

Q.1)

Consider the following two statements:

S1: A cyclic dependency always lead to a deadlock

S2: If the valid bit is clear (equals 0) in a PTE needed for a memory access, the desired page will be swapped in from the backing store.

Which of the above statements are not correct?

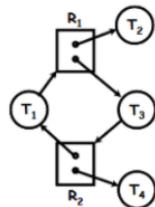
 A    \$1 only B    \$2 only C    Both \$1 and \$2

Correct Option

Solution: (C)

Explanation:

S1)

*No. The cycle dependency may only be temporary (eventually resolve itself). Here is an example given in class that has a cyclic dependency by is not deadlocked:*

S2) False.

A 1 in valid-invalid bit signifies that the page is in memory and 0 signifies that the page may be invalid or haven't brought into the memory just yet. It doesn't mean it is always a page fault, it could be a trap.

 D    Neither \$1 nor \$2

Q.2)

Subject: Data Structures

Max Marks: 1

Suppose that you implement a queue using a null-terminated singly-linked list, maintaining a reference to the item least recently added (the front of the list) but not maintaining a reference to the item most recently added (the end of the list). What are the worst case running times for enqueue and dequeue?

 A    constant time for both enqueue and dequeue B    constant time for enqueue and linear time for dequeue C    linear time for enqueue and constant time for dequeue

Correct Option

Solution: (C)

 D    linear time for both enqueue and dequeue

Q.3)

The time complexity represented by  $T(n)$  in the following recurrence relation is

Subject: Algorithms

Max Marks: 1

$$T(n)=4T(n/2)+\log n$$

 A     $\Theta(n \log n)$  B     $\Theta(n)$  C     $\Theta(n^2)$ 

Correct Option

**Solution:** (c)

**Solution:**

Applying masters theorem  $a=4$   $b=2$   $k=0$   $p=1$

$a > b^k$

$$T(n) = \Theta(n^{\log_b a}) \\ = \Theta(n^2).$$

**D**

None of the above

**Q.4)**

The output of the following C code is \_\_\_\_\_

```
int sum=0;
for(int i=1;i<5;i++)
for(int j=10;j<15;j++)
    sum += i+j;
printf("%d\n",sum);
```

Subject: C Programming

Max Marks: 1



**Solution:** (290)

**Answer:** 290

**Explanation:**

First Iteration  $i=1$  and  $j=10$

Sum=65 ( $11+12+13+14+15$ )

Second Iteration  $i=2$  and  $j=10$

Sum =70 ( $12+13+14+15+16$ )

Third Iteration  $i=3$  and  $j=10$

Sum =75 ( $13+14+15+16+17$ )

Fourth Iteration  $i=4$  and  $j=10$

Sum =80 ( $13+14+15+16+17$ )

Total Sum =  $65+70+75+80 = 290$

Correct Answer

**Q.5)**

Which of the following is the correct binary equivalent of  $15C.38_{16}$  ?

Subject: digital logic systems

Max Marks: 1



**A**

000101011100.00111010<sub>2</sub>

**B**

000101011100.00111100<sub>2</sub>

Correct Option

**Solution:** (B)

**Solution:**

$$15C_{16} \Rightarrow 0001\ 0101\ 1100$$

For  $0.38_{16}$  also we will simply write binary form of 3 and 8 after the dot i.e.  $0.38 = .0011\ 1000$

Hence, the final binary representation will be:  $0001\ 0101\ 1100.\ 0011\ 1000_2$

Thus correct option is (ii)

**C**

000101011110.00111000<sub>2</sub>

**D**

None of the above

**Q.6)**

Given is a set of jobs to be scheduled for execution on a uniprocessor system.

Subject: operating systems

Max Marks: 1



Job	Arrival Time	Burst Time	Priority
J1	0	10	2
J2	2	8	1
J3	3	3	3
J4	10	4	2

J5	12	1	3
J6	15	4	1

Using non preemptive priority scheduling, the Completion Time of job J5 is \_\_\_\_\_ units.

Note : Here the arrival time is used as a tie break mechanism.

Also lower number means higher priority.

Correct Answer

**Solution:** (30)

Explanation :

The Gantt chart is provided below:

$J_1$	$J_2$	$J_6$	$J_4$	$J_3$	$J_5$
0	10	18	22	26	29

The job J5 completes at 30 units of time.

Q.7)

Subject: Computer Networks

Max Marks: 1

In a selective repeat sliding window protocol the bandwidth of the link is 10 Mbps. The size of the frame is 10 KB and the one-way delay is 100 msec. If the efficiency of the protocol is 60 % then the minimum number of sequence bits that are required for the protocol is?

Correct Answer

**Solution:** (5)

**Explanation:**

$$T_t = \text{Frame size} / \text{Bandwidth} = 10 \text{ KB} / 10 \text{ Mbps} = 8 \text{ ms}$$

$$T_p = 100 \text{ msec}$$

$$a = T_p/T_t = 100 \text{ msec} / 8 \text{ ms} = 12.52 \text{ ms}$$

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

$$60/100 = WS / (1 + 2a)$$

$$WS = 15.6$$

For selective repeat protocol

$$SWS \leq 2^{m-1}$$

$$15.6 \leq 2^{m-1}$$

$$m = 5$$

Q.8)

Subject: Computer Networks

Max Marks: 1

For which of the following UDP does not give any assurance?

A

Flow control

B

Acknowledgments

C

Error control for a bad segment

D

All of the above

Correct Option

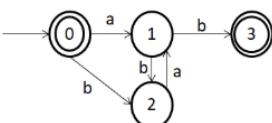
**Solution:** (0)

**Explanation:**

UDP is a connectionless and unreliable protocol. UDP does not do flow control, error control or retransmission of a bad segment. UDP is faster than TCP.

Q.9)

Consider the following finite state machine M



The regular expression for the language accepted by M is

Subject: Theory of Computation, Compiler Design

Max Marks: 1

The regular expression for the language accepted by M is

A  $\epsilon + a(ba)^*b + b(ab)^*b$

B  $\epsilon + a(ba)^*b + b(ba)^*ab$

C  $\epsilon + (a+ba)(ba)^*b$

Correct Option

Solution: (c)

Explanation:

Apply Arden's Lemma

Equation for 0 =  $\epsilon$  ----- (1)

Equation for 1 =  $0a + 2a \Rightarrow 1 = a + 2a$  Substitute  $\epsilon$  in 0 ----- (2)

Equation for 2 =  $0b + 1b \Rightarrow 2 = b + 1b$  ----- (3)

Substitute (3) in 2

$1 = a + 2a = a + (b + 1b)a = a + ba + 1ba$

$1 = (a + ba) + 1ba \Rightarrow R = Q + RP \Rightarrow R = QP^*$

$1 = (a + ba)(ba)^*----- (4)$

Equation for 3 =  $1b$

$\Rightarrow 3 = (a + ba)(ba)^*b$

From the given M both 0 and 3 are the final states.

The RE for the given M is

$\epsilon + (a + ba)(ba)^*b$

D  $\epsilon + (a+ab)(ba)^*b$

Q.10)

Subject: Engineering-Mathematics

Max Marks: 1

If  $\lim_{x \rightarrow \infty} \frac{ax^2 + bx + c}{x^2 + 20x + 2020} = 15$  then the value of

$15a^2 + 12 = \underline{\hspace{2cm}}$

Correct Answer

Solution: (3387)

Solution: 3387

$\lim_{x \rightarrow \infty} \frac{ax^2 + bx + c}{x^2 + 20x + 2020}$  it is in  $\infty/\infty$  indeterminate form applying L'hospital's rule

$= \lim_{x \rightarrow \infty} \frac{2ax + b}{2x + 20}$  it again  $\infty/\infty$  indeterminate form applying L'hospital's rule

$= \lim_{x \rightarrow \infty} \frac{2a}{2} = a = 15$ .

Now the value  $15a^2 + 12 = 15 * (15)^2 + 12 = 3387$ .

