Q.1 Pen : Write :: Knife : _____

Which one of the following options maintains a similar logical relation in the above?

Options
1. Cut

2. Sharp
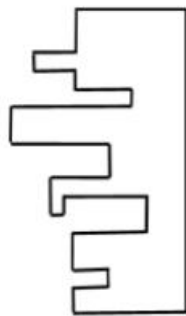
3. Blunt

4. Vegetables

Answer: 1

Q.2 Gauri said that she can play the keyboard _____ her sister.

Options
1. as better as

2. as well as
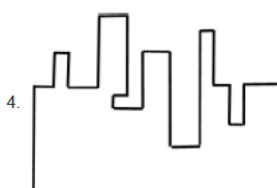
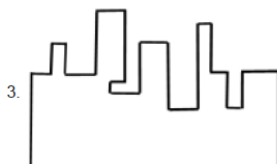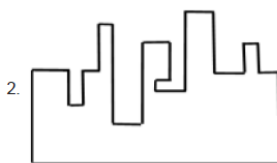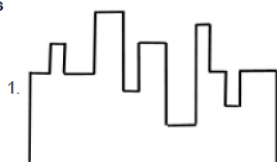3. as nicest as

4. as worse as

Answer: 2

Q.3

A jigsaw puzzle has 2 pieces. One of the pieces is shown above. Which one of the given options for the missing piece when assembled will form a rectangle? The piece can be moved, rotated or flipped to assemble with the above piece.
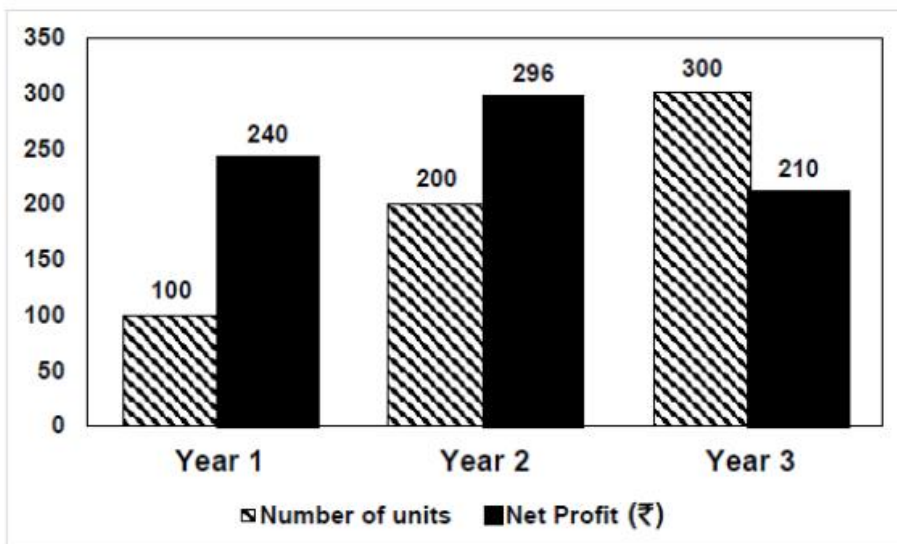
Options

1.

2.

3.

4.

Answer: 3

Q.4

If θ is the angle, in degrees, between the longest diagonal of the cube and any one of the edges of the cube, then, $\cos\theta =$

Options

1. $\dfrac{1}{\sqrt{2}}$

2. $\dfrac{\sqrt{3}}{2}$

3. $\dfrac{1}{2}$

4. $\dfrac{1}{\sqrt{3}}$

Answer: 4

Q.5

☒Number of units ■Net Profit (₹)

The number of units of a product sold in three different years and the respective net profits are presented in the figure above. The cost/unit in Year 3 was ₹ 1, which was half the cost/unit in Year 2. The cost/unit in Year 3 was one-third of the cost/unit in Year 1. Taxes were paid on the selling price at 10%, 13% and 15% respectively for the three years. Net profit is calculated as the difference between the selling price and the sum of cost and taxes paid in that year.

The ratio of the selling price in Year 2 to the selling price in Year 3 is _____.

Options 1. 3:4

2. 1:2

3. 1:1

4. 4:3

Answer: 4

Q.6 Six students P, Q, R, S, T and U, with distinct heights, compare their heights and make the following observations.

