist.

close