Q.11)

Subject: Theory of Computation,Compiler Design

Max Marks: 1

Which of following languages are CFLS

- $L = \{w\#w^R\#w \mid w \in \{0, 1\}^*\}$
- $L = \{w \mid w \text{ is a string of the form } (0^*1)^*, \text{ with all sets of } 0\text{'s the same length}\}$

A I only

B II only

C Both I and II

D Neither I nor II

Correct Option

Solution: (D)

Explanation:

I.  $L = \{w\#w^R\#w \mid w \in \{0, 1\}^*\}$

Example strings in L include 01#10#01, 110#011#110, and 000#000#000. Let  $z = 0^n\#0^n\#0^n$ .  $z \in L$ . According to the pumping lemma,  $z = uvwxy$  such that  $|vx| \leq n$  and  $uv^iwx^i y \in L$ . Clearly neither v nor x may contain a # and be pumped to get a string in L. If v and x contain only 0's, then these 0's are from 2 adjacent sets only, not all 3 sets. Therefore, pumping v and x will give a string with a different number of 0's in one or two

sets but not the third and so the string would not be in L. Hence, L is not context-free.

- II.  $L = \{w \mid w \text{ is a string of the form } (0^*1)^*, \text{ with all sets of } 0\text{'s the same length}\}$

The strings of this language are  $\epsilon, 0101, 001001, 00010001, \dots$ . Let  $z = 0^n10^n$ . By the pumping lemma,  $z$  may be rewritten as  $uvwxy$  such that  $1 \leq |vx| \leq n$  and  $uvy$  is in  $L$ . It is obvious that neither  $v$  nor  $x$  can contain 1. If  $vx$  contains only 0's in one or even two of the 3 sets of 0's,  $uvy$  will not be in  $L$ . Given the length of  $vx$ , it cannot span all 3 sets of 0's. Hence,  $L$  is not context-free.

Q.12)

The 5 stages of the processor have the following latencies:

Fetch	Decode	Execute	Memory	WriteBack
200ps	150ps	120ps	190ps	140ps

Find the difference between the Cycle times of a non-pipelined processor and pipelined processor in ps. Assume that when pipelining, each pipeline stage costs 20ps extra for the registers between pipeline stages.

Subject: computer organization

Max Marks: 1

Correct Answer

Solution: (580)

Answer: 580

Explanation:

Because there is no pipelining, the cycle time must allow an instruction to go through all stages in one cycle.

Non-pipelined processor CT =  $200 + 150 + 120 + 190 + 140 = 800$ ps

Pipelined processor CT =  $200 + 20 = 220$  ps

Difference =  $800 - 220 = 580$

Q.13)

Consider a memory system with a cache, a main memory and a virtual memory. The access times and hit rates are as shown in the table.

Subject: computer organization

Max Marks: 1

	Cache	Main	Virtual Memory
Hit rate	80%	99%	100%
Access time	5ns	100ns	8ms

Find the average access time for the hierarchy in ns.

Correct Answer

Solution: (16025)

Answer: 16,025

Explanation:

$$\begin{aligned} AMAT &= H1*T1 + (1-H1)(H2*T2 + (1-H2)H3(T1+T2+T3)) \\ &= 0.8*(5\text{ns}) + 0.2*(0.99*(100+5) + 0.01*1*(8000000+100+5)) = \\ &4+0.2(103.95+80001.05) = 4+0.2(80105) = 4+16,021 = 16025\text{ns} \end{aligned}$$

Q.14)

A computer uses RAM chips of  $1024 \times 1$  capacity. The number of chips and the size of the decoder needed to provide a memory capacity of 16KB.

Subject: computer organization

Max Marks: 1

A 128, 7x128

B 128, 4x16

Correct Option

Solution: (B)

Explanation:

RAM chip size =  $1024 \times 1$

Memory required = 16KB  
 Total number of chips required =  $16\text{KB}/1024 = 16*8 = 128$   
 Each row we need to arrange 8 chips as the memory is Byte addressable and  
 $1\text{B} = 8 \text{ bits}$   
 Number of rows = 16  
 Size of the decoder to enable the chip select = 4x16

C 16, 4x16

D 64, 6x64

Q.15)

The maximum number of edges in a bipartite graph on 19 vertices is \_\_\_\_\_

Subject: Discrete Mathematics

Max Marks: 1

Correct Answer

Solution: (30)

**Explanation:**

To have the maximum number of edges, each vertex from one set should have an edge to every vertex from the other set, therefore it becomes a complete bipartite graph.

Now, complete binary graph has  $m * n$  edges where  $m$  is the number of vertices in set A and  $n$  is the number of vertices in set B.

If :

.

$m = 8, n = 11$ , then  $m * n = 88$

$m = 9, n = 10$ , then  $m * n = 90$

$m = 10, n = 9$ , then  $m * n = 90$

$m = 11, n = 8$ , then  $m * n = 88$

.

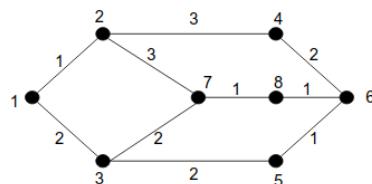
Thus, we see that the maximum number of edges in a bipartite graph is 90

Q.16)

Subject: Algorithms

Max Marks: 1

What is the cost shortest path reported from vertex 1 to 6 by Dijkstra's Algorithm in the below graph?



Correct Answer

Solution: (5)

Solution: 5

The minimal cost reported path is 1-3-5-6 which has cost 5.

Q.17)

Consider the below given statements:

- I. Referential integrity constraints are always specified between two entities in a schema.
  - II. Referential integrity constraints are always specified between entities having recursive relation.
- Which of the above statements is incorrect?

A Only I

B Only II

C Both I and II

Subject: DBMS

Max Marks: 1

Correct Option

Solution: (C)

Solution:

Referential integrity constraints can also be specified within an entity. For example, consider the self referential entity where we have a recursive foreign key with in a single relation.

This statement is opposite of statement I. It is not always the case of recursive or self referential relationship. Referential integrity exists between the two individual entities also.

Therefore, both the statements are incorrect.

D

Neither I nor II

Q.18)

The language generated by the given Grammar is

$$S \rightarrow 1S|AA$$

$$A \rightarrow 0A1|\epsilon$$

A

$$L = \{1^k 0^{2n} 1^{2n} : n, k \geq 0\}$$

B

$$L = \{1^k 0^n 1^n 0^m 1^m : m, n, k \geq 0\}$$

C

$$L = \{1^k 0^n 1^n 0^m 1^m : m, n, k \geq 0\}$$

Correct Option

Solution: (c)

Explanation:

Given grammar is

$$S \rightarrow 1S|AA$$

$$A \rightarrow 0A1|\epsilon$$

$\Rightarrow S \rightarrow 1S$  will generate any number of 1's  $\Rightarrow 1^k, k \geq 0$

$S \rightarrow AA$  and  $A \rightarrow 0A1|\epsilon$

$$A \Rightarrow 0^n 1^n$$

$$A \Rightarrow 0^m 1^m$$

$$S \Rightarrow \{1^k 0^n 1^n 0^m 1^m : m, n, k \geq 0\}$$

D

$$L = \{1^k 0^n 1^n 0^m 1^m : m, n, k \geq 0\}$$

Q.19)

Let A and B be the given two sets:

$$A = \{1, 2, 3\} \text{ and } B = \{1, 4\}$$

Subject: Discrete Mathematics

Max Marks: 1

Let set  $Z = (A - B) \times B$ ,

Where  $\times$  represents the cartesian product

The cardinality of Z is \_\_\_\_\_

C

Correct Answer

Solution: (4)

Answer : 4

Explanation:

$$Z = (A - B) \times B = \{2, 3\} \times \{1, 4\} = \{(2, 1), (2, 4), (3, 1), (3, 4)\}$$

The cardinality of Z, which is basically the size of the set = 4 elements

Q.20)

The following context-free grammar can parse all the lowercase roman numerals from 1-99. The terminal symbols are { c, l, x, v, i } and the initial symbol is S.

Subject: Theory of Computation, Compiler Design

Max Marks: 1

$$\begin{array}{lcl} S & \rightarrow & xTU \mid lX \mid X \\ T & \rightarrow & c \mid l \\ X & \rightarrow & xX \mid U \\ U & \rightarrow & iY \mid vi \mid I \\ Y & \rightarrow & x \mid v \\ I & \rightarrow & ii \mid \epsilon \end{array}$$

Then First(S) is

A

$$\{x, l, i, v\}$$

A {x, i, v, ε }

B {x, l, i, v, ε }

Correct Option

Solution: (c)

**Explanation:**

$$\begin{aligned}\text{First}(S) &= \{x, l\} \cup \text{First}(X) \\ \text{First}(X) &= \{x\} \cup \text{First}(U) \\ \text{First}(U) &= \{i, v\} \cup \text{First}(I) \\ \text{First}(I) &= \{i, \epsilon\} \\ \text{First}(S) &= \{x, l, i, v, \epsilon\}\end{aligned}$$

C {x, c, l, i, v, ε }

Q.21)

Which of the following statements is not true?

