

Q.1)

Consider a file of 8192 records. Each record is 16 bytes long and its keys field is of size 6 bytes. The file is ordered on a key field, and the file organization is un-spanned. The file is stored in a file system with a block size of 512 bytes, and the size of a block pointer is 10 bytes. If the primary index is built on the key field of the file, and a multivalued index scheme is used to store the primary index, the number of first level and second level blocks in the multilevel index are respectively



16 and 1



8 and 2



8 and 1

Correct Option

Solution: (C)

Solution:

It is given as index is based on primary key of the relation, hence the index will come under the category of sparse index. Therefore, number of pointers from 1st level index to data blocks = No. of data blocks.

Since, block size = 512 bytes

Record size = 16 bytes

So, the number of records that can be stored in 1 block = 512/16 = 32

Since, total number of records is given as 8192. Therefore, number of data blocks required = 8192/32 = 256. This is nothing but number of pointers.

The number of pair that can be stored in 1 index block = block size / [key size + pointer size] = 512/[6 + 10] = 32. But we have 256 pointers pointing to records of the database in data blocks.

So, the number of 1st level index blocks required = total number of pointers / pairs that can be stored in 1 index block = 256/32 = 8

Now these 8 disk blocks need to be pointed to by higher level of indexing. Since one index block can store 32 pairs but here we need only 8. Each pointer of 2nd level index will point to a 1st level index block. So, number of second level index blocks required = 1.

Hence, the correct answer is 8 and 1.

Note: In question we are asked for multilevel indexing, so we continue to do indexing to higher levels till number of index blocks at that level = 1.



None of these

Q.2)

Subject: Data Structures

Max Marks: 1

Consider the standard algorithm for converting a decimal number (base 10) into a binary number (base 2). This algorithm makes use of a single stack and works by continually taking the modulo 2 of the number and also continually dividing it by two. This allows us to finally obtain the bits of the integer. The number of times n a number has to be pushed to this stack in order to be fully converted can be expressed as a function f(n). What is f(n)?



login

Correct Option

Solution: (A)

Solution:

The standard algorithm for converting a decimal number to binary is the following.

1. Input a number N
2. Initialize a stack S.
3. Start loop. While N does not equal 0
 - Digit = N % 2
 - Push Digit to S
 - Divide N by 2. N = N/2
4. Print the items in the stack in reversed order. The output is the binary representation of N

Since N is being continuously divided by 2 until it equals 0, we see that the loop runs $\lfloor \log_2^n \rfloor + 1$

 n^2  n^3  2^n

Q.3)

Subject: digital logic systems

Max Marks: 1

For a given function F(a,b,c), what is the maximum number of boolean expressions could be formed satisfying the relation F(a, b', c') = F(a, b, c) ?

8

16

Correct Option

Solution: (B)**Solution:**

Since $F(a, b', c') = F(a, b, c)$, therefore, the boolean expression must satisfy the situation that if 'c' is there than there should also be 'c', similarly for 'a' and 'b'. Case1: If (a,b',c') is present in the expression than expression must also have (a,b,c) , vice versa is also true.

Case2: If (a',b',c') is present in the expression than expression must also have (a',b,c) , vice versa is also true.

Case3: If (a,b',c) is present in the expression than expression must also have (a,b,c') , vice versa is also true.

Case4: If (a',b',c) is present in the expression than expression must also have (a',b,c') , vice versa is also true.

All the 4 cases have 2 possibilities. Either the term is present or it is not present. Therefore, the number of boolean expressions will be: $2 * 2 * 2 * 2 = 16$

c 12**d** 20

Q.4)

Which of the following is the correct conversion of $(863)_{10}$ into gray code?

Subject: digital logic systems

Max Marks: 1

a 1100001111**b** 0111100001**c** 1000011111**d** 1011110000

Correct Option

Solution: (D)**Solution:**

First, we will convert $(863)_{10}$ to binary which will be: 1101011111

Since for binary to gray conversion for given binary number $b_4b_3b_2b_1$ is given as $g_4g_3g_2g_1$, where:

$$g_4 = b_4$$

$$g_3 = b_4 \text{ XOR } b_3$$

$$g_2 = b_3 \text{ XOR } b_2$$

$$g_1 = b_2 \text{ XOR } b_1$$

Therefore, on applying this we will get:

$$1\ 1\ 0\ 1\ 0\ 1\ 1\ 1\ 1 \Rightarrow \text{Binary}$$

~~1101011111~~

1 0 1 1 1 1 0 0 0 0

Q.5)

Consider a processor with a 2 ns clock cycle, a miss penalty of 20 clock cycles, a miss rate of 0.05 misses per instruction, and a cache access time (hit time) of 1 clock cycle. Assume that the read and write miss penalties are the same. The average memory access time (AMAT) in nanoseconds is_____

Subject: computer organization

Max Marks: 1

C

Correct Answer

Solution: (4)

Answer:4

Explanation:

$$\text{AMAT} = \text{Hit time} + \text{Miss rate} \times \text{Miss penalty} = 2 \text{ ns} + 0.05 \times (20 \times 2 \text{ ns}) = 4 \text{ ns}$$

Q.6)

Which of the following statements is/are true about increase/decrease policies for fairness and efficiency in congestion control?

Subject: Computer Networks

Max Marks: 1

1. Additive increase reduces fairness.

2. Additive increase improves efficiency.

3. Multiplicative increase improves fairness.

4. Multiplicative decrease improves fairness.

A Only 1**B** Only 2

C Only 1 and 4

D Only 2 and 4

Correct Option

Solution: (D)

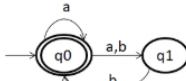
Explanation:

When we increase the window size in the Additive increase phase it will increase the efficiency of the host by sending more segments in the round trip time. In multiple-decrease algorithm gives us fairness because there must be some bottleneck link in the network that are not able to send the packets. So it is fair to decrease the window size.

For AIMD, every additive increase multiplicative decrease cycle improves fairness just a little bit more, while every additive increase takes the network closer to the efficiency line.

Q.7)

Consider the following nondeterministic finite automata



The regular expression that represents the given NFA is

A $(a+b)^*$

B $(a+(aa+bb))^*$

C $a^*+(ab+bb)^*$

D $(a+(ab+bb))^*$

Correct Option

Solution: (D)

Explanation:

By applying the arden's lemma

Equation for $q_0 = \epsilon + q_0a + q_1b \rightarrow (1)$

$$q_1 = q_0(a+b) \rightarrow (2)$$

$$\Rightarrow q_0 = \epsilon + q_0a + q_0(a+b)b$$

$$\Rightarrow q_0 = \epsilon + q_0(a+(a+b)b)$$

$$\Rightarrow q_0 = \epsilon(a+(a+b)b)^*$$

$$\Rightarrow q_0 = (a+(a+b)b)^* \Rightarrow (a+(ab+bb))^*$$

Q.8)

Given the following matrices of the following order

Subject: Algorithms

Max Marks: 1

Matrix	Order
A	$10*2$
B	$2*4$
C	$4*6$
D	$6*12$
E	$12*2$
F	$2*7$

These Matrices are multiplied using the following parenthesization
what is the number of multiplication operations in this
parenthesization_____.
 $(A(BC))((DE)F)$

Correct Answer

Solution: (816)

Solution 816

The number of multiplication operations to multiply two matrices of order $p*q$ and $q*r$ are $= p*q*r$.

Number of Multiplication operations for $BC=2*4*6$

Number of Multiplication operations for $A(BC)=10*2*6$

Number of Multiplication operations for $(DE)=6*12*2$

Number of Multiplication operations for $(DE)F=6*2*7$

Number of Multiplication operations for $(A(BC))((DE)F)=10*6*7$

Total number of multiplication operations for $(A(BC))((DE)F)=48+120+144+84+420=816$.