Observation I: S is taller than R.

Observation II: Q is the shortest of all.

Observation III: U is taller than only one student.
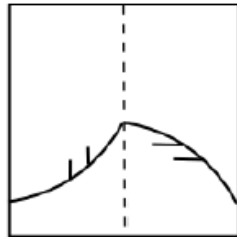
Observation IV: T is taller than S but is not the tallest.

The number of students that are taller than R is the same as the number of students shorter than _____.
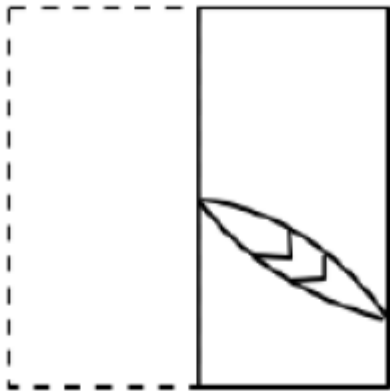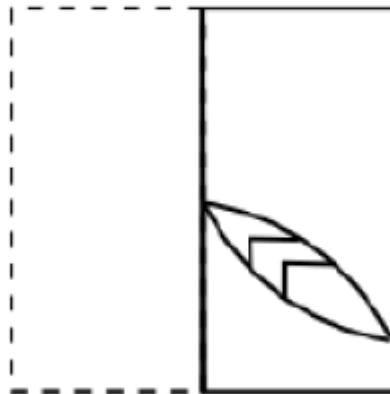
Options 1. R

2. P

3. T

4. S

Answer: 4

Q.7

A transparent square sheet shown above is folded along the dotted line. The folded sheet will look like _____.
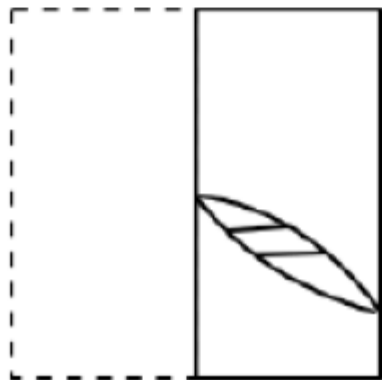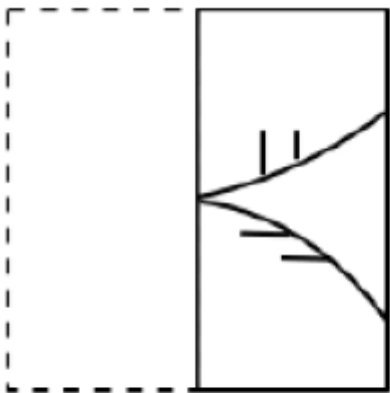
Options

1.

2.

3.

4.

Answer: 2

Q.8 The number of students in three classes is in the ratio 3:13:6. If 18 students are added to each class, the ratio changes to 15:35:21.

The total number of students in all the three classes in the beginning was:

Options 1. 66

2. 88

3. 22

4. 110

Answer: 2

Q.9 Listening to music during exercise improves exercise performance and reduces discomfort. Scientists researched whether listening to music while studying can help students learn better and the results were inconclusive. Students who needed external stimulation for studying fared worse while students who did not need any external stimulation benefited from music.

Which one of the following statements is the CORRECT inference of the above passage?

Options 1.
Listening to music has a clear positive effect on physical exercise. Music has a positive effect on learning only in some students.

2.
Listening to music has no effect on learning and a positive effect on physical exercise.

3.
Listening to music has a clear positive effect both on physical exercise and on learning.

4.
Listening to music has a clear positive effect on learning in all students. Music has a positive effect only in some students who exercise.

Answer: 1

Q.10

If $\left(x-\dfrac{1}{2}\right)^2 - \left(x-\dfrac{3}{2}\right)^2 = x+2$, then the value of x is:

Options 1. 6

2. 4

3. 2

4. 8

Answer: 4

CS Computer Science & Information Technology

Q.1 Suppose the following functional dependencies hold on a relation U with attributes P, Q, R, S, and T:

$$P \rightarrow QR$$
$$RS \rightarrow T$$

Which of the following functional dependencies can be inferred from the above functional dependencies?