Subject: digital logic systems

Max Marks: 1



- I. The number of bits required to represent 31 in signed 2's complement is 6.
- II. The number of bits required to represent -16 in signed 2's complement is 4 bits.

A Only I

B Only II

Correct Option

Solution: (B)

**Solution:**

- I. Since, the range of the signed 2's complement numbers are from  $-2^{(n-1)}$  to  $2^{(n-1)} - 1$ , where n represents the number of bits. Therefore,  
 $\Rightarrow 2^{(n-1)} - 1 \geq 31$   
 $\Rightarrow 2^{(n-1)} \geq 32$   
 $\Rightarrow 2^{(n-1)} \geq 2^5$   
 $\Rightarrow n - 1 = 5$   
 $\Rightarrow n = 6$   
Hence, this is true.
- II. Since, the range of the signed 2's complement numbers are from  $-2^{(n-1)}$  to  $2^{(n-1)} - 1$ , where n represents the number of bits. Therefore,  
 $\Rightarrow -2^{(n-1)} \leq -16$   
 $\Rightarrow 2^{(n-1)} \geq 16$   
 $\Rightarrow 2^{(n-1)} \geq 2^4$   
 $\Rightarrow n - 1 = 4$   
 $\Rightarrow n = 5$   
Hence, this is not true

C Both I and II

D Neither I nor II

Q.22)

Consider the relation schema R(A, B, C, D, E, G) with functional dependencies set  $F = \{AB \rightarrow C, AG \rightarrow E, B \rightarrow D, E \rightarrow G\}$ . Note, F is the minimum cover to itself. Which of the following decompositions of R(A, B, C, D, E, G) is both lossless and dependency preserving?

Subject: DBMS

Max Marks: 1



A {ABC, CDE, EG}

B {ABCD, AEG}

C {ABCE, BD, AEG}

Correct Option

Solution: (C)

**Solution:**

- (i) This decomposition is neither lossless nor dependency preserving. The dependency  $AG \rightarrow E$  is not preserved

- (ii) This decomposition is dependency preserving but not lossless as they do not have a common key in between them.
- (iii) This decomposition is lossless as first we can join {ABCDE} and {AEG} losslessly, since {AE} is the candidate key for {AGE}. Then, {ABCEG} and {BD} can be joined losslessly since {B} is a candidate key for {BD}. It is also dependency preserving.
- Thus, the correct option is (iii).

D Both (ii) and (iii)

Q.23)

Consider the following function definition:

```
int fun1 (int n)
{
    return (n == 0)? 0 : n2 + fun1 (n - 1);
}
```

The value returned by fun1(4) is \_\_\_\_\_

Subject: C Programming

Max Marks: 1

**Solution:** (30)

**Answer:** 30

**Explanation:**

$$\begin{aligned} & 4^2 + 3^2 + 2^2 + 1^2 + \text{fun1}(0) \\ & = 16 + 9 + 4 + 1 + 0 \\ & = 30 \end{aligned}$$

Correct Answer

Q.24)

In asymmetric based encryption. If both sender and attacker encrypt the data with the public key of the receiver and the receiver is decrypting with its own private key. How the receiver will ensure that data is coming from the sender but not from the attacker by using?

Subject: Computer Networks

Max Marks: 1

A Integrity

B Confidentiality

C Assessing

D Authentication

Correct Option

**Solution:** (D)

**Explanation:**

For ensuring data is coming from the reliable source the sender must authenticate with the receiver.

Q.25)

Let N be an arbitrary natural number with  $N > 1$ . Which one of the following statements is not TRUE?

Subject: Data Structures

Max Marks: 1

A A binary tree of height N may have  $N + 1$  nodes

B A binary tree of height N may have  $N^2$  nodes.

C A binary tree of height N may have  $2N$  nodes.

D A binary tree of height N may have  $N!$  nodes.

Correct Option

**Solution:** (D)

Note:

For option d if we take  $n = 3$

The total number of nodes =  $3! = 6$

We can make a height 3 binary tree using 6 nodes

Here all options are true

Q.26)

Given a set of elements  $A = \{35, 25, 21, 15, 66, 9\}$ . Which of the following is possibly the result of a partition (partition routine of quicksort) call on any permutation of the given elements of the set given as input. Also note that this version of partition is randomised i.e. the pivot need not be selected as the first element of the array.

Subject: Algorithms

Max Marks: 2

A 25, 21, 15, 9, 66, 35

B 66, 9, 15, 21, 25, 35

C 21, 9, 15, 35, 25, 66

Correct Option

Solution: (c)

**Solution:**

When the partition routine/function is called whichever element is chosen to be the pivot after the call of the partition the pivot should reach its correct position (as in completely sorted array) and all the elements left of them are smaller than it and all the elements to the right of the pivot are larger than it.

The complete sorted array along with positions is as follows

Position	1	2	3	4	5	6
Array	9	15	21	25	35	66

Option A

Position	1	2	3	4	5	6
Array	25	21	15	9	66	35

None of the elements is in its correct position.

Option B

Position	1	2	3	4	5	6
Array	66	9	15	21	25	35

None of the elements is in its correct position.

Option C

Position	1	2	3	4	5	6
Array	21	9	15	35	25	66

Here the last element is at its correct position, and all elements to the left of it are smaller than it and all elements to its right are greater than it. Therefore option C is the correct answer.

D None of the above

Q.27)

If 3 numbers are randomly selected from the first 20 consecutive natural numbers without replacement, then the probability that their product is an odd number is

Subject: Engineering-Mathematics

Max Marks: 2

A 17/19

B 2/19

Correct Option

Solution: (B)

**Solution B**

If the product of 3 numbers is odd then all three numbers should be odd.

No of ways we can do that  $C(10,3)$ .

The total number of ways we can select 3 numbers =  $C(20,3)$

Require probability =  $C(10,3)/C(20,3) = 2/19$ .

C  $C(10,2)/C(20,2)$

D None of the above

Q.28)

The solution to the system of linear equations

Subject: Engineering-Mathematics

Max Marks: 2

$$2x+3y+4z=12$$

$$3x+7y+8z=26$$

$$11x+5y+12z=19$$

$$\text{Is } (x,y,z) \text{ then the value of } x^2+y^2+z^2 = \underline{\hspace{2cm}}$$

Correct Answer

**Solution:** (292.5625)

### Solution 292.5625

Solution by Gaussian elimination

Convert the augmented matrix into the row echelon form:

$$\left( \begin{array}{ccc|c} 2 & 3 & 4 & 12 \\ 3 & 7 & 8 & 26 \\ 11 & 5 & 12 & 19 \end{array} \right) \xrightarrow{\text{R}_2 - \frac{3}{2}\text{R}_1} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 12 \\ 0 & \frac{1}{2} & 2 & 8 \\ 11 & 5 & 12 & 19 \end{array} \right) \xrightarrow{\text{R}_3 - \frac{11}{2}\text{R}_1} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 12 \\ 0 & \frac{1}{2} & 2 & 8 \\ 0 & -\frac{23}{2} & -10 & -47 \end{array} \right) \xrightarrow{\text{R}_3 - \frac{23}{5}\text{R}_2} \left( \begin{array}{ccc|c} 2 & 3 & 4 & 12 \\ 0 & \frac{1}{2} & 2 & 8 \\ 0 & 0 & -\frac{4}{5} & -\frac{21}{5} \end{array} \right) \xrightarrow{\text{R}_3 \cdot -\frac{5}{4}}$$

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

$$\frac{4}{5}z = -\frac{21}{5}$$

$$z = -\frac{21}{4}$$

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

$$\frac{1}{2}y - 8 - 2z = 8 - 2 \cdot \frac{21}{4} = -\frac{35}{2}$$

$$y = -7$$

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

$$2x + 12 - 3y - 4z - 12 - 3(-7) - 4 \cdot \frac{21}{4} = -18$$

$$x = -9$$

The value of  $x^2 + y^2 + z^2 = 81 + 49 + (51/4)^2 = 292.5625$ .

Clean

**Q.29)**

The number of optimal schedules for the given set of tasks and their profits and deadlines is

Subject: Algorithms

Max Marks: 2

Task	Profit	Deadline
1	10	6
2	12	2
3	47	4
4	10	4
5	12	2
6	13	6
7	50	1
8	7	7
9	7	7
10	10	5

Note: Because the correct option is not present marks are allocated to all for this question.