Q.9)

Subject: Theory of Computation

Max Marks: 1

Which of the following is/are decidable

- I. $A_{REX} = \{ \langle R, w \rangle \mid R \text{ is a regular expression that generates string } w \}$
- II. $E_{CFG} = \{ \langle G \rangle \mid G \text{ is a CFG with } L(G) = \emptyset \}$
- III. $REG_{TM} = \{ \langle M \rangle \mid M \text{ is a TM and } L(M) \text{ is regular} \}$
- IV. $E_{TM} = \{ \langle M \rangle \mid M \text{ is a TM with } L(M) = \emptyset \}$

 A I and II Only

Correct Option

Solution: (A)

Explanation: $A_{REX} = \{ \langle R, w \rangle \mid R \text{ is a regular expression that generates string } w \}$

Decidable

 $E_{CFG} = \{ \langle G \rangle \mid G \text{ is a CFG with } L(G) = \emptyset \}$ Decidable $REG_{TM} = \{ \langle M \rangle \mid M \text{ is a TM and } L(M) \text{ is regular} \}$ Undecidable $E_{TM} = \{ \langle M \rangle \mid M \text{ is a TM with } L(M) = \emptyset \}$ Undecidable B II and III Only C I, II and III Only D I, II, III and IV

Q.10)

Subject: Algorithms

Max Marks: 1

The time complexity of the recurrence relation given below is

$$T(n) = 3/2T(n/4) + n^2$$

 A $\Omega(n)$

Correct Option

Solution: (B)

This recurrence relation can be solved using Masters Theorem

 $a=3/2$ $b=4$ $k=2$ $p=0$ $a \leq b^k$ $T(n)=\Theta(n^2)$. C $\Omega(n^2 \log n)$ D $\Omega(\log^2 n)$

Q.11)

Subject: Engineering-Mathematics

Max Marks: 1

A function $f(x) = \frac{x^2}{|x|}$ for $x \neq 0$ and $f(0)=0$ then at $x=0$ $f(x)$ is

 A Continuous

Correct Option

Solution: (A)

Explanation:At $x=0$ the value of the function is 0, now let us look at the left-hand limit

$$\lim_{x \rightarrow 0^-} \frac{x^2}{|x|} = \frac{x^2}{-x} = x = 0$$

$$\lim_{x \rightarrow 0^+} \frac{x^2}{|x|} = \frac{x^2}{x} = x = 0$$

Left-hand limit = Right-hand limit.

Which is same as $f(0)=0$, therefore the function is continuous. B Discontinuous C Cannot be determined

D None of the above

Q.12)

Consider the following predicate statements:

Subject: Discrete Mathematics

Max Marks: 1

S1 : Every person who is taking CS 473 has a Facebook page.
S2 : There is a person who is taking CS 473 and teaching CS 173.

Let P be a set of all people
A(x) means "x is teaching CS 173."
T(x) means "x is taking CS 473."
F(x) means "x has a Facebook page."

Predicate formulae :

P1 : $\forall x \in P [T(x) \rightarrow F(x)]$
P2 : $\exists z \in P [T(z) \wedge A(z)]$

Which of the following is incorrect?

- A S1 can be represented by P1
- B S2 can be represented by P2
- C S2 cannot be represented by P1
- D None of the above

Correct Option

Solution: (D)

Explanation:

Options A, B and C are correct. Therefore Option D is the answer.

P1 : $\forall x \in P [T(x) \rightarrow F(x)]$
S1 : Every person who is taking CS 473 has a Facebook page.

P2 : $\exists z \in P [T(z) \wedge A(z)]$
S2 : There is a person who is taking CS 473 and teaching CS 173.

Q.13)

Which of the following statements is/are True?

Subject: Data Structures

Max Marks: 1

- I. A tree with n nodes and the property that the heights of the two children of any node differ by at most 2 has $O(\log n)$ height.
- II. The depths of any two leaves in a max heap differ by at most 1.

- A Only I
- B Only II
- C Both I and II

Correct Option

Solution: (C)

Solution:

- I. **True.** Using the same approach as proving AVL trees have $O(\log n)$ height, we say that n_h is the minimum number of elements in such a tree of height h.

$$n_h \geq 1 + n_{h-1} + n_{h-3} \quad (1)$$

$$n_h > 2n_{h-3} \quad (2)$$

$$n_h > 2^{h/3} \quad (3)$$

$$h < 3\log n_h \quad (4)$$

$$h = O(\log n) \quad (5)$$
- II. True. A heap is derived from an array and new levels to a heap are only added once the leaf level is already full. As a result, a heap's leaves are only found in the bottom two levels of the heap and thus the maximum difference between any two leaves' depths is 1.

- D Neither I nor II

Q.14)

The left factored grammar for the given grammar is
 $S \rightarrow S^* \mid S \cup S \mid S? \mid T$

Subject: Compiler Design

Max Marks: 1

$T \rightarrow T a | T b | T c | \epsilon$

- A S → SS'
 S' → * | US | ? | [T]
 T → TT' | ε
 T' → a | b | c

- B S → SS' | [T]
 S' → * | US | ?
 T → TT' | ε
 T' → a | b | c

Correct Option

Solution: (B)

Explanation:

Given grammar is

$$S \rightarrow S^* | S \cup S | S? | [T]$$

$T \rightarrow T a | T b | T c | \epsilon$

The Left factored grammar for the given grammar is

$$S \rightarrow SS' | [T]$$

$$S' \rightarrow * | US | ?$$

$$T \rightarrow TT' | \epsilon$$

$$T' \rightarrow a | b | c$$

- C S → SS' | [T]
 S' → * | US | ?
 T → TT'
 T' → a | b | c | ε

- D S → SS' | [T]
 S' → * | US | ?
 T → TT' | ε
 T' → a | b | c | ε

Q.15)

Both your L1 instruction and data caches separate a 32-bit address as follows:

Subject: computer organization

Max Marks: 1

bits 0 - 3 = offset

bits 4 - 14 = index

bits 15 - 31 = tag

How much space is required to store the tags for the L1 instruction cache?

A 32KB

B 33KB

C 34KB

D 34Kb

Correct Option

Solution: (D)

Explanation:

Size of cache line: $2^{\text{offset}} = 2^4 = 16$ bytes

Number of cache lines: $2^{\text{index bits}} = 2^{11} = 2048$

Total cache size: $16 \times 2048 = 32\text{KB}$

Total tag size: $17 \times 2048 = 34\text{Kb}$

Q.16)

Which of the following languages is/are Regular

Subject: Theory of Computation

Max Marks: 1

- I. $L = \{wtw \mid w, t \in \{0,1\}^*\}$.
 II. $L = \{0^n 1^m 0^n \mid m, n \geq 0\}$

A I Only

Correct Option

Solution: (A)

$L = \{wtw \mid w, t \in \{0,1\}^*\}$ Regular

We can represent them with the regular language in which each string starts and ends with the same character.

$L = \{0^n 1^m 0^n \mid m, n \geq 0\}$ Non-Regular

we need one memory element to prove that exactly n number of zeros are repeated in the string.

B II Only

C I and II Only

D Neither I nor II

Q.17)

Consider the following schedule S:

S: R1(A), W2(A), C2, W1(A), W3(A), C3, C1;

Which of the following statements is not true about the above schedule S?

Subject: DBMS

Max Marks: 1

A Schedule S is allowed under Thomas write rule for the given timestamp as 1, 2, 3 for T1, T2 and T3 respectively.

B Schedule S is view serializable and cascadeless

C Schedule S is allowed under Timestamp ordering protocol for the given timestamp as 1, 2, 3 for T1, T2 and T3 respectively.

Correct Option

Solution: (C)

Solution:

(i) The schedule S is having cycle in its precedence graph. Hence, it is not CSS but it has blind writes, therefore, we will check for the view serializability.

- (a). Initial read is done by T1; therefore, T1 should be performed before T2 and T3 ($T1 \rightarrow T2, T1 \rightarrow T3$)
- (b). R-W sequence will be maintained. Hence $T1 \rightarrow T2$
- (c). Final write is done by T3 hence $T2 \rightarrow T3$

Therefore, given schedule S is equivalent to serial schedule $T1 \rightarrow T2 \rightarrow T3$. Hence, it is serializable.

(ii) For the given timestamp as 1, 2, 3 to T1, T2, T3 respectively. W1(A) will not be done by TWR as $WTS(A) > TS(A)$ (since $2 > 1$). Hence, schedule is allowed under TWR.

(iii) Due to W1(A), (since $2 > 1$) this transaction will be rolled back and therefore schedule S will not be allowed under TSP for the given timestamp as 1, 2, 3 for T1, T2 and T3 respectively.

D None of the above.

Q.18)

Consider a selective repeat sliding window protocol, the window size of the sender is 64. What will be the sequence number for the 500th frame?

Subject: Computer Networks

Max Marks: 1

Correct Answer

Solution: (115)

Explanation:

Window size of selective repeat $2^{(n-1)} = 64$.

So, n = 7 bits

In 7 bits possible sequence number = 128 = 0 to 127

For first 128 frames = 0 to 127

For next 128 frames = 0 to 127

For next 128 frames = 0 to 127

Upto then 384 frames completed transmission

Left 116 frames out of 350 = 0 to 115

Hence 115 is the sequence number for the 500th frame.

Q.19)

How many edges does the complete bipartite graph, $K_{m,n}$ have?

Subject: Discrete Mathematics

Max Marks: 1

A m^n

B n^m

C $2^m n$

D None of the above

Correct Option

Solution: (D)

Explanation:

The vertex set of $K_{m,n}$ consists of two disjoint sets, A and B, say, such that: A contains m vertices and B contains n vertices. Each vertex in A is adjacent to each vertex in B. No

two vertices in A, or in B, are adjacent. Hence, the degree of each vertex in A is n, and the degree of each vertex in B is m. Therefore, the sum of the degrees is $2mn$, and therefore there are mn edges.