Options 1. $R \rightarrow T$

2. $P \rightarrow R$

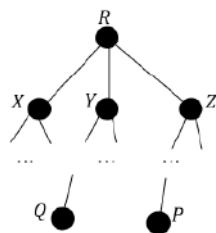3. $PS \rightarrow Q$

4. $PS \rightarrow T$

Answer: 2, 3 and 4

Q.2 Consider a computer network using the distance vector routing algorithm in its network layer. The partial topology of the network is as shown below.

The objective is to find the shortest-cost path from the router R to routers P and Q. Assume that R does not initially know the shortest routes to P and Q. Assume that R has three neighbouring routers denoted as X, Y, and Z. During one iteration, R measures its distance to its neighbours X, Y, and Z as 3, 2, and 5, respectively. Router R gets routing vectors from its neighbours that indicate that the distance to router P from routers X, Y, and Z are 7, 6, and 5, respectively. The routing vector also indicates that the distance to router Q from routers X, Y, and Z are 4, 6, and 8, respectively. Which of the following statement(s) is/are correct with respect to the new routing table of R, after updation during this iteration?

Options

1. The distance from R to P will be stored as 10.

2. The next hop router for a packet from R to P is Y.

3. The next hop router for a packet from R to Q is Z.

4. The distance from R to Q will be stored as 7.

Answer: 2 and 4

Q.3 In an examination, a student can choose the order in which two questions (QuesA and QuesB) must be attempted.
- If the first question is answered wrong, the student gets zero marks.
- If the first question is answered correctly and the second question is not answered correctly, the student gets the marks only for the first question.
- If both the questions are answered correctly, the student gets the sum of the marks of the two questions.

The following table shows the probability of correctly answering a question and the marks of the question respectively.

question	probability of answering correctly	marks
QuesA	0.8	10
QuesB	0.5	20

Assuming that the student always wants to maximize her expected marks in the examination, in which order should she attempt the questions and what is the expected marks for that order (assume that the questions are independent)?

Options

1. First QuesB and then QuesA. Expected marks 22.

2. First QuesA and then QuesB. Expected marks 16.

3. First QuesA and then QuesB. Expected marks 14.

4. First QuesB and then QuesA. Expected marks 14.

Answer: 2

Q.4 Consider the string **abbccddeee**. Each letter in the string must be assigned a binary code satisfying the following properties:

1. For any two letters, the code assigned to one letter must not be a prefix of the code assigned to the other letter.
2. For any two letters of the same frequency, the letter which occurs earlier in the dictionary order is assigned a code whose length is at most the length of the code assigned to the other letter.

Among the set of all binary code assignments which satisfy the above two properties, what is the minimum length of the encoded string?

1. 21

2. 23

3. 25

4. 30

Answer: 2

Q.5 Consider the following two statements about regular languages:

S_1: Every infinite regular language contains an undecidable language as a subset.

S_2: Every finite language is regular.

Which one of the following choices is correct?

1. Both S_1 and S_2 are true.

2. Neither S_1 nor S_2 is true.

3. Only S_2 is true.

4. Only S_1 is true.

Answer: 1

Q.6

Consider the following multi-threaded code segment (in a mix of C and pseudo-code), invoked by two processes P1 and P2, and each of the processes spawns two threads T1 and T2:

```
int x = 0;  // global
Lock L1;    // global
main() {
  create a thread to execute foo();  // Thread T1
  create a thread to execute foo();  // Thread T2
  wait for the two threads to finish execution;
  print (x);}

foo() {
  int y = 0;
  Acquire L1;
  x = x + 1;
  y = y + 1;
  Release L1;
  print (y);}
```

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

Options 1.

Both T1 and T2, in both the processes, will print the value of y as 1.

2. Both P1 and P2 will print the value of x as 2.

3. At least one of the threads will print the value of y as 2.

4. At least one of P1 and P2 will print the value of x as 4.

Answer: 1 and 2

Q.7

For a statement S in a program, in the context of liveness analysis, the following sets are defined:

$USE(S)$: the set of variables used in S
$IN(S)$: the set of variables that are live at the entry of S
$OUT(S)$: the set of variables that are live at the exit of S

Consider a basic block that consists of two statements, S_1 followed by S_2. Which one of the following statements is correct?