A

2

B

4

Correct Option

**Solution:** (B)

In order to get the optimal schedule, we need to sort the tasks in decreasing order of profits and then allocate the tasks as late as possible while respecting the deadlines.

Following is the optimal schedule for the given tasks.

Time	1	2	3	4	5	6	7
Task	7	2/5	----	3	----	6	8/9
Profit	50	12	10	47	10	13	7

1. In the time slots 2 we can either schedule process 2 or 5 and
2. In the time slot 3, we can schedule task 1 or 4 or 10 all the possibilities are as follows
  - a. If we have task 1 in time slot 3 we can have only task 10 in time slot 5
  - b. If we have task 4 in time slot 3 we can have either task 1 or task 10 in time slot 5
  - c. If we have task 10 in time slot 3 then we can have only task 1 in time slot 5.

In all, we have 4 possibilities in this case which are shown diagrammatically below.

Time Slot	3	5

task	1	10
Profit	10	10

Time Slot	3	5
Task	10	1
Profit	10	10

Time Slot	3	5
Task	4	1/10
Profit	10	10

3. In time slot 7 we can either schedule task 8 or 9

so there are  $2^*4^*2 = 16$  possible schedules which will give the optimal profit.

C

8

D

1

Q.30)

Subject: Discrete Mathematics

Max Marks: 2

Suppose that  $(R \Rightarrow S) \vee \sim(P \wedge Q)$  is false.

Which proposition has the truth value as false?

A

R

B

S

Correct Option

**Solution:**

For this to be false, both  $R \Rightarrow S$  and  $\sim(P \wedge Q)$  must be false.

The only way that  $R \Rightarrow S$  can be false is if  $R$  is true and  $S$  is false.

The only way that  $\sim(P \wedge Q)$  can be false is if  $P \wedge Q$  is true.

The only way that  $P \wedge Q$  can be true is if  $P$  and  $Q$  are both true.

Therefore  $R, P$  and  $Q$  are all true, and  $S$  is false.

C

P

D

Can't be determined

Q.31)

Subject: Theory of Computation, Compiler Design

Max Marks: 2

The number of basic blocks from the given code is \_\_\_\_\_

- (1)  $B := C$
- (2)  $I := 0$
- (3)  $T := 4 * I$
- (4)  $U := A[T]$
- (5)  $V := U * U$
- (6)  $W := 4 * I$
- (7)  $A[W] := V$
- (8) if  $V > D$  goto 13
- (9)  $I := I + 1$
- (10) if  $I < B$  goto 3
- (11)  $X := C + D$
- (12)  $E := X$
- (13)  $Y := C + B$
- (14)  $F := Y$

Correct Answer

**Solution:** (5)

**Explanation:**

DDI (1) D — C

```

BB1 (1) D := 0
-----
(2) I := 0

BB2 (3) T := 4 * I
(4) U := A[T]
(5) V := U * U
(6) W := 4 * I
(7) A[W] := V
(8) if V > D goto 13
-----
BB3 (9) I := I + 1
(10) if I < B goto 3
-----
BB4 (11) X := C + D
(12) E := X
-----
BB5 (13) Y := C + B
(14) F := Y

```

Q.32)

A man is known to speak the truth 3 out of 4 times. He throws a die and reports that it is a six. The probability that it is actually a six is

Subject: Engineering-Mathematics

Max Marks: 2

 A

3/8

Correct Option

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

Let A be the event that six occurs when a die is thrown.  $P(A)=1/6$ .

$P(\sim A)=5/6$ .

Let E be the event that the man reports that it is a six.

Since the man speaks the truth 3 out of 4 times,  $P(E|A) = 3/4$ ,  $P(E|\sim A) = 1/4$ .

Since A,  $\sim A$  are mutually exclusive and exhaustive events, by Bayes' theorem

$$P(A|E) = \frac{P(A)P(E|A)}{P(A)P(E|A) + P(\sim A)P(E|\sim A)} = \frac{\frac{1}{6} \cdot \frac{3}{4}}{\frac{1}{6} \cdot \frac{3}{4} + \frac{5}{6} \cdot \frac{1}{4}} = \frac{3}{8}.$$

 B

2/7

 C

1/9

 D

4/5

Q.33)

Consider AVL trees whose nodes are integers, and heaps of integers, i.e. complete binary trees whose nodes are integers and meet the heap-order property. Which one of the following statements is correct?

Subject: Data Structures

Max Marks: 2

 A

Every non-empty AVL tree of integers is a heap of integers, but not vice versa.

 B

Every non-empty heap of integers is an AVL tree of integers, but not vice versa.

 C

Every non-empty AVL tree of integers is a heap of integers, and vice versa.

 D

None of the Above

Correct Option

**Solution:** (D)**Solution:** None of the Above

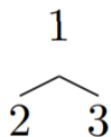
**Counter example for :** Every non-empty AVL tree of integers is a heap of integers, but not vice versa.

2



5 is a non-empty AVL tree or integers, but not a heap because  $\angle > 1$

**Counter Example for : Every non-empty heap of integers is an AVL tree of integers, but not vice versa.**



3 is a non-empty heap, but not an AVL tree because  $2 > 1$

**Counter example for: Every non-empty AVL tree of integers is a heap of integers, and vice versa.**

Both of the above are counter examples for this case

Thus, "none of the above" is correct

Q.34)

Subject: Algorithms

Max Marks: 2

Which one of the following best describes the order of the value stored in the variable **sum** after the execution of the following code snippet of the C Programming language.

```
int sum=1;
for(i=1;i<=n;i++)
{
    for(j=1;i<=n;j*=2)
    {
        for(k=n/2;k<=n;k++)
        {
            sum*=2;
        }
    }
}
```

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

B  $O(n \log n)$

C  $O(n^2)$

D None of the above

Correct Option

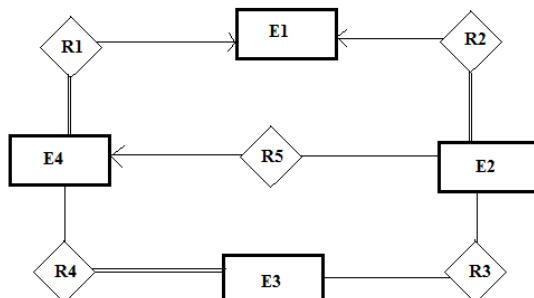
Solution: (D)

Solution D

The outer loop executes  $n$  times. The second loop with a counter as  $j$  executes  $O(\log n)$  times and innermost loop is executed  $n/2$  times which is  $O(n)$  times, therefore, the total number of times the line  $sum*=2$  is executed is  $O(n^2 \log n)$  each time it gets multiplied by 2, therefore the value stored in sum is of the order of  $O(2^{n^2 \log n}) = O(n^{n^2})$ .

Q.35)

Consider the below given ER diagram:



Subject: DBMS

Max Marks: 2

The minimum number of relations required to represent the above ER diagram are

Correct Answer

**Solution:** (5)

**Solution:** 5

For entity E1 and E2, there will be 2 separate relations for E1 and E2 due to many-to-one relationships with total participation on many sides. Thus, # of relations = 2

For entity E2 and E3, there will be 3 relations for E2, R3 and E3 respectively due to many-to-many relationships with both sides total participation. Thus, # of relations = 4 (as E2 already counted in the above inference)

For entity E2 and E4, 2 relations are required due to one-to-one relationship with both sides partial participation. # of relations = 5 (as E2 is already counted in the above inference)

For entity E3 and E4, 2 relations are required due to many-to-many relationships with one side total participation. Since both E3 and E4 are already counted in the number of relations, therefore, # of relations = 5

Similarly for entity E1 and E4. Therefore, the number of relations = 5.

Q.36)

Which of the following statements is/are False

- I. Every recognizable language can be recognized by a TM that either accepts or loops, but never rejects.
- II. If a language is decidable, then every proper subset of that language is decidable.
- III. If  $A \leq_m B$  and B is a regular language then A is a regular language.

A

I, II and III

B

I and III only

C

II and III only

Subject: Theory of Computation, Compiler Design

Max Marks: 2

Correct Option

**Solution:** (c)

**Explanation:**

- I. Every recognizable language can be recognized by a TM that either accepts or loops, but never rejects.

This statement is true. Proof: For any recognizable language L, we have a TM M that recognizes it.

We can construct a new TM M' that also recognizes L but never rejects:

“On input w:

1. Run M on w.
2. If M accepts then accept.
3. If M rejects then loop.”

This TM recognizes the same language as M because it accepts iff M accepts. It never rejects because instead of rejecting it loops.