Q.20)

Consider the following C program.

```
#include <stdio.h>
int main()
{
    int arr[2][3][3];
    printf("%lu ",sizeof(arr));
    printf("%lu ",sizeof(*arr));
    printf("%lu ",sizeof(**arr));
    printf("%lu\n",sizeof(***arr));
    return 0;
}
```

Choose the correct answer for this as this code is running on a 64-bit machine.

Subject: C Programming

Max Marks: 1



A

72 36 12 4

Correct Option

Solution: (A)

Solution:

int arr[2][3][3]; // A 3D array or two 2D arrays of 3 rows and 3 columns are declared as integer types. So total elements in the array are: $2 \times 3 \times 3 = 18$.

As we know that in many programming environments for C and C-derived languages on 64-bit machines, int variables are still 32 bits wide, but long integers and pointers are 64 bits wide.

printf("%lu ", sizeof(arr)); // it is asking for size of whole array that is
No. of elements * size of each element = $18 \times 4 = 72$

printf("%lu ", sizeof(*arr)); // it is pointing to the first 2D array so total elements in one 2D array = $3 \times 3 = 9$ then size of this = $9 \times 4 = 36$

printf("%lu ", sizeof(**arr)); // **arr points to the first array , first row and we know that there are 3-elements in each row so size of will print = $3 \times 4 = 12$

printf("%lu\n", sizeof(***arr)); // ***arr points to the first array, first row and first element and we know that the size of each element which is of integer type is 4 byte so it will print 4.

So, the correct answer is 72 36 8 4.

B

72 36 8 4

C

96 48 24 4

D

96 36 12 4

Q.21)

Subject: computer organization

Max Marks: 1



Suppose that we want to enhance the processor used for Web server. The new processor is 10 times faster on computation in the Web serving application than the original processor. Assuming that the original processor is busy with computation 40% of the time and is waiting for I/O 60% of the time. Then the overall speedup gained by incorporating the enhancement is _____ (Evaluate up to two decimal places)

Correct Answer

Solution: (1.56)

Answer: 1.56

Explanation:

$$\text{Speedup} = \frac{1}{(1 - \text{Fraction}_{\text{enhanced}}) \frac{\text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}}}$$

$$\text{Fraction}_{\text{enhanced}} = 40\% = 0.4$$

$$\text{Speedup}_{\text{enhanced}} = 10$$

$$\text{Speedup}_{\text{overall}} = 1 / ((1 - 0.4) + (0.4 / 10)) = 1 / (0.6 + (0.4 / 10)) \approx 1.56$$

Q.22)

Subject: operating systems

Max Marks: 1



An engineer has designed a FAT-like system and he has used 24 bits for each entry. For a 32-GB disk, what is the minimum size of a file allocation in this system?

A

1 KB

Correct Option

B

2 KB

Solution: (B)

Explanation:

SOLUTION:

A 32 GB disk has 2^{35} bytes of storage. If each entry in the FAT has 24 bits, then there can be at most 2^{24} allocation chunks (one per FAT entry), so each allocation chunk must be 2^{11} bytes = 2KB

 C

4 KB

 D

8 KB

Q.23)

Out of 8 boys and 5 girls, a committee of 6 members is to be formed. The number of ways in which this can be done so as to include at least 2 boys and 1 girl

 A

$${}^8C_5 * {}^5C_1 + {}^8C_4 * {}^5C_2 + {}^8C_3 * {}^5C_3 + {}^8C_2 * {}^5C_4$$

Correct Option

Solution: (A)

Solution:

The members of the committee can be chosen in one of the following ways

- 5 boys 1 Girl
- 4 boys 2 girls
- 3 boys 3 girls
- 2 boys 4 girls

The number of ways we can do it is in

$${}^8C_5 * {}^5C_1 + {}^8C_4 * {}^5C_2 + {}^8C_3 * {}^5C_3 + {}^8C_2 * {}^5C_4 \text{ ways.}$$

 B

$${}^8C_4 * {}^5C_2 + {}^8C_3 * {}^5C_2 + {}^8C_3 * {}^5C_3 + {}^8C_2 * {}^5C_2$$

 C

$${}^8C_2 * {}^5C_3 + {}^8C_2 * {}^5C_1 + {}^8C_2 * {}^5C_2 + {}^8C_2 * {}^5C_3$$

 D

$${}^8C_6 * {}^5C_3 + {}^8C_4 * {}^5C_3 + {}^8C_5 * {}^5C_2 + {}^8C_5 * {}^5C_2$$

Q.24)

Given are two statements:

- S1 : Contiguous allocation is superior to linked allocation in terms of file access performance for both sequential access and direct access.
 S2: All these benefits apply to contiguous allocation in memory management.

Which of the above are not false?

 A

S1 only

 B

S2 only

 C

S1 and S2

Correct Option

Solution: (C)

Explanation:

Direct access in a linked allocation has to be performed by sequentially accessing all the blocks, while in contiguous allocation the correct disk address can be calculated. Since the adjacent blocks are contiguously allocated, and most modern hard disks have special designs (such as interleaving) to make sequential access from contiguous blocks efficient (less seek and rotational latency) contiguous allocation scheme has better performance than linked allocation scheme. The advantage of reduced seek time might not apply to memory management because the access time for main memory is approximately the same, irrespective of whether the addresses are contiguous or not. Although recent advancements in main memory design have produced faster access time for sequential access, the speedup is only a few times compared to three orders of magnitude savings in seek time in sequential disk accesses. Thus contiguous memory allocation does have the same great benefits as contiguous disk allocation.

 D

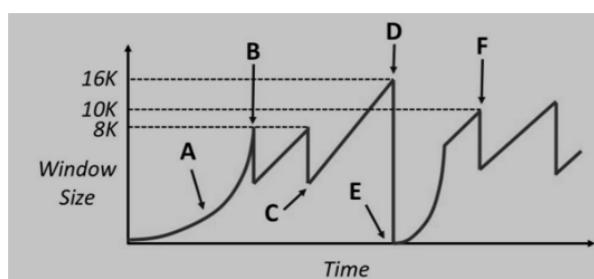
None of the above

Q.25)

Name the event at B which occurs that causes the sender to decrease its window?

Subject: Computer Networks

Max Marks: 1



Triple Duplicate ACK

Correct Option

Solution: (A)**Explanation:**

Three duplicate ACK= Weak possibility of congestion= Start congestion avoidance

Timeout= High possibility of congestion= Slow start Phase

In the figure, it has shown that at B window size is suddenly reduced. It can be because of two reasons either timeout or three duplicate ACK.

In the timeout, we again start the window with slow start phase but here we are starting with a threshold so d is not the answer.

Here A is the answer because after multiple decreases of window size we are again increasing the window from the threshold.

B Slow Start**C** Packet loss**D** Time out**Q.26)**

Consider the following tasks for a person with their associated profits and deadlines, given that the person can complete one item in one unit time. How much extra profit could be made by this person given that he has a chance to extend the deadline for any task he wishes _____

Subject: Algorithms

Max Marks: 2

Task	Profit	Deadline
T ₁	20	4
T ₂	12	4
T ₃	17	3
T ₄	15	1
T ₅	4	4
T ₆	3	5
T ₇	9	2

Note: One or more deadline may be extended.

Correct Answer

Solution: (13)

Solution 13

The optimal job sequence can be found out by the greedy method by sorting the tasks in decreasing order of profits and scheduling them as late as possible, We get the following optimal schedule

Time Slot	1	2	3	4	5
Task	T ₄	T ₂	T ₃	T ₁	T ₆

The Tasks T₇ and T₅ cannot be scheduled if the person had the chance to extend the deadline then he could make profits associated with these tasks as well i.e. 9+4=13.

Q.27)

Which of the following is/are CFLs

Subject: Theory of Computation

Max Marks: 2

- I. L = {w ∈ (a+b)* | n_a(w) + n_b(w) ≠ n_c(w) }
- II. L = { aⁿb^mc^k | n=m or m ≠ k }

A I Only**B** II Only**C** Both I and II

Correct Option

Solution: (C)**Explanation:**

- I. L = {w ∈ (a+b)* | n_a(w) + n_b(w) ≠ n_c(w) } CFL

We can construct a NPDA for the language by using one stack, by applying push operation on the input symbols a, b and apply pop operation whenever c has been encountered. Two possible

cases a+b is greater than c if more number of a's and b's are there and a+b is less than c if more number of symbols than a and b.

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

We can construct a NPDA for the given language.