Options

1. $OUT(S_1) = IN(S_2)$

2. $OUT(S_1) = USE(S_1) \cup IN(S_2)$

3. $OUT(S_1) = IN(S_1) \cup USE(S_1)$

4. $OUT(S_1) = IN(S_2) \cup OUT(S_2)$

Answer: 1

Q.8

For a given biased coin, the probability that the outcome of a toss is a head is 0.4. This coin is tossed 1,000 times. Let X denote the random variable whose value is the number of times that head appeared in these 1,000 tosses. The standard deviation of X (rounded to 2 decimal places) is _____.

Answer: 15.49

Q.9 A bag has r red balls and b black balls. All balls are identical except for their colours. In a trial, a ball is randomly drawn from the bag, its colour is noted and the ball is placed back into the bag along with another ball of the same colour. Note that the number of balls in the bag will increase by one, after the trial. A sequence of four such trials is conducted. Which one of the following choices gives the probability of drawing a red ball in the fourth trial?

1. $\dfrac{r+3}{r+b+3}$

2. $\dfrac{r}{r+b}$

3. $\left(\dfrac{r}{r+b}\right)\left(\dfrac{r+1}{r+b+1}\right)\left(\dfrac{r+2}{r+b+2}\right)\left(\dfrac{r+3}{r+b+3}\right)$

4. $\dfrac{r}{r+b+3}$

Answer:

Q.10 Consider the following ANSI C code segment:

```
z = x + 3 + y->f1 + y->f2;
for (i = 0; i < 200; i = i + 2){
 if (z > i) {
   p = p + x + 3;
   q = q + y->f1;
 } else {
   p = p + y->f2;
   q = q + x + 3;
 }
}
```

Assume that the variable y points to a **struct** (allocated on the heap) containing two fields **f1** and **f2**, and the local variables **x**, **y**, **z**, **p**, **q**, and **i** are allotted registers. Common sub-expression elimination (CSE) optimization is applied on the code. The number of addition and dereference operations (of the form **y->f1** or **y->f2**) in the optimized code, respectively, are:

1. 403 and 102

2. 303 and 2

3. 203 and 2

4. 303 and 102

Answer: 2

Q.11 Consider a set-associative cache of size 2KB ($1\text{KB} = 2^{10}$ bytes) with cache block size of 64 bytes. Assume that the cache is byte-addressable and a 32-bit address is used for accessing the cache. If the width of the tag field is 22 bits, the associativity of the cache is _____.

Answer: 2

Q.12 For two n-dimensional real vectors P and Q, the operation $s(P,Q)$ is defined as follows:

$$s(P,Q) = \sum_{i=1}^{n}(P[i] \cdot Q[i])$$

Let $\mathcal{L}$ be a set of 10-dimensional non-zero real vectors such that for every pair of distinct vectors $P, Q \in \mathcal{L}$, $s(P,Q) = 0$. What is the maximum cardinality possible for the set $\mathcal{L}$?

Answer: 3

Q.13 Consider a computer system with multiple shared resource types, with one instance per resource type. Each instance can be owned by only one process at a time. Owning and freeing of resources are done by holding a global lock (L). The following scheme is used to own a resource instance :

```
function OWNRESOURCE(Resource R)
    Acquire lock L // a global lock
    if R is available then
        Acquire R
        Release lock L
    else
        if R is owned by another process P then
            Terminate P, after releasing all resources owned by P
            Acquire R
            Restart P
            Release lock L
        end if
    end if
end function
```

Which of the following choice(s) about the above scheme is/are correct?

1. The scheme may lead to starvation.

2. The scheme ensures that deadlocks will not occur.

3. The scheme violates the mutual exclusion property.

4. The scheme may lead to live-lock.

Answer: 1 and 2

Consider the following directed graph:
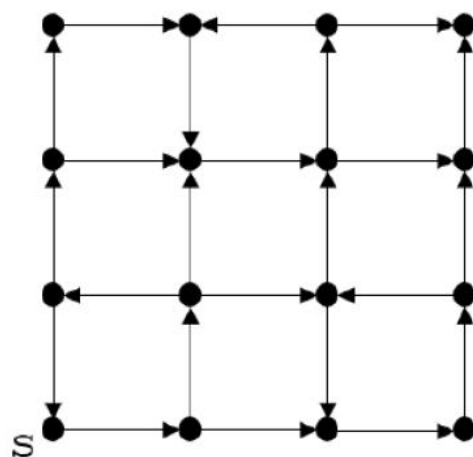
Which of the following is/are correct about the graph?