- II. This statement is false. Counterexample: We know that  $A_{TM}$  is undecidable. Let  $\Sigma$  be the alphabet that  $A_{TM}$  is defined over.  $A_{TM} \subset \Sigma^*$  and  $\Sigma^*$  is regular and therefore decidable.

- III. This statement is false. Counterexample: Let  $A = \{0^n 1^n \mid n \geq 0\}$  and  $B = 0^* 1^*$ . B is regular because it is defined by a regular expression, and A is one of our canonical examples of a non-regular language.

The following is a mapping function from A to B:

“On input w:

1. If w is in A then output 01.
2. Otherwise output 10.”

This is a computable function because testing whether a string is in a context-free language is decidable.

If  $w \in A$  then  $f(w) = 01 \in B$  and if  $w \notin A$  then  $f(w) = 10 \notin B$ .

D

II only

Q.37)

Subject: operating systems

Max Marks: 2

Let's say in a system, it takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the page to be replaced is modified. Memory access time is 100 nanoseconds. Assume that the page to be replaced is modified 70 percent of the time. The maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds is :

 A6.1 \* 10<sup>-6</sup>

Correct Option

Solution: (A)

**Explanation:**

Let  $p$  be the page fault rate (the probability that a memory access results in a page fault). Then  $(1 - p)$  is the probability that a memory access costs 100 nsec. The probability that a page fault costs 20 msec is  $0.7 * p$  and the probability that a page fault costs 8 msec is  $0.3 * p$ . Since 1 nsec = 1000000 msec,

$$(1 - p) * 100 + 0.7 * p * 2000000 + 0.3 * p * 8000000 = 200$$

$$(14000000 + 2400000 - 100)p = 100$$

$$p = 100/(16400100) = 6.1 * 10^{-6}$$

 B8.5 \* 10<sup>-4</sup> C4.7 \* 10<sup>-5</sup> D

None of the above

Q.38)

Subject: computer organization

Max Marks: 2

You are given a non-pipelined processor design which has a cycle time of 10ns and average CPI of 1.4. If the 5 stages are 1ns, 1.5ns, 4ns, 3ns, and 0.5ns and the pipeline stalls 20% of the time for 1 cycle and 5% of the time for 2 cycles (these occurrences are disjoint). What is the speedup compared to the original processor? (Assume average CPI for a pipelined processor is 1 and each pipeline stage added also adds 20ps due to register setup delay, Evaluate the answer upto two decimal places)

 A

2.67

Correct Option

Solution: (A)

**Explanation:**

Stage delays are 1ns, 1.5ns, 4ns, 3ns, and 0.5ns

CPI for a non-pipelined processor is 1.4

Old performance = old CT \* old CPI = 10 \* 1.4 = 14

The cycle time is limited by the slowest stage, so CT = 4ns.

Adding 20ps due to the register setup delay

New CT= 4.2 ns

New CPI = 0.2(1+1) + 0.05(1+2) + 0.75(1) = 1.3

New performance = new CT \* new CPI = 4.02 \* 1.3 = 5.226

Speedup = 14/5.226 = 2.67

 B

3.48

 C

4.21

 D

None of these

Q.39)

Subject: Theory of Computation,Compiler Design

Max Marks: 2

Produce a CFG G for L1 ∪ L2 where L1 = {0<sup>n</sup>1<sup>n</sup>2<sup>m</sup>3<sup>m</sup> : n, m ≥ 0} and L2 = {0<sup>n</sup>1<sup>m</sup>2<sup>n</sup>3<sup>n</sup> : n, m ≥ 0}.

 AS → A<sub>1</sub>A<sub>2</sub>BA<sub>1</sub> → 0A<sub>1</sub>1 | εA<sub>2</sub> → 2A<sub>2</sub>3 | ε

B → 0B3 | C

C → 1C2 | ε

 BS → A<sub>1</sub>A<sub>2</sub> | BA<sub>1</sub> → 0A<sub>1</sub>1 | ε

Correct Option

$A_2 \rightarrow 2A_23 \mid \epsilon$   
 $B \rightarrow 0B3 \mid C$   
 $C \rightarrow 1C2 \mid \epsilon$

Solution: (B)

Explanation:

$S \rightarrow A_1A_2 \mid B$   
 $A_1 \rightarrow 0A_11 \mid \epsilon$   
 $A_2 \rightarrow 2A_23 \mid \epsilon$   
 $B \rightarrow 0B3 \mid C$   
 $C \rightarrow 1C2 \mid \epsilon$   
 $A_1 \Rightarrow 0^n1^n \mid n \geq 0$   
 $A_2 \Rightarrow 2^m3^m \mid m \geq 0$   
 $S \rightarrow A_1A_2 \Rightarrow L1 = \{0^n1^n2^m3^m : n, m \geq 0\}$   
 $S \rightarrow B \Rightarrow 0^nC3^n$   
 $C \rightarrow 1^m2^m$   
 $\Rightarrow 0^n1^m2^m3^n = \{0^n1^m2^m3^n : n, m \geq 0\}$ .  
 $\Rightarrow S = L1 \cup L2$ .

c)  $S \rightarrow A_1A_2 \mid B$   
 $A_1 \rightarrow 0A_11 \mid \epsilon$   
 $A_2 \rightarrow 2A_23 \mid \epsilon$   
 $B \rightarrow B_1B_2$   
 $B_1 \rightarrow 0B_11 \mid \epsilon$   
 $B_2 \rightarrow 2B_23 \mid \epsilon$

d)  $S \rightarrow A_1A_2B$   
 $A_1 \rightarrow 0A_11 \mid \epsilon$   
 $A_2 \rightarrow 2A_23 \mid \epsilon$   
 $B \rightarrow B_1B_2$   
 $B_1 \rightarrow 0B_11 \mid \epsilon$   
 $B_2 \rightarrow 2B_23 \mid \epsilon$

Q.40)

Consider the following schedule on database object A, B, C, and D:

Subject: DBMS

Max Marks: 2

Time	T1	T2	T3
1			
2			R(C)
3			
4			
5			
6	R(A)		
7			
8			
9			
10			W(C)
11		R(A)	
12		W(A)	
13			
14			
15			
16	W(B)		
17			
18			
19			
20	R(D)		
21			
22			
23		Commit	
24			
25			
26			
27	Commit		
28			
29			
30			
31			W(B)
32			
33			Commit

Which of the following statements is correct about the given schedule?

A) Schedule is permitted by strict 2PL.

Correct Option

Solution: (A)

Solution:

The above given schedule is permitted by basic 2PL as well as by strict 2PL. As the transaction T2 can acquire exclusive lock on A at timestamp 8, as it is a shared lock. Hence, the correct option is (i).

B Schedule is not permitted by basic 2PL

C Neither (i) nor (ii)

D Both (i) and (ii)

Q.41)

Which of the following sequence is not graphical?

Subject: Discrete Mathematics

Max Marks: 2

A 3,3,3,3,2

B 6,6,5,4,3,2,2

Correct Option

Solution: (B)

**Explanation:**

A. Apply Havel-Hakimi:

$$\begin{array}{ccccccc} 3, & 3, & 3, & 3, & 2 \\ \rightarrow 0, & 2, & 2, & 2, & 2 \\ \rightarrow 2, & 2, & 2, & 2 \end{array}$$

Since the sequence 2, 2, 2, 2 is graphic (it is the degree sequence of  $C_4$ ), then the original sequence is graphic.

B. Apply Havel-Hakimi:

$$\begin{array}{ccccccc} 6 & 6 & 5 & 4 & 3 & 2 & 2 \\ 5 & 4 & 3 & 2 & 1 & 1 & \\ 3 & 2 & 1 & 0 & 0 & & \\ 1 & 0 & -1 & 0 & & & \end{array}$$

Not a graphic sequence, we cannot have -1 as a degree of a vertex.

C. Apply Havel-Hakimi:

$$\begin{array}{ccccccc} 2, & 2, & 2, & 1, & 1 \\ \rightarrow 0, & 1, & 1, & 1, & 1 \\ \rightarrow 1, & 1, & 1, & 1 \end{array}$$

Since the sequence 1, 1, 1, 1 is graphic (it is the degree sequence of  $K_2 + K_2$ ), then the original sequence is graphic.