Case1: We can check for equality of a's and b's by sending or pushing all a's into the stack and apply POP operation on the stack for each b in the input then apply skip operation.

Case2: Skip all a's and push all b's on to the stack and then apply pop operation for each c of the input. If more c's are there skip all and accept. If more b's are there in the stack then apply pop or remove all from the stack and accept.

Neither I nor II

Q.28)

Consider a router that interconnects three subnets: Subnet 1, Subnet 2 and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also, suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 interfaces, and Subnet 3 is to support at least 12 interfaces. Provide three network addresses (of the form A.B.C.D/X) that satisfy these constraints.

A Subnet 1 = 223.1.17.0/27, Subnet 2 = 223.1.17.128/25 Subnet 3 = 223.1.17.192/28

B Subnet 1 = 223.1.17.0/26, Subnet 2 = 223.1.17.64/26, Subnet 3 = 223.1.17.128/26

C Subnet 1 = 223.1.17.0/25, Subnet 2 = 223.1.17.128/25, Subnet 3 = 223.1.17.192/28

D Subnet 1 = 223.1.17.0/26, Subnet 2 = 223.1.17.128/25, Subnet 3 = 223.1.17.64/26

Correct Option

Solution: (D)

Explanation:

Prefix = 223.1.17/24

First subnet = 6 host bits (64>at least 60), net bits = 24 fixed, subnet bits= 2

So mask = 24 +2 = 26

Hence, 223.1.17.00 000000 = 223.1.17.0/26

Second subnet = 7 host bits(128>at least 90), net bits = 24 fixed, subnet bits = 1

So mask = 24 +1 = 25

Hence, 223.1.17.1 0000000 = 223.1.17.128/25

The third subnet = 6 host bits (64> at least 12), net bits = 24 fixed, subnet bits = 2

Mask =26

Hence, 223.1.17.01 000000 = 223.1.17.64/26

Q.29)

What will be the output of the following code.

Subject: C Programming

Max Marks: 2

```
#include<stdio.h>
enum week{Mon, Tue=3, Wed, Fri, Sat, Sun};

int main()
{
    enum week day;
    day = Fri;
    static int n=10;
    if(Mon)
        n= n*3;
    else
        if (Fri)
            n= n*5;
        else
            n=n*2;
    printf("%d %d",day,n);
    return 0;
}
```

What will be the output for the following code.

3 30

5 20

5 50

Correct Option

Solution: (c)

Solution: Ans is 5 50

Enumeration is a user defined datatype in C language. It is used to assign names to the integral constants which makes a program easy to read and maintain.

Initially enum starts with 0 so values will be

Mon=0, and Tue is assigned with 3 so it will move further after 3 as

Tue=3, Wed=4, Fri=5, Sat=6, Sun=7

So if(Mon) will be failed and then we go to the

if(Fri)=if(5) so it will be true then we go out of if else

And then it will print day= Fri=5 and n = n*5 = 50

So output will be 5 50.

5 51

Q.30)

S1 : Let G be a group. Suppose that the order of every non-identity element of G is 2.

It can be proven that G is an abelian group.

S2 : Every cyclic group is abelian.

Subject: Discrete Mathematics

Max Marks: 2

A Only S1 is true

B Only S2 is true

C Both S1 and S2 are True

Correct Option

Solution: (c)

Explanation:

S1 :

Let x and y be elements of G. Then we have

$$1 = (xy)^2 = (xy)(xy).$$

Multiplying the equality by yx from the right, we obtain

$$\begin{aligned} yx &= (xy)(xy)(yx) \\ &= x y x y^2 x \\ &= x y x^2 (\text{since } y^2 = 1) \\ &= x y (\text{since } x^2 = 1) \end{aligned}$$

Thus we obtain $xy = yx$ for any elements $x, y \in G$.

Thus the group G is an abelian group.

S2:

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

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

Let a and b be arbitrary elements in G.

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

It follows that :

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

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

Thus G is an abelian group.

D None of the above

Q.31)

Consider a Graph G_n which consists of n vertices and the weight of an edge E_{ij} from vertex i to vertex j, is given by the following fragment of code, where E is the Adjacency Matrix. The cost of the Minimal Spanning Tree represented by G_5 is ____.

Note in the below function ceil() calculates ceil of a fractional value, and the function abs calculate the absolute value.

```
for (i=1;i<=n;i++)
{
```

Subject: Algorithms

Max Marks: 2

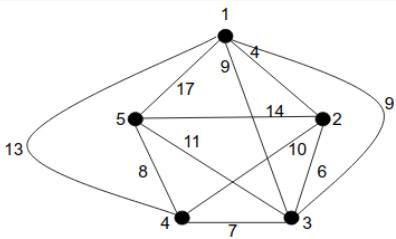
```

for (j=0; j<=n; j++)
{
    if(i<j)
    {
        if((i+j)<=ceil(n/2))
        {
            E[i][j]=abs((2*i)-(3*j));
        }
        else
        {
            E[i][j]=abs((3*i)-(4*j));
        }
    }
    else if(j>i)
    {
        E[i][j]=E[j][i];
    }
    else
    {
        E[i][j]=0;
    }
}
}
}

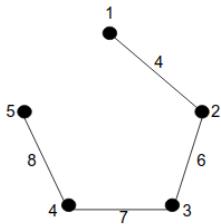
```

Correct Answer

Solution: (25)



On applying Kruskal's algorithm we add sort the edges in increasing order and we get the following MST.



The cost of the MST is $=4+6+7+8=25$.

Q.32)

Consider a virtual memory system where each memory access without page fault takes 200 nsec (10^{-9} seconds). In case of page faults, 20 msec (10^{-3} seconds) is needed for page-fault handling.

Calculate the effective memory access time if the page fault rate is 10^{-6} and 10^{-3} , respectively.

Subject: operating systems

Max Marks: 2



210 ns and 22.4 μ s



222.2 ns and 21.5 μ s



220 ns and 20.2 μ s

Correct Option

Solution: (c)

Explanation:

Effective memory access time = $(1 - \text{page fault rate}) * (\text{memory access time}) + (\text{page fault rate}) * (\text{page fault access time})$

$$= (1 - 10^{-6}) * (200 * 10^{-9}) + (10^{-6}) * (20 * 10^{-3}) = 2 * 10^{-7} + 2 * 10^{-8} - 2 * 10^{-13} = 2.2 * 10^{-7} = 220 \text{ ns} \text{ (page fault rate} = 10^{-6}\text{)}.$$

$$= (1 - 10^{-3}) * (200 * 10^{-9}) + (10^{-3}) * (20 * 10^{-3}) = 2 * 10^{-7} + 2 * 10^{-5} - 2 * 10^{-10} = 2.02 * 10^{-5} = 20.2 \text{ us (page fault rate} = 10^{-3}\text{)}.$$

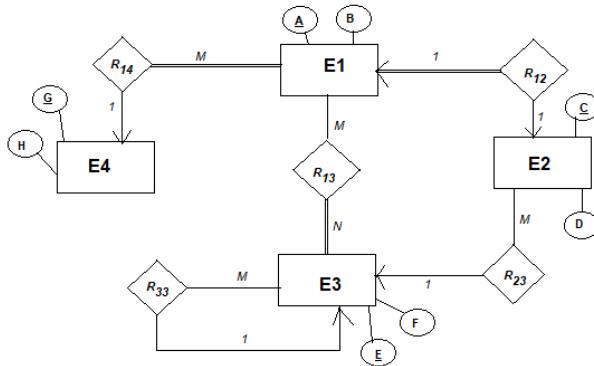
D None of the above

Q.33)

Subject: DBMS

Max Marks: 2

Consider the following E-R diagram:



The minimum number of relations required to represent this E-R diagram in relational model is _____

Correct Answer

Solution: (4)

Solution: 4

On considering Entity E1 and E2. Since they have one-to-one relationship between them, therefore, we can merge them into a relation. Hence, entity E1 and E2 will form a relation together. Therefore, total # of relation = 1

On considering relation E1 and E4. Since there is a many-to-one relationship with total participation on many side, therefore we need a minimum of two relations in order to satisfy all constraints. Hence, entity E4 could not be merged with E1 and will form a separate relation. Therefore, total # of relation = 2.

On considering relation E3 with its self referential one-to-many relationship, we can accommodate this relationship in a single relation E3 itself. Therefore, total # of relation = 3 (due to relation E3).

On considering many-to-many relationships between E1 and E3, we will have separate relation for R13 and there is already a separate relation for E1 and E3 existing (from the above points). Therefore, total # of relation = 4

Hence, the total number of relations possible for the given E-R diagram is 4.