1. The graph does not have a topological order.

2.
For each pair of vertices u and v, there is a directed path from u to v.

3.
The graph does not have a strongly connected component.

4.
A depth-first traversal starting at vertex S classifies three directed edges as back edges.

Answer: 1

Consider the following sets, where $n \geq 2$:

S_1: Set of all $n \times n$ matrices with entries from the set $\{a, b, c\}$
S_2: Set of all functions from the set $\{0, 1, 2, ..., n^2 - 1\}$ to the set $\{0, 1, 2\}$

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

1. There does not exist an injection from S_1 to S_2.

2. There exists a surjection from S_1 to S_2.

3. There exists a bijection from S_1 to S_2.

4. There does not exist a bijection from S_1 to S_2.

Answer: 2 and 3

COMMON FEATURES
IN ALL COURSES

▶ **Doubt Discussions** (App Based + Facebook Group)
▶ **Query Resolution** Time 3 – 4 Working Hours
▶ **Dedicated Mentor** For Doubt Discussion
▶ **No View Restriction** On Recorded Lecture

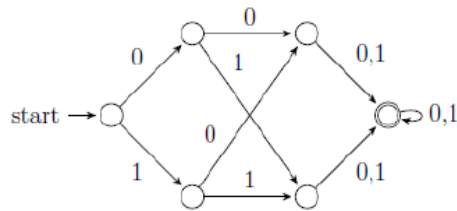Q.16 Consider a Boolean function $f(w, x, y, z)$ such that

$$f(w, 0, 0, z) = 1$$
$$f(1, x, 1, z) = x + z$$
$$f(w, 1, y, z) = wz + y$$

The number of literals in the minimal sum-of-products expression of f is _____

Answer 6

Q.17 Consider the following deterministic finite automaton (DFA).

The number of strings of length 8 accepted by the above automaton is _____.

Answer: 256

Q.18 In a directed acyclic graph with a source vertex s, the *quality-score* of a directed path is defined to be the product of the weights of the edges on the path. Further, for a vertex v other than s, the quality-score of v is defined to be the maximum among the quality-scores of all the paths from s to v. The quality-score of s is assumed to be 1.
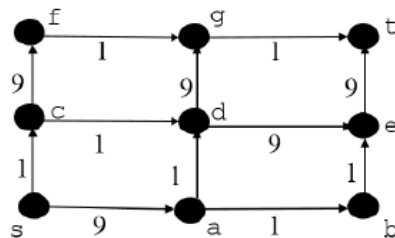
The sum of the quality-scores of all the vertices in the graph shown above is _____.

Answer: 929

Q.19 Let L_1 be a regular language and L_2 be a context-free language. Which of the following languages is/are context-free?

Options

1. $(L_1 \cap L_2) \cup (\overline{L_1} \cap L_2)$

2. $L_1 \cup (L_2 \cup \overline{L_2})$

3. $L_1 \cap \overline{L_2}$

4. $\overline{\overline{L_1} \cup \overline{L_2}}$

Answer: 1, 2 and 4

Q.20 Consider a pipelined processor with 5 stages, Instruction Fetch (IF), Instruction Decode (ID), Execute (EX), Memory Access (MEM), and Write Back (WB). Each stage of the pipeline, except the EX stage, takes one cycle. Assume that the ID stage merely decodes the instruction and the register read is performed in the EX stage. The EX stage takes one cycle for ADD instruction and two cycles for MUL instruction. Ignore pipeline register latencies.
Consider the following sequence of 8 instructions:

ADD, MUL, ADD, MUL, ADD, MUL, ADD, MUL

Assume that every MUL instruction is data-dependent on the ADD instruction just before it and every ADD instruction (except the first ADD) is data-dependent on the MUL instruction just before it. The *Speedup* is defined as follows:

$$Speedup = \frac{\text{Execution time without operand forwarding}}{\text{Execution time with operand forwarding}}$$

The *Speedup* achieved in executing the given instruction sequence on the pipelined processor (rounded to 2 decimal places) is _____.