C 2,2,2,1,1

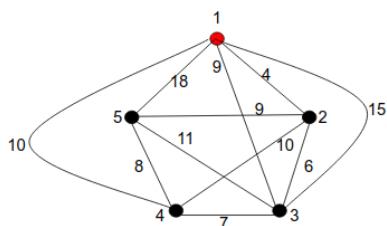
D None of the above

Q.42)

A supplier has to cover all the shops in the city and supply his goods he starts from the godown and can end his journey at the last shop, what is the minimum cost required for him for his journey given that vertex below denotes a shop and the vertex in red denotes the godown and the edges connecting vertices denotes the cost to travel from one shop to another.

Subject: Algorithms

Max Marks: 2

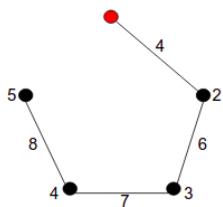


Correct Answer

Solution: (25)

Solution 25

The cost of the journey will be equal to the cost of the MST because the supplier can end the journey at the last shop. On applying Prim's algorithm starting at vertex 1, we get the following spanning tree.  
Cost=4+6+7+8=25.



Q.43)

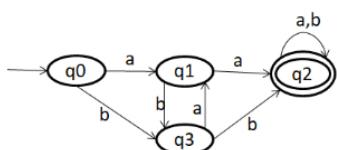
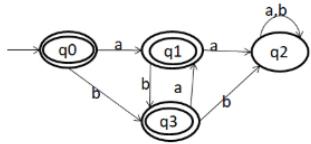
Minimum number of states in a Deterministic finite automata that accepts the language  $L = \{w \in \{a,b\}^*: w \text{ has neither aa nor bb as a substring}\}$  is \_\_\_\_\_

Subject: Theory of Computation, Compiler Design

Max Marks: 2

Correct Answer

Solution: (4)

**Explanation:**
 $L = \{w \in \{a,b\}^*: w \text{ has neither aa nor bb as a substring}\}$ 
 $L' = \{w \in \{a,b\}^*: w \text{ has either aa or bb as a substring}\}$ 
DFA that accepts the language  $L'$  isDFA that accepts the given language  $L$  is

Q.44)

In the congestion control method of TCP we are having a connection between nodes A and node B which is called connection X.

Subject: Computer Networks

Max Marks: 2

There is another TCP connection between node C and node D which is called connection Y. The initial threshold window size for connection X is 20 KB and for Y is 16 KB. Both the connections X, Y are working independently and follow the Additive increase multiplicative decrease algorithm (AIMD) for congestion control with a maximum segment size of 2 KB. The first timeout occurs at the fifth transmission in connection X and at the sixth transmission in connection Y. After every third transmission from timeout, you again encounter the timeout in both X and Y. At which transmission the connection Y reaches to the same threshold value of the connection X for the first time.

A

5

B

6

Correct Option

Solution: (B)

Explanation:

Connection X

Initial Threshold = 20 KB

First transmission = 2 KB

Second transmission = 4 KB

Third transmission = 8 KB

Fourth transmission = 16 KB

Fifth transmission = 20 KB [ Th reached, timeout occurs, New threshold = 10 KB]

Sixth transmission = 2 KB

Connection Y

Initial Thereshold= 16 KB

First Transmission = 2 KB

Second Transmission= 4 KB

Third Transmission= 8 KB

Fourth Transmission = 16KB [ Thersh reached]

Fifth Transmission= 18 KB

Sixth Transmission= 20KB [ Timeout, thereshold = 10 KB]

At the sixth transmission, the connection Y reaches the same threshold value which is 10 KB for the first time.

C

The same threshold will never occur at the K

D

None of the above

Q.45)

Consider the following C-Programming code. what is the result after the

Subject: C Programming

Max Marks: 2

execution.

```
#include <stdio.h>
int main(){
    static int gate[2020];
    int i=0;
    gate[i] = ++i;
    printf("\n %d %d %d", gate[0], gate[i], gate[i*i]);
    return 0;
}
```

- A 0 0 1
- B 0 1 0
- C 1 0 0

- D None of these

Correct Option

**Solution:** (D)

Solution: 0 1 1

**static int gate[2020];** Default Initial Value for static variable is 0, hence each cell gets initialized with value 0.

```
int i=0;
gate[i] = ++i; Here ++i is a pre increment,
⇒ it will get increment and assign the value of i to gate[i]
⇒ gate[i] will get 1
gate[i*i] is nothing but gate[1] = gate[i] = 1
```

**Q.46)**

Subject: computer organization

Max Marks: 2



A 16-way set-associative cache memory unit with a capacity of 32 KB is built using a block size of 8 words. The word length is 32 bits. The size of the physical address space is 4 GB. The number of bits for the TAG field and the size of the TAG memory in Bytes including valid bit is \_\_\_\_\_

- A 20, 2816B
- B 21, 2816B

Correct Option

**Solution:** (B)

**Explanation:**

Physical address size = 32 bits.

Cache size = 32k bytes =  $2^{15}$  Bytes.

Block size = 8 words =  $8 \cdot 4$  Byte = 32 Bytes (where each word = 4 Bytes).

No. of blocks =  $2^{15} - 2^5 = 2^{10}$ .

Block offset = 10 bits.

No. of sets =  $2^{10}/16 = 2^6$ .

Set offset = 6 bits

Byte offset =  $8 \cdot 4$  Bytes = 32 Bytes =  $2^5$  = 5 bits.

TAG =  $32 - (6 + 5) = 21$  bits.

TAG	Set Index	Byte Offset
21	6	5

$$\begin{aligned}\text{TAG Memory} &= (21\text{bits}+1\text{v}) * \text{Number of cache blocks} \\ &= (22\text{bits}) * 1024 = 22528 \text{ bits} = 2816\text{B}\end{aligned}$$

- C 19, 2688B
- D None of these

**Q.47)**

Subject: operating systems

Max Marks: 2



We are given a 750 GB disk which has a data transfer rate of 40 Mbps ( $40 \cdot 10^6$  bps) and has 12000 RPM. The controller has a 2 ms initiation time. Given that 4096 bytes is the size of the block. And 8 ms is the average seek time.

Given the above information, and if we assume there is no queueing at the controller, the nearest value of average read time of a random block from the disk is:

**A** 26 ms

**B** 13 ms

**C** 42 ms

**D** 5 ms

**Correct Option**

**Solution:** (B)

**Explanation:**

$$T_{read} = Controller + Seek + Rotational + Xfer Time$$

$$= 2ms + 8ms + \frac{1}{2} \left( \frac{60000 \frac{ms}{min}}{12000 \frac{revolutions}{min}} \right) + \left( \frac{4096 bytes}{40 \times 10^6 \frac{bytes}{s}} \right) \times \left( 10^{-3} \frac{s}{ms} \right) = 12.6024 ms$$

$$T_{read} = 12.6024 ms$$

Nearest option is 13 ms. Therefore, the answer is 13 ms.

**Q.48)**

Which of the switching method uses in the forwarding of the frame that receives the entire frame and applies the CRC check before forwarding the frame?

**A** Rapid switching

**B** Cut through switching

**C** Store and forward switching

**D** None of these

**Correct Option**

**Solution:** (C)

**Explanation:**

Store-and-forward switching will wait until the entire frame has arrived before forwarding it. Then the LAN switch will store each complete frame into switch memory buffers and check errors before making a forwarding decision. It uses CRC for error checking.

**Q.49)**

Which of the following is the correct match for list I and list II for the below given circuit?

List I	List II
a) W	I. $ABC' + A'C + B'C$
b) X	II. $A'BC + AB'C$
c) Y	III. $ABC$
d) Z	IV. $A \oplus B \oplus C$

**A** W - IV, X - I, Y - II, Z - III

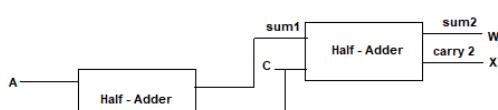
**B** W - IV, X - II, Y - I, Z - III

**Correct Option**

**Solution:** (B)

**Solution:**

Since in the given figure:





For a half-adder sum =  $A \oplus B = A'B + AB'$  and carry =  $AB$

Expression at sum1 will be:  $A \oplus B$

Expression at carry1 will be:  $AB$

Expression at sum2 will be:  $A \oplus B \oplus C = W$

Expression at carry2 will be:  $(A \oplus B)C = (AB' + A'B)C = AB'C + A'BC = X$

Expression at sum3 will be:  $AB \oplus C = (AB)'C + ABC' = ABC' + (A' + B')C = ABC' + A'C + B'C = Y$

Expression at carry3 will be:  $ABC = Z$

Hence, the correct option for the match is (ii).