Q.34)

Subject: Engineering-Mathematics

Max Marks: 2

The given system of linear equations

$$2x+3y+4z=19$$

$$7x+2y+z=32$$

$$3x - 2y + 5z = 20$$

The absolute value of the sum of solution for x, y, z is ____ (enter 10000 in case of no solution or infinitely many solutions)

Correct Answer

Solution: (7)

Solution: 7

Solving By Gauss Jordan Elimination Method

The absolute value of the sum of the solution $= |4+1+2| = 7$

Q.35

Subject: Theory of Computation

Max Marks: 2

The minimum number of states in a DFA that accepts the following language $L = \{w \mid w \in \{0, 1\}^*, w \text{ contains either three consecutive } 0's \text{ or three consecutive } 1's\}$.

 A

5

 B

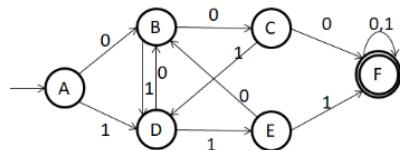
6

Correct Option

Solution: (B)

Explanation:

Example strings include 0111, 0000, 0001110,.....

 C

7

 D

8

Q.36

Subject: Compiler Design

Max Marks: 2

Consider the following grammar

$\text{prog} \rightarrow \text{stmt}$
 $\text{stmt} \rightarrow \text{if expr then block} \mid \text{while expr do block} \mid \text{expr ;}$
 $\text{expr} \rightarrow \text{term} \Rightarrow \text{id} \mid \text{isZero? term} \mid \text{not expr} \mid \text{++ id} \mid \text{-- id}$
 $\text{term} \rightarrow \text{id} \mid \text{const}$
 $\text{block} \rightarrow \text{stmt} \mid \{ \text{stmts} \}$
 $\text{stmts} \rightarrow \text{stmt stmts} \mid \epsilon$

Then Follow(stmt) is _____

 A

{\$, if, while, id, const, isZero?, not, ++, --}

Correct Option

Solution: (A)

Explanation:

Given grammar is

$\text{prog} \rightarrow \text{stmt}$
 $\text{stmt} \rightarrow \text{if expr then block}$
 $\text{stmt} \rightarrow \text{while expr do block}$
 $\text{stmt} \rightarrow \text{expr ;}$
 $\text{expr} \rightarrow \text{term} \Rightarrow \text{id}$
 $\text{expr} \rightarrow \text{isZero? term}$
 $\text{expr} \rightarrow \text{not expr}$
 $\text{expr} \rightarrow \text{++ id}$
 $\text{expr} \rightarrow \text{-- id}$
 $\text{term} \rightarrow \text{id}$
 $\text{term} \rightarrow \text{const}$
 $\text{block} \rightarrow \text{stmt}$
 $\text{block} \rightarrow \{ \text{stmts} \}$
 $\text{stmts} \rightarrow \text{stmt stmts}$
 $\text{stmts} \rightarrow \epsilon$

At RHS 3 productions contains stmt

$\text{Follow(stmt)} = \text{Follow(Block)} = \text{Follow(stmt)}$

$$\begin{aligned}
 &= \text{Follow(prog)} = \{\$\} // \text{prog is the start symbol} \\
 &\quad = \text{First(stmts)}
 \end{aligned}$$

$$\text{First(stmts)} = \text{First(stmt)} \cup \{\epsilon\}$$

$$\text{First(stmt)} = \{\text{if, while, isZero?, not, ++, --, id, const}\}$$

$$\Rightarrow \text{Follow(stmt)} = \{\$\} \cup \{\text{if, while, isZero?, not, ++, --, id, const}\} \cup$$

Follow(stmts)

$$\Rightarrow \text{Follow(stmt)} = \{\$\}, \{\text{if, while, isZero?, not, ++, --, id, const}\} \}$$

 B

{\$, if, while, id, const, isZero?, not, ++, --}

 C

{\$, if, while, isZero?, not, ++, --}

 D

{\$, if, while, id, const, not, ++, --}

Consider the following code.

```
#include <stdio.h>
#define pro(x,y) x*y
int main(void)
{
    printf("%d", pro(4,5));
    printf("%d", pro(3+4, 5+6));
    return 0;
}
```

In the given code, first printf statement result is stored in A and second printf statement result is stored in B then B-A is equivalent to..?

 A

57

 B

47

 C

7

 D

9

Correct Option

Solution: (D)**Solution:**

```
printf("%d", pro(4,5)); = 4*5 = 20 =X
printf("%d", pro(3+4, 5+6)); = 3+4*5+6 = 3+20+6 = 29 =Y
Y-X = 29-20 = 9
```

So, the correct answer is 9.

In TCP, the initial RTT is 20 msec and the initial deviation is 5 msec. The acknowledgements for the first two segments are received in time 30 msec and 40 msec

Find the time out timer value for the second segment in msec using Jacobson's Algorithm. Use $\alpha = 0.5$.

Correct Answer

Solution: (55)**Ans: 55****Explanation:**

Initial round trip time ($IRTT_1$) = 20 msec

Initial deviation (ID_1) = 5 msec

Time out timer value (TOT_1) = $4 \times ID_1 + IRTT_1 = 4 \times 5 + 20 = 40$ msec

ACK comes after = 30 msec

Which means Actual round trip time ($ARTT_1$) = 30 msec

Actual deviation (AD_1) = $| IRTT_1 - ARTT_1 | = | 20 - 30 | = 10$ msec

The values for second segment

Initial round trip time ($IRTT_2$)

$$= \alpha \times IRTT_1 + (1-\alpha) \times ARTT_1$$

$$= 0.5 \times 20 + (1-0.5) \times 30$$

$$= 10 + 15$$

$$= 25 \text{ msec}$$

Initial deviation (ID_2)

$$= \alpha \times ID_1 + (1-\alpha) \times AD_1$$

$$= 0.5 \times 5 + (1-0.5) \times 10$$

$$= 2.5 + 5$$

$$= 7.5 \text{ msec}$$

So, Time out timer value (TOT_2)

$$= 4 \times ID_2 + IRTT_2$$

$$= 4 \times 7.5 + 25$$

$$= 55 \text{ msec}$$

S1 : If f is a bijection, then $f(S \cap T) = f(S) \cap f(T)$

S2 : If f and a are injections, then $f \circ a$ is an injection.

Which of the above statement(s) is/are not false?

- A S1 only
- B S2 only
- C Neither S1 nor S2
- D Both S1 and S2

Correct Option

Solution: (D)

Explanation:

S1 :

Since $f(S \cap T) \subseteq f(S) \cap f(T)$ for a function f , we need to prove that $f(S) \cap f(T) \subseteq f(S \cap T)$ for a bijection f .

Let y be an arbitrary element of $f(S) \cap f(T)$.

Then there is an element x_1 in S and an element x_2 in T such that $y = f(x_1) = f(x_2)$.

Since f is a bijection, it is an injection.

Hence if $f(x_1) = f(x_2)$, then $x_1 = x_2$.

Hence $x_1 (= x_2) \in S \cap T$.

Hence $y (= f(x_1) = f(x_2)) \in f(S \cap T)$.

Hence $f(S) \cap f(T) \subseteq f(S \cap T)$ if f is a bijection.

S2 :

Let x_1 and x_2 be arbitrary elements in A .

Suppose that $f(g(x_1)) = f(g(x_2))$.

Then since f is an injection, $g(x_1) = g(x_2)$.

Then since g is an injection, $x_1 = x_2$.

That is for any pair of elements x_1 and x_2 in A if $f(g(x_1)) = f(g(x_2))$,

then $x_1 = x_2$. Hence $f \circ g$ is an injection.

Q.40)

The value of $f(0)$ so that $f(x)$ is continuous at $x=0$ is ____

$$f(x) = \frac{3x+4 \tan x}{x}$$

Subject: Engineering-Mathematics

Max Marks: 2

Correct Answer

Solution: (?)

Solution: 7

At $x=0$ $f(x)$ is not defined let us check for the left and right-hand limits

$$\text{LHL} = \lim_{x \rightarrow 0^-} \frac{3x+4 \tan x}{x} \text{ it is in } \frac{0}{0} \text{ indeterminate form}$$

Applying L'Hopital's rule

$$= \lim_{x \rightarrow 0^-} \frac{3+4 \sec^2 x}{1} = 7$$

$$\text{RHL} = \lim_{x \rightarrow 0^+} \frac{3x+4 \tan x}{x} \text{ it is in } \frac{0}{0} \text{ indeterminate form}$$

Applying L'Hopital's rule

$$= \lim_{x \rightarrow 0^+} \frac{3+4 \sec^2 x}{1} = 7$$

The Left-hand limit=Right-hand limit=7 if $f(0)$ is defined as 7 then $f(x)$ will be continuous.