Answer: 1.88(if register read and write cannot be perform in same cycle) or 1.44 (if register read and write can be perform in same cycle)

Q.21 Suppose that P is a 4×5 matrix such that every solution of the equation $Px = 0$ is a scalar multiple of $[2\ \ 5\ \ 4\ \ 3\ \ 1]^T$. The rank of P is _____.

Answer: 4

Q.22 Consider the following ANSI C program:

```
int main() {
    Integer x;
    return 0;
}
```

Which one of the following phases in a seven-phase C compiler will throw an error?

Options
1. Syntax analyzer

2. Machine dependent optimizer

3. Semantic analyzer

4. Lexical analyzer

Answer: 1

Q.23 Consider a three-level page table to translate a 39-bit virtual address to a physical address as shown below.

```
<------------- 39-bit virtual address ------------->

-------------------------------------------------------
|  Level 1   |  Level 2   |  Level 3   |    Page    |
|  offset    |  offset    |  offset    |   offset   |
|_____|_____|_____|_____|
    9 bits        9 bits       9 bits       12 bits
```
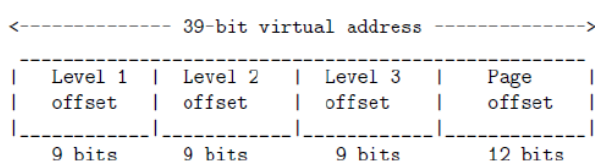
The page size is 4KB (1KB $= 2^{10}$ bytes) and page table entry size at every level is 8 bytes. A process P is currently using 2GB (1GB $= 2^{30}$ bytes) virtual memory which is mapped to 2GB of physical memory. The minimum amount of memory required for the page table of P across all levels is _____ KB.

Answer: 4108

Q.24 Consider the following statements S1 and S2 about the relational data model:

S1: A relation scheme can have at most one foreign key.
S2: A foreign key in a relation scheme R cannot be used to refer to tuples of R.

Which one of the following choices is correct?

Options

1. S1 is false and S2 is true.

2. Both S1 and S2 are false.

3. S1 is true and S2 is false.

4. Both S1 and S2 are true.

Answer: 2

Q.25 Consider the following augmented grammar with $\{\#, @, <, >, a, b, c\}$ as the set of terminals.

$$S' \rightarrow S$$
$$S \rightarrow S \# c S$$
$$S \rightarrow S S$$
$$S \rightarrow S @$$
$$S \rightarrow < S >$$
$$S \rightarrow a$$
$$S \rightarrow b$$
$$S \rightarrow c$$

Let $I_0 = \text{CLOSURE}(\{S' \rightarrow \bullet S\})$. The number of items in the set $\text{GOTO}(\text{GOTO}(I_0, <), <)$ is _____.

Answer: 8

Q.26 If x and y are two decimal digits and $(0.1101)_2 = (0.8xy5)_{10}$, the decimal value of $x + y$ is _____.

Answer: 3

Q.27 For a string w, we define w^R to be the reverse of w. For example, if $w = 01101$ then $w^R = 10110$.
Which of the following languages is/are context-free?

Options

1. $\{ww^R xx^R \mid w, x \in \{0,1\}^*\}$

2. $\{wxx^R w^R \mid w, x \in \{0,1\}^*\}$

3. $\{wxw^R \mid w, x \in \{0,1\}^*\}$

4. $\{wxw^R x^R \mid w, x \in \{0,1\}^*\}$

Answer: 1, 2 and 3

Consider the cyclic redundancy check (CRC) based error detecting scheme having the generator polynomial X^3+X+1. Suppose the message $m_4m_3m_2m_1m_0 = 11000$ is to be transmitted. Check bits $c_2c_1c_0$ are appended at the end of the message by the transmitter using the above CRC scheme. The transmitted bit string is denoted by $m_4m_3m_2m_1m_0c_2c_1c_0$. The value of the checkbit sequence $c_2c_1c_0$ is