**C**    W - III, X - II, Y - I, Z - IV

**D**    W - III, X - I, Y - II, Z - IV

Q.50)

Subject: Data Structures

Max Marks: 2

Insert the following keys in an array of size 17 using the modulo division method. Use double hashing to resolve collisions. Take  $h'(k) = (\text{key} \% 7) + 1$  as the second hash function

94, 37, 29, 40, 84, 88, 102, 63, 67, 120, 122

What is the value present at the location 7 \_\_\_\_\_

Correct Answer

**Solution:** (122)

**Solution:** 122

There will be no collisions when you insert the elements 94, 37, 29, 40, 84. Those elements are placed at the locations 9, 3, 12, 6, 16.

When you are trying to hash element 88, it will collide at the location 3, so we will apply double hashing on it. It will place at the location 8

The final hash table is after hashing all elements

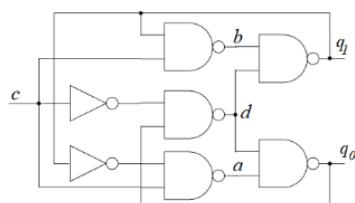
value	Location
102	0
120	1
	2
37	3
67	4
	5
40	6
122	7
88	8
94	9
	10
	11
29	12
63	13
	14
	15
84	16

Q.51)

Subject: digital logic systems

Max Marks: 2

Consider the following asynchronous circuit:



Which of the following is the correct state table of the above circuit?

**A**

c	$q_1$	$q_0$	$q_{a1}$	$q_{a0}$

0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	1	1
1	0	0	0	1
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

B

c	q <sub>1</sub>	q <sub>0</sub>	q <sub>n1</sub>	q <sub>n0</sub>
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	1	1
1	0	0	0	1
1	0	1	0	1
1	1	0	1	0
1	1	1	1	0

Correct Option

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

For the given asynchronous circuit the expressions of variables will be:

$$a = (q_1 \cdot c)^*$$

$$b = (q_1 \cdot c)^*$$

$$d = (c^* \cdot q_0)^*$$

$$q_{n1} = (b \cdot d)^*$$

$$q_{n0} = (a \cdot d)^*$$

For the given expressions, the truth table will be:

c	q <sub>1</sub>	q <sub>0</sub>	q <sub>n1</sub>	q <sub>n0</sub>
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	1	1
1	0	0	0	1
1	0	1	0	1
1	1	0	1	0
1	1	1	1	0

C

c	q <sub>1</sub>	q <sub>0</sub>	q <sub>n1</sub>	q <sub>n0</sub>
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	1	1
1	0	0	0	1
1	0	1	1	1
1	1	0	1	0
1	1	1	1	0

D

c	q <sub>1</sub>	q <sub>0</sub>	q <sub>n1</sub>	q <sub>n0</sub>
0	0	0	0	1
0	0	1	1	1
0	1	0	1	0
1	0	1	1	1

v	1	1	1	1
1	0	0	0	1
1	0	1	0	1
1	1	0	1	0
1	1	1	1	0

Q.52)

Subject: Discrete Mathematics

Max Marks: 2



Given below is a function f

$$f : \mathbb{Z} \times \mathbb{Z} \rightarrow \mathbb{Z} \times \mathbb{Z} \text{ defined as } f((x, y)) = (x + y, x)$$

Which of the following is correct regarding the above function?



f is only injective



f is only surjective



f is both injective and surjective

Correct Option

Solution: (c)

Answer:

f is injective

**Proof.** Suppose  $f((a, b)) = f((c, d))$ .Then the definition of f implies  $(a + b, a) = (c + d, c)$ .Since these ordered pairs are equal, it must be that  $a + b = c + d$  and  $a = c$ .From  $a + b = c + d$  and  $a = c$ , it follows  $a + b = a + d$ , so  $b = d$ .Therefore we have  $a = c$  and  $b = d$ , so  $(a, b) = (c, d)$ .

It follows that f is injective.

f is surjective

**Proof.** Take an arbitrary element  $(a, b)$  in the codomain  $\mathbb{Z} \times \mathbb{Z}$ .Then certainly  $(b, a - b)$  is in the domain  $\mathbb{Z} \times \mathbb{Z}$ .Observe that  $f((b, a - b)) = (a - b + b, b) = (a, b)$ .

This shows that f is surjective.



None of the above

Q.53)

Subject: operating systems

Max Marks: 2



Given the following snapshot of a system, which has 4 types of resources R1, R2, R3 and R4 while A, B , C and D are the 4 processes.

	Allocation				Request				Available			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
A	1	0	1	1	0	1	0	0	0	0	0	0
B	1	1	0	0	0	1	1	0				
C	1	0	1	1	0	0	0	0				
D	0	0	0	0	1	0	1	0				

Which of the following processes are involved in a deadlock?



A and B

Correct Option

Solution: (A)

Explanation:

Since  $Available = [0, 0, 0, 0]$ , only C can run as its request is  $[0, 0, 0, 0]$ . After C completes, it returns its allocation  $[1, 0, 1, 1]$ , making the new  $Available = [1, 0, 1, 1] = [0, 0, 0, 0] + [1, 0, 1, 1]$ . Now, D can run because its request is  $[1, 0, 1, 0]$ , which is smaller than  $Available = [1, 0, 1, 1]$ . After D's completion, it returns its allocation  $[0, 0, 0, 0]$ . As a result, the  $Available$  is still  $[1, 0, 1, 1]$ . At this time, neither A nor B can run, because both A and B require one  $R_2$  which is not available. Therefore, the system is in a deadlock state, and the involved processes are A and B.



B and C



C and D

D None of the above

Q.54)

Consider the following set S of functional dependencies:

$$F1: A \rightarrow C$$

$$F2: BD \rightarrow A$$

$$F3: C \rightarrow B$$

Which of the following functional dependency can be deduced from S?

A  $CD \rightarrow A$

B  $BC \rightarrow A$

C  $AD \rightarrow B$

D Both (i) and (iii)

Correct Option

Solution: (D)

**Solution:**

(i)  $CD \rightarrow A$  holds for given dependencies S. Since  $CD \rightarrow BD$  (from F3 augmentation). With  $CD \rightarrow BD$  and dependency F2 transitivity we can get  $CD \rightarrow A$ .

(ii)  $BC \rightarrow A$  does not hold. Consider the following counter example with 2 tuples given below:

a1, b1, c1, d1

a2, b1, c1, d2

(iii) The dependency  $AD \rightarrow B$  holds; Since  $AD \rightarrow A$  due to reflexivity and  $A \rightarrow B$  due to F1 and F3 transitivity. With the above 2 inferences transitivity  $AD \rightarrow B$  holds.

Thus, both (i) and (iii) dependencies hold.

Q.55)

The postorder traversal of a binary search tree is

25, 33, 30, 35, 42, 48, 40, 60, 58, 50.

The inorder traversal of the same tree is 25, 30, 33, 35, 40, 42, 48, 50, 58, 60. What is the length of the longest path from one leaf to another leaf? \_\_\_\_\_

(Note: Length of longest path means total number of nodes present in that path)

Subject: Data Structures

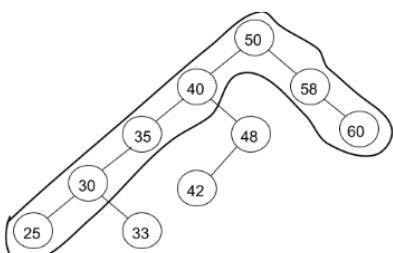
Max Marks: 2

Correct Answer

Solution: (?)

**Solution:** 7

After constructing binary search from postorder and inorder is



Total number of nodes = 7

Q.1)

Fill in the blanks with the most appropriate word.

The present \_\_\_ has not prevented the railway minister from announcing an increasing number of superfast trains.

Subject: General Aptitude

Max Marks: 1

A crisis

Correct Option

Solution: (A)

**Solution:** Only something negative can prevent a good measure. We have two choices representing negativity: (a) and (b). But (b) is not applicable: A syndrome is a medical condition that is characterized by a particular group of signs and symptoms.

B syndrome

c generation

d stability

Q.2)

Combine the following simple sentences into a complex sentence.

We visited the Golden Temple. Gurunanak Devji preached his first sermon here.

Subject: General Aptitude

Max Marks: 1

a We visited the Golden Temple wherein Gurunanak Devji preached his first sermon.

b We visited the Golden Temple because Gurunanak Devji preached his first sermon.

c We visited the Golden Temple where Gurunanak Devji preached his first sermon.