Q.41)

Suppose that a set of processes arrive for execution at the times indicated in the table. The duration of each process execution is also shown in the table.

Subject: operating systems

Max Marks: 2

Process	Arrival Time (msec)	Burst Duration (msec)
P1	0	8
P2	2	3
P3	3	1
P4	4	7

Compute the average waiting time and average turnaround time (we assume that each process has a single CPU burst, and we ignore context switch cost). Scheduler uses Round Robin with Quantum size 4, then which of the following option is true?

A

Avg TAT is 11.45 msec and Avg WT is 6.2 msec

B

Avg TAT is 10.25 msec and Avg WT is 5.5 msec

Correct Option

Solution: (B)

Explanation:

Round Robin Scheduling with Quantum Size 4:

Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Process	P1	P2	P3	P4			P1			P4									

Process	Start Time	Finish Time	Turn-around Time	Waiting Time
P1	0	16	16	(12-4)
P2	2	7	5	(4-2)
P3	3	8	5	(7-3)
P4	4	19	15	(8-4)+(16-12)

Average Turn-around Time = 10.25 msec

Average Waiting Time = 5.5 msec

C

Avg TAT is 12.55 msec and Avg WT is 6.6 msec

D

None of the above

Q.42)

Subject: C Programming

Max Marks: 2

Consider the following code.

```
#include<stdio.h>
int foo(int a, int b)
{
    int c = a, d = b;
    while(a != b)
    {
        if(a < b)
            a = a+c;
        else
            b = b+d;
    }
    return a;
}

int main()
{
    printf("%d",foo(4,16));
    return 0;
}
```

What the following code is doing.

A

Performing addition of two numbers.

B

Performing multiplication of two numbers.

C

Finding highest common factors of two numbers.

D

Finding lowest common factors of two numbers.

Correct Option

Solution: (D)

Solution: Finding lowest common factors of two numbers.

Here, we will start from main ()

```
int main()
printf("%d",foo(4,16)); // here
we are calling foo(4,16) so go to
the body of foo()
```

```
int foo(int a, int b)// here a=4,
b=16
{
```

```

int c = a, d = b; // declaring c
and d and assigning values as
c=4, d=16
while(a != b) // condition true
if(a < b) // 4<16 true
a = a+c;
else
b = b+d;
}
return a;// 16 will be returned
here
}

while(a != b) // condition true
if(a < b) // 4<16 true
a = a+c; // a=4+4 = 8

while(a != b) // condition true
if(a < b) // 8<16 true
a = a+c; // a=8+4 = 12

while(a != b) // condition true
if(a < b) // 12<16 true
a = a+c; // a=12+4 = 16

while(a != b) // condition true
16!=16 : condition false

```

Back to the main function and 16 will be printed here.

So, we can conclude that it is printing LCM of given two numbers.

The correct answer is finding lowest common factor of two numbers.

Q.43)

Subject: computer organization

Max Marks: 2

Consider a main memory constructed with Synchronous DRAM chips that have the following timing requirements: 1 bus cycle to transfer the address, 10 bus cycles access latency, and 1 bus cycle to transfer a word. Assume that 32-bits of data can be transferred in parallel. If a 200-MHz clock is used for the bus and memory, and burst mode is used to transfer a block, how long does it take to access and transfer 32 bytes of data? (in Nanoseconds)



Correct Answer

Solution: (90)

Explanation:

Clock Rate = 200 MHz, Clock cycle for bus and memory = 5 ns

Time to transfer 32 bytes (8 words) = 1 cycle (address) + 10 cycles (latency to get first word) + 7 cycles (7 remaining words) = 18 bus cycles = 18 * 5 ns = 90 ns

Q.44)

Subject: computer organization

Max Marks: 2

The table below describes the performance of two processors, the rAlpha and the c86, and two compilers on a common 'benchmark' program.

	GHz	Cost	Compiler A		Compiler B	
			Instructions	Average CPI	Instructions	Average CPI
rAlpha	3.4	\$100	7000	1.2	5000	1.5
c86	2.6	\$100	1500	2.2	1000	4.0

which compiler-machine combinations will give the best performance.



rAlpha-Compiler A



c86 -Compiler A

Correct Option

Solution: (8)

Explanation:

	Compiler A	Compiler B
rAlpha	$\frac{7000 \times 1.2}{3.4 \times 10^9} = 2.47 \times 10^{-6}$ seconds	$\frac{5000 \times 1.5}{3.4 \times 10^9} = 2.20 \times 10^{-6}$ seconds
c86	$\frac{1500 \times 2.2}{2.6 \times 10^9} = 1.26 \times 10^{-6}$ seconds	$\frac{1000 \times 4.0}{2.6 \times 10^9} = 1.53 \times 10^{-6}$ seconds



rAlpha- Compiler B



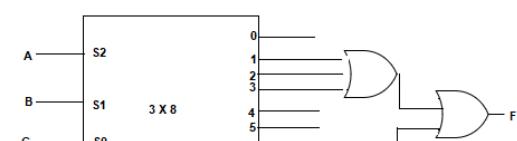
C86 - Compiler B

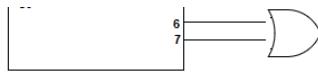
Q.45)

Subject: digital logic systems

Max Marks: 2

Consider the below given decoder:





The total number of variables function $F(A, B, C)$ is free from are _____

[Correct Answer](#) | [Attempted](#)

Solution: 0

Solution: 0

The minterms associated with function F are $= \Sigma(1, 2, 3, 6, 7)$. The k-map for F will be:

A\BC	00	01	11	10
0		1	1	1
1			1	1

The minimal expression will be: $B + A'C$. Since all the three variables are involved in minimal expression, hence, function F is not free from any variable.

Q.46)

In a bank, each customer is given a unique identification number cid. All the current account holders may have same (Firstname, Last Name) pair. As per the RBI regulations, the bank also collects everyone's Aadhaar Card Number. The company's database stores the following fields: (cid, firstname, last name, age, aadhaar). Which of the rows in the following do not contain wrong information?

NOTE:

Some of them may have the same first names, or the same last names.

Each key is a tuple, enclosed by round brackets.

Each cell may contain multiple keys, but does not list all possible values.

No .	Super Keys	Candidate Keys	Primary Keys
1	(cid), (aadhaar age), (cid, aadhaar)	(cid), (aadhaar)	(cid), (aadhaar)
2	(cid), (first name, last name)	(aadhaar)	(cid)
3	(cid, first name), (aadhaar, last name)	(cid), (aadhaar)	(aadhaar)
4	(cid, aadhaar), (aadhaar, firstname, last name)	(firstname, last name), (aadhaar)	(aadhaar)

A Row 1 and 2

B Only Row 3

[Correct Option](#)

Solution: (B)

Explanation:

Only (cid) and (aadhaar) are candidate keys. Any superset of those are superkeys and any ONE of those can be chosen as primary key.

C Row 2 and 3

D Only Row 4

Q.47)

For the given relation $R(A, B, C)$ and $S(A, B, C)$. Simplify the following.

[Subject: DBMS](#)

[Max Marks: 2](#)

$$\sigma_{A>C}((R \cup S) - (R - S) - (S - R))$$

A $\sigma_{A>C}(R \bowtie S)$

B $\sigma_{A>C}(R \cup S)$

C $\sigma_{A>C}(R \cap S)$

[Correct Option](#)

Solution: (A)

Solution:

The operation sequence will result in:

$$((R \cup S) - (R - S) - (S - R)) = (R \cap S)$$

Here, we are subtracting the uncommon values of both R and S and thus it will return the intersection of R and S.

D

$$\sigma(R \cap S)$$

Q.48)

Subject: Computer Networks

Max Marks: 2



Let S be a publicly available trusted service that knows the public keys of all users. Alice communicates with S to obtain Bob's public key using the following protocol:

1. $A \rightarrow S : A, B$

2. $S \rightarrow A : [K_B, B]K_s^{-1}$

In step 1, Alice sends along with her identity A and asks S for Bob's public key. In step 2, S responds by returning Bob's public key K_B along with his identity B, and signs the message. Which of the following attacks is this protocol vulnerable to?

A

Mallory can tamper with S's response so as to substitute her own public-key K_m instead of K_B .

B

Since S's response is not encrypted, Mallory can use K_B to decrypt any messages Alice sends to Bob in the future.

C

Mallory replies step 1 of Alice by encrypting with its own private key and sends a response to Alice acting as S response.

D

None of these.

Correct Option

Solution: (D)**Explanation:**

- Doesn't work because it requires Mallory to forge a signature on (K_m, B) .
- Not possible because Mallory requires private key of B (K_B^{-1}) to decrypt the messages which is only known to B.
- Since Alice has S public key it will know that the reply does not come from Alice.
- None of these

Q.49)

Subject: Discrete Mathematics

Max Marks: 2

**Consider the following statements:**

S1 : Let \ll be the relation on Z^2 such that $(x, y) \ll (p, q)$ if and only if either $x < p$, or else $x = p$ and $y \leq q$. That is, when the first coordinates are different, they determine the ordering of pairs, e.g. $(0, 8) \ll (1, 3)$. But when the first coordinates are the same, we compare the second coordinates, e.g. $(1, 3) \ll (1, 8)$.

S2 : Let \sim be the relation on Z such that $x \sim y$ if and only if $4 \mid 3x + 5y$.

Claims:

C1 : \ll is antisymmetric

C2 : \sim is transitive.

Which of the above claims are correct?

A

Only C1 is true

B

Only C2 is true

C

Both C1 and C2 are true

Correct Option

Solution:

SOLUTION: (4)

Explanation:

A.

We need to show: $\forall(x, y), (p, q) \in Z^2$,
 $(x, y) \ll (p, q)$ and $(p, q) \ll (x, y)$ implies
 $(x, y) = (p, q)$.

$(x, y) \ll (p, q)$ means that either $x < p$ or both $x = p$ and $y \leq q$.

Similarly, $(p, q) \ll (x, y)$ means that either $p < x$ or both $p = x$ and $q \leq y$.

If both $(x, y) \ll (p, q)$ and $(p, q) \ll (x, y)$, x must equal p to be consistent between both definitions.

Consequently, $y \leq q$ and $q \leq y$, so we conclude $y = q$ and $(x, y) = (p, q)$.

B.

We need to show $\forall x, y, z \in Z$, $x \sim y$ and $y \sim z$ implies $x \sim z$.

If $x \sim y$ and $y \sim z$, then we have $4|3x+5y$ and $4|3y+5z$.

By the definition of divides, there are some $a, b \in Z$ such that $4a=3x+5y$ and $4b=3y+5z$.

Rearranging these equations, we know $3x=4a-5y$ and similarly $5z=4b-3y$.

Now consider $3x+5z$.

From our equations above, $3x+5z=(4a-5y)+(4b-3y)=4a+4b-8y=4(a+b-2y)$.

Since $(a+b-2y)$ is an integer, we have $4|3x+5z$ and $x \sim z$, by the definitions of divides and \sim . Thus we've shown that \sim is transitive.

D

Neither C1 nor C2 is true

Q.50)

Subject: digital logic systems

Max Marks: 2



Consider the below given function table of YZ-FF.

Y	Z	Q_n
0	0	Q
0	1	Q
1	0	1
1	1	Q'

If YZ-FF is realised using a T-FF, the number of literals in the minimal expression of T for canonical form SOP are _____

Correct Answer

Solution: (4)

Solution: 4

Since the YZ-FF is realised using a T-FF, therefore we need to get the characteristic table of YZ-FF using the excitation table of T-FF.

The excitation table of T-FF is:

Q	Q_n	T
0	0	0
0	1	1
1	0	1
1	1	0

The Characteristic table of YZ-FF is:

Y	Z	Q	Q _n	T
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	0
1	0	0	1	1
1	0	1	1	0
1	1	0	1	1
1	1	1	0	1

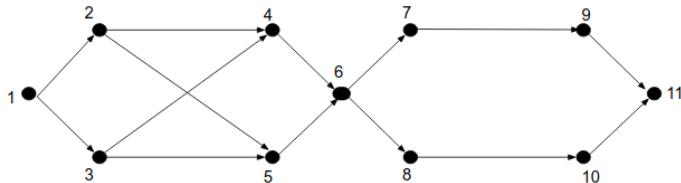
The k-map for T will be:

YZQ	00	01	11	10
0	0	0	0	0
1	1	0	1	1

Since, the minimal expression is $YZ + YQ'$, therefore, the number of literals are 4.

Q.51)

Which is of the following is not a topological sorting of the below graph.



A

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

B

1, 3, 2, 5, 4, 6, 7, 8, 9, 10, 11.

C

1, 3, 2, 4, 5, 6, 8, 7, 10, 9, 11.

D

1, 3, 2, 4, 5, 6, 8, 9, 7, 10, 11.

Correct Option

Solution: (D)

Solution D Option

By looking at the graph and verifying each of the options

If vertex 1 is the source then

1 should come before 2,3

2,3 order can be changed but they should come before 4,5.

Among 4,5 their order can be reversed.

After 4,5 only we can have 6.

After 6 only we can have 7,8

Among 7,8 the order can be changed and after it, if 7 precedes 9 then 8 should precede 10.

11 should be at the end of the ordering.

By observing the options we can say that options A, B, C are valid options whereas in case of option d 1, 3, 2, 4, 5, 6, 8, 9, 7, 10, 11 If we observe the underlined path 9 precedes 7 but 9 does not precede 10, hence it is an incorrect topological ordering of the above graph.

Q.52)

Given the following fragment of code determine the space complexity of the function fun().

```
int fun(int n)
{
    int i,j,sum=0;
    for(i=1;i<=n;i++)
```

Subject: Algorithms

Max Marks: 2

```

{
    int *a=(int *)malloc(i*sizeof(int));
    for(j=1;j<=i;j++)
    {
        a[j]=j;
        sum+=a[j];
    }
    sum+=i;
    free(a);
}
printf("Sum is =%d",sum);
}

```

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

B $O(n^2)$

C $O(n)$

Correct Option

Solution: (C)

Solution:

Each iteration (ith iteration) of the outer loop creates an array of size i and frees the memory the maximum amount of memory will be allocated when i=n i.e. in the last iteration which requires an array of size n, therefore the space complexity of the function fun() is $O(n)$.

D None of the above.

Q.53)

Consider the following grammar where S is the start symbol:

Subject: Compiler Design

Max Marks: 2

$S \rightarrow \text{ictSeS} \mid \text{ictS} \mid a$

The given grammar is

A LL(1) but not SLR(1)

B Not LL(1) but SLR(1)

C Neither LL(1) nor SLR(1)

Correct Option

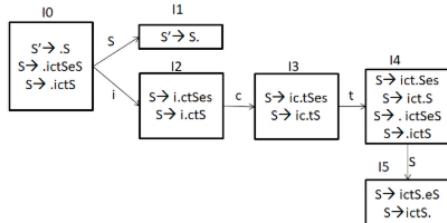
Solution: (C)

Explanation:

The given grammar $S \rightarrow \text{ictSeS} \mid \text{ictS} \mid a$ is not the left factored grammar. Not LL(1). Factor is ictS . We need to convert it into left factored grammar.

Need to check for SLR(1) or Not

The Canonical collection of items for the given grammar is



State I5 contains the reduction and shift operation on terminal e

{e} intersection Follow(S) = {e} $\cap \{\$, e\} \neq \emptyset$

Contains SR conflict. The given grammar is not SLR(1).

D Both LL(1) and SLR(1)

Q.54)

A student came up with the following algorithm for solving the critical section problem for two processes P0 and P1. We use P_i and P_j , where i is either 0 or 1, and $j = 1 - i$ is the index of the other process. Initially, $\text{flag}[0]$ and $\text{flag}[1]$ are set to false.

Subject: operating systems

Max Marks: 2

Entry code for process P_i :

$\text{flag}[i] := \text{true};$

```

turn := i ;
while (flag[i] and turn = j) do no-op;

```

Exit code for process Pi:

```
flag[i] := false;
```

Which of the following option is True for the above given solution?

Satisfies mutual exclusion only

Does not satisfy mutual exclusion and progress

Does not satisfy mutual exclusion and bounded Waiting

Correct Option

Solution: (c)

Explanation:

The given algorithm does not satisfy mutual exclusion.

Consider the following scenario:

Process 0 arrives. Since flag[1] is false gets to the critical region. Process 1 arrives before process 0 leaves critical region. Since it sets turn = 1, process 1 enters critical region. Thus both process 0 and process 1 are in critical section violating mutual exclusion. However, note that it is NOT TRUE that every process that arrives always gets into the critical section without waiting.

For example, if process 0 arrives and sets flag[0] to true and turn to 0.

Before it continues process 1 arrives sets flag[1] to true and turn to 1 and gets to the critical section. Now if process 0 continues, it has to wait at the while loop because turn is 1.

The given algorithm satisfies progress.

If there is only one process, say process i, in the system, then flag[j] is false and hence process i does not have to wait. If both processes are in the system, then turn equals either 1 or 0 and hence one of the processes can always enter the critical section. Thus the case of processes waiting at the while loop forever never arises.

The given algorithm does not satisfy bounded waiting in a single-processor system.

Suppose process 0 is waiting for process 1 to finish. It is true that when process 1 completes it sets flag[1] to false. But before process 0 is scheduled again, another process 1 could be scheduled and since it can enter the critical section it could deny the chance for process 0.