Correct Option

Solution: (c)

Solution: Here the confusion arises in-between "wherein" and "where", which word would fit the best for the sentence. "Wherein" is used when we are talking something formal. The literal meaning for "wherein" is "in which" and "wherein" refers to a preceding context and "where" does not. So "where" is the most suitable word here.

d Gurunanak Devji preached his first sermon at the Golden Temple.

Q.3)

Understand the relationship between the given words and accordingly select the correct option which is the odd one.

BARGE : VESSEL:

Subject: General Aptitude

Max Marks: 1

a Shovel: Instrument

b Book: Anthology

Correct Option

Solution: (b)

Solution:

Barge is a flat-bottom boat which is used for carrying or transporting heavy loads; whereas, a vessel can mean a craft or a vehicle designed for water transportation. So, the relation in the word is 'type of' i.e. barge is a type of vessel. The shovel is a type of instrument, the rim is type of edge, and training is a type of preparation. Thus, the only option that does not match the given relationship is an option (b), because an anthology may be a type of a book, but not the other way around.

c Rim : Edge

d Training : Preparation

Q.4)

Find the odd one out in the following series

22, 30, 50, 80, 150, 242

Subject: General Aptitude

Max Marks: 1

a 29

b 237

c 146

d 80

Correct Option

Solution: (d)

Solution: The following series is formed by

$$20 * (1^3 + 1) = 22$$

$$20 * (2^3 + 2) = 30$$

$$20 * (3^3 + 3) = 50$$

$$20 * (4^3 + 4) = 88$$

$$20 * (5^3 + 5) = 150$$

$$20 * (6^3 + 6) = 242$$

Hence the odd number is 80

Q.5)

Select the correct option which may be a synonym or antonym of the given word below

WAIVE

Subject: General Aptitude

Max Marks: 1

a Restrict

b Relax

Correct Option

Solution: (b)

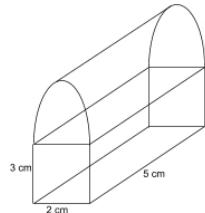
**Solution:** Waive is used as the discounts or relaxations given in a loan or a debt, e.g., 'I will waive off the interest for the last two months' thus the synonym will be release/relax, permit means to allow, admit means to accept, restrict means to stop or control.

**C** Permit

**D** Admit

**Q.6)**

Find the total surface area of this block



Subject: General Aptitude

Max Marks: 2

**A**  $(62 + 9\pi) \text{ cm}^2$

**B**  $(64 + 3\pi) \text{ cm}^2$

**C**  $(62 + 6\pi) \text{ cm}^2$

Correct Option

**Solution:** (C)

**Solution:** Total area of half cylinder of radius 1 cm =  $\pi rh + \pi r^2$

$$\begin{aligned} &= \pi r(h+r) \\ &= \pi(5+1) \\ &= 6\pi \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Total area of cuboid} &= 2\{lw + lh + hw\} \\ &= 2\{(5*2) + (5*3) + (3*2)\} \\ &= 2\{10 + 15 + 6\} \\ &= 62 \text{ cm}^2 \end{aligned}$$

$$\text{So, total surface area} = (62 + 6\pi) \text{ cm}^2$$

**D**  $(64 + 6\pi) \text{ cm}^2$

**Q.7)**

Bablu's investment is  $\frac{3}{4}$  of the investment of Chetan. Aman's investment is 20% more than that of Bablu. How much is the investment done by Chetan, if the total investment made by all is ₹ 19,080.

Subject: General Aptitude

Max Marks: 2

**A** 6,500

**B** 7,200

Correct Option

**Solution:** (B)

**Solution:** We will assume the investment done by Chetan to be ₹ 100.

Then the investment done by Bablu will be  $100 * \frac{3}{4} = ₹ 75$ .

Therefore, Aman's Investment =  $75 + 75 * 20\% = ₹ 90$

Now we can find the investment ratio of Aman, Bablu and Chetan, i.e.,

$90 : 75 : 100 = 18 : 15 : 20$

Hence, Chetan's Investment =  $19080 * \frac{20}{53} = ₹ 7,200$

**C** 8,250

**D** 9,000

**Q.8)**

Below is a table showing the statistics of 5 Metropolitan cities in India.  
Population of Hyderabad and Mumbai is 15,70,000. The population in Hyderabad is more than that of Mumbai and the difference is of 5,30,000. Urban literate female population of Hyderabad is approximately what percent of the total population of all the cities? Given that Population of Kolkata is half the population of Mumbai, Bangalore and Delhi. During the survey it was concluded that 30% of the female are illiterate and out of the literate females 10% are rural.

Subject: General Aptitude

Max Marks: 2

Name of the Cities	Population	Ratio of Urban People to Rural People	Ratio of Illiterate to Literate	Ratio of Female to Male
Kolkata	-	9:11	3:2	-
Delhi	9,50,000	-	-	4:11
Mumbai	-	5:8	4:7	-
Bangalore	8,30,000	-	-	3:7
Hyderabad	-	3:7	3:2	11:10

**A** 5.5%

**B** 6.6%

**C** 7.7% Correct Option

**Solution:** (c)

**Solution:** Hyderabad + Mumbai = 15,70,000  
 Hyderabad - Mumbai = 5,30,000  
 By solving the above we get,  
 Population of Hyderabad =  $\frac{15,70,000+5,30,000}{2} = 10,50,000$   
 Population of Mumbai =  $15,70,000 - 10,50,000 = 5,20,000$   
 Population of Kolkata =  $\frac{5,20,000+8,30,000+9,50,000}{2} = 11,50,000$   
 Number of Females in Hyderabad =  $10,50,000 * \frac{11}{21} = 5,50,000$   
 Since 30% of the females are illiterate then we can say that 70% of the females are literate.  
 Hence number Literate Females in Hyderabad =  $5,50,000 * \frac{70}{100} = 3,85,000$   
 Now we know that since 10% are rural then 90% would be from Urban.  
 Hence number of Urban Literate Females in Hyderabad  
 $= 3,85,000 * \frac{90}{100} = 3,46,500$   
 Total Population of all the cities  
 $= 11,50,000 + 9,50,000 + 5,20,000 + 8,30,000 + 10,50,000 = 45,00,000$   
 Urban Literate Females in Hyderabad out of total population (in %)  
 $= \frac{346500}{4500000} * 100 = 7.7\%$

**D** Cannot be determined

Q.9)

Subject: General Aptitude

Max Marks: 2

Two friends Divya and Mohit wanted to open a stationery shop. Divya's investment was ₹ 40,000 and Mohit's investment was ₹ 50,000. After 8 months Mohit was replaced by Sagar. Sagar joined the business by investing ₹ 30,000. The profit for the year was ₹ 50,000. What is the share of profit of Sagar?

**A** 6,000 Correct Option

**Solution:** (A)

**Solution:** Profit Ratio of Divya, Mohit and Sagar  
 $= (40000 * 12) : (50000 * 8) : (30000 * 4)$   
 $= 12 : 10 : 3$   
 Therefore, Sagar's share of profit =  $\frac{3}{25} * 50000 = ₹ 6,000$

**B** 8,000

**C** 2,000

**D** 4,000

Q.10)

Subject: General Aptitude

Max Marks: 2

There is a tank on the terrace which can be filled with the help of a pump. The pump usually takes 4 hrs to fill the empty tank full. By mistake Mr. Mohan the caretaker left the tap of the tank open. As a result the empty tank was filled in 5 hrs. How much time does it take to empty the full tank when the pump is switched off?

**A** 10 hrs

B

20 hrs

Correct Option

**Solution:** (B)

**Solution:** Let the time taken by the tap to empty the full tank be  $p$  hrs.

In 1 hr it will empty  $\frac{1}{p}$  of the tank.

In 1 hr the amount of tank which can be filled is  $\frac{1}{4}$

Therefore, the net amount of water which can be filled in the tank in an hour

$$= \left(\frac{1}{4} - \frac{1}{p}\right)$$

As per the question the tank is filled in 5 hrs when the tap of the tank is open.

So, the amount of tank filled in 1 hr when the tap is on  $= \frac{1}{5}$

Hence we can say,

$$\frac{1}{4} - \frac{1}{p} = \frac{1}{5}$$

$$\Rightarrow 5(p - 4) = 4p$$

$$\Rightarrow 5p - 20 = 4p$$

$$\Rightarrow p = 20$$

C

5 hrs

D

8 hrs

close