None of the above

Q.55)

In circularly doubly linked list, insertion and deletion of a node in the middle of the list involves the modification of how many pointer links.

Subject: Data Structures

Max Marks: 2

1 pointer

2 pointer

Correct Option

Solution: (B)

Solution: Ans is 2 pointers

In the circular double linked list, while deleting the middle node only two pointers modified.

The node which is previous to deleting node whose next pointer.

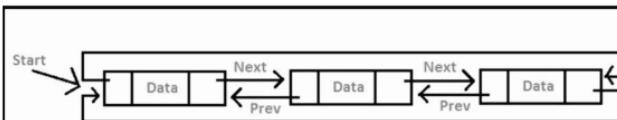
The node which is next to deleting node whose prev pointer

Similarly, while insertion two pointers are modified.

Structure of the node

```

struct node
{
    int data;
    struct node *next; // Pointer to next node
    struct node *prev; // Pointer to previous node
};
```



3 pointer

4 pointer

Q.1)

Select an appropriate antonym for Aggressive

Subject: General Aptitude

Max Marks: 1

Complaisant

Correct Option

Solution: (A)

SOLUTION:

Aggressive means combative or hostile. Complaisant its opposite means accommodating or agreeable.

A Hasty

B Undue

C Costly

Q.2)

The question contains four arguments of three sentences each. Choose the set in which the third statement is a logically derived conclusion of the first two. A. MD is an actor. Some actors are pretty. MD is pretty. B. Some men are cops. All cops are brave. No brave is a man. C. All men are brave. Some men are cops. Some cops are brave. D. All the actors are pretty. MD is not an actor. MD is not pretty.

Subject: General Aptitude

Max Marks: 1

A D only

B Only

Correct Option

Solution: (B)

Solution:

Here, option C is the only valid choice. Those 'some men', who are cops are also brave people. Statement A is invalid. MD not necessarily be among the actors who are pretty. Statement B is invalid as the third statement is not a logical conclusion of the other two. While statement D is also invalid as MD may still be pretty without being an actor.

C A only

D B and C

Q.3)

SECRET: CLANDESTINE

In the above question, a related pair of words or phrases is followed by lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.

Subject: General Aptitude

Max Marks: 1

A Overt: Furtive

B Covert: Stealthy

Correct Option

Solution: (B)

Solution:

Both are pairs of synonyms. All four words (in the question and the correct answer option) mean 'secret'. Hence, option b is the right choice.

C Open: Closed

D News: Rumour

Q.4)

Subject: General Aptitude

Max Marks: 1

Find gcd $(2^{100} - 1, 2^{120} - 1)$.

A $2^{20} - 1$

Correct Option

Solution: (A)

Solution: The GCD of $A^x - 1$ & $A^y - 1$ is given by $A^{(GCD\ of\ x, y)} - 1$. Hence, the required answer will be $2^{(GCD\ of\ 100, 120)} - 1 = 2^{20} - 1$

B $2^{40} - 1$

C $2^{60} - 1$

D $2^{10} - 1$

Q.5)

Two horses started simultaneously towards each other and meet each other 3 hrs 20 min later. How much time will it take the slower

horse to cover the whole distance if the first arrived at the place of departure of the second 5 hours later than the second arrived at the point of departure of the first?

Subject: General Aptitude

Max Marks: 1

A 10 hours

Correct Option

Solution: (A)

Solution:

Since the two horses meet after $3 \times 60 + 20 = 200$ min, they cover 0.5% of the distance per minute (combined) or 30% per hour. This condition is satisfied only if the slower rider takes 10 hours (thereby covering 10% per hour) and the faster rider takes 5 hours (thereby covering 20% per hour).

B 5 hours

C 15 hours

D 6 hours

Q.6)

What comes in place of question mark?

35Z34, 42U36, 55P44, 64K48, ?

Subject: General Aptitude

Max Marks: 2



A 72F50

B 73F52

Correct Option

Solution: (B)

Solution: Here reverse positions are to be considered.

35-34 = 1, A has position 1.

But when reversed Z has position 1.

42-36 = 6 ; 6 means 1+5

U has position 6 in reverse

55-44 = 11 ; 11 means 6+5

P has position 11 in reverse

64-48 = 16 ; 16 means 11+5

K has position 16 in reverse

Next difference has to be 16+5 = 21

21 is position of F in reverse

Answer is option b where 73-52 = 21

C 73U36

D 84G64

Q.7)

If S_1 is the sum of an arithmetic progression of 'n' odd number of terms and S_2 is the sum of the terms of the series in odd places , then

$$\frac{S_1}{S_2}$$

Subject: General Aptitude

Max Marks: 2



A $\frac{2n}{n+1}$

Correct Option

Solution: (A)

Solution: Odd numbers are 1, 3, 5, 7, 9, 11, 13,, n

Therefore, S_1 = Sum of odd numbers = n^2

S_2 = Sum of numbers at odd places

3, 7, 11, 15,

$a = 3$, $d = 7 - 3 = 4$, and number of term = $\frac{n}{2}$

$$S_2 = \frac{n}{2} * [2 * 3 + (\frac{n}{2} - 1) * 4]$$

$$= \frac{n}{4}[6 + 2n - 4]$$

$$= \frac{n}{4}[2n + 2]$$

$$= \frac{n(n+1)}{2}$$

$$\text{Therefore, } \frac{S_1}{S_2} = \frac{n^2}{\frac{n(n+1)}{2}}$$

$$= \frac{2n}{n+1}$$

B $\frac{n}{n+1}$

C $\frac{n+1}{2n}$

D $\frac{n-1}{n}$

Q.8)

But _____ are now regularly written not just for tools but well-established practices, organizations, and institutions, not all of which seem to be _____ away.

Subject: General Aptitude

Max Marks: 2



A reports, withering

B stories, trading

C books, dying

D obituaries, fading

Correct Option

Solution: (D)

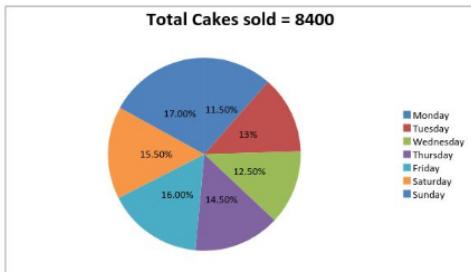
Solution:

In this case, the second blank exhibits a negative sentiment and all the options (other than trading) point to this. The use of 'but' and 'not all' in the sentence helps us identify that we require a pair of opposite sentiments. This is accomplished by obituaries and fading. These words give us the pair of opposite sentiments we require.

Q.9)

Subject: General Aptitude

Max Marks: 2



Note: Cakes on Everyday = No of Vanilla Cakes + No of chocolate cakes

The ratio of no of vanilla cakes sold to chocolate cakes sold is 2 : 1 of the total cakes sold on Monday and the ratio of the number of vanilla cakes sold to chocolate cakes sold is 3 : 2 in the total cakes sold on Wednesday. Then difference of vanilla cakes sold on Monday and vanilla cakes sold on Wednesday is?

A

13

B

14

Correct Option

Solution: (B)

Solution: Monday cakes sold = $8400 * 11.5\% = 966$

Ratio of vanilla : chocolate = 2 : 1

$$\text{Vanilla} = \frac{2}{3} * 966 = 644$$

Wednesday cakes sold = $8400 * 12.5\% = 1050$

Ratio of vanilla : chocolate = 3 : 2

$$\text{Vanilla} = \frac{3}{5} * 1050 = 630$$

$$\text{Difference} = 644 - 630 = 14$$

C

15

D

16

Q.10)

Subject: General Aptitude

Max Marks: 2

A sum is divided between A and B in the ratio of 1 : 2. A purchased a car from his part, which depreciates $14\frac{2}{7}\%$ per annum and B deposited his amount in a bank, which pays him 20% interest per annum compounded annually. By what percentage will the total sum of money increase after two years due to this investment pattern (approximately)?

A

25%

B

26.666%

C

30%

D

20%

Correct Option

Solution: (D)

Solution: Let the amounts be ₹ 100 and ₹ 200 respectively. The value of the 100 would become $100 * (1 - \frac{1}{7}) * (1 - \frac{1}{7}) = 100 * \frac{6}{7} * \frac{6}{7} = \frac{3600}{49} = ₹ 73.46$

The other person's investment of 200 would be $200 * 1.2 * 1.2 = ₹ 288$

The total value would become $288 + 73.46 = ₹ 361.46$.

Hence the increase in % =

$$\frac{361.46 - 300}{300} * 100 = \frac{61.46}{300} * 100 = 20.49\% = 20\% (\text{approx})$$

close