Options
1. 111

2. 101

3. 110

4. 100

Answer: 4

Consider the following ANSI C program.
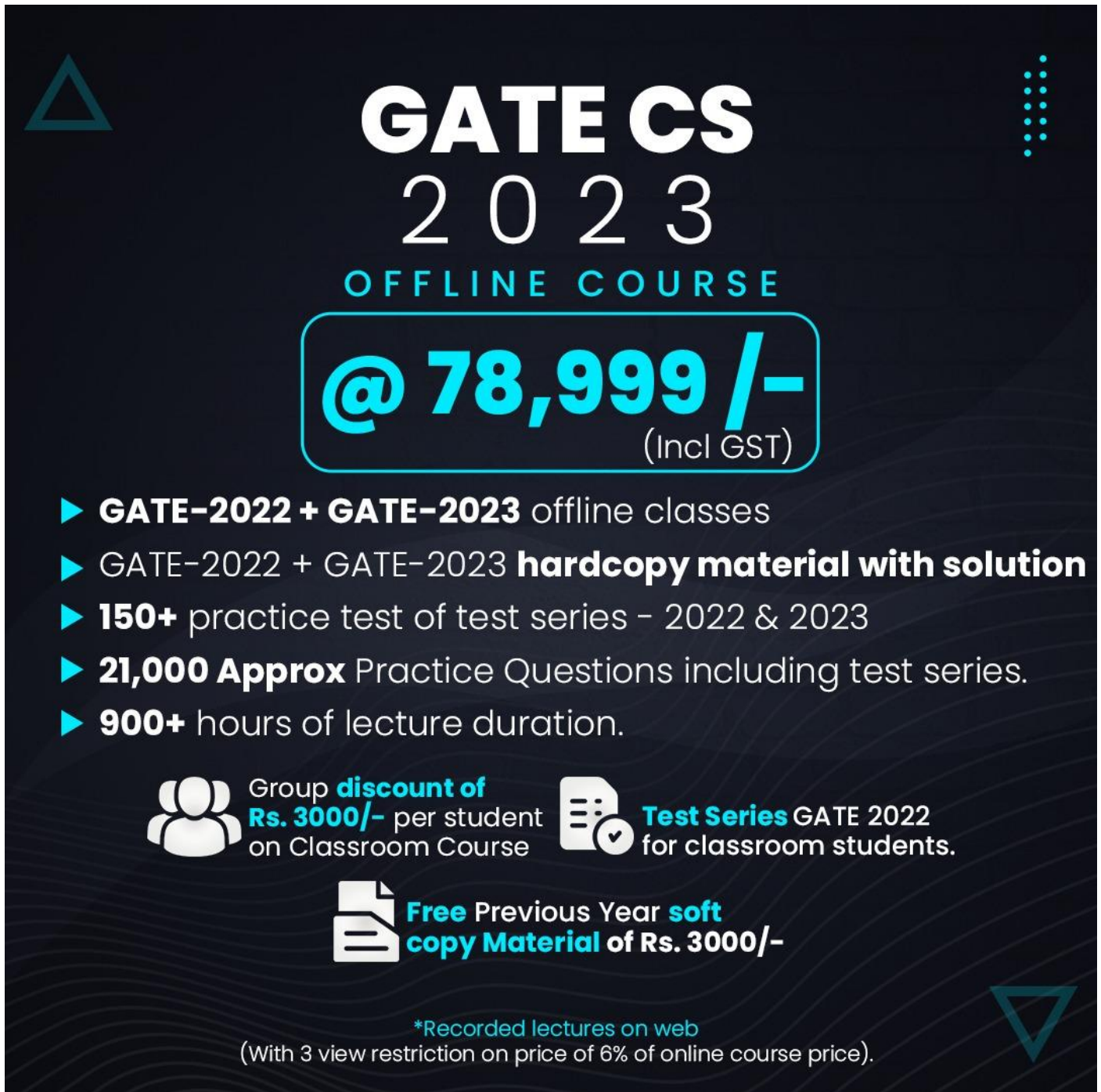
```c
#include <stdio.h>

int foo(int x, int y, int q)
{
    if ((x <= 0) && (y <= 0))
        return q;
    if (x <= 0)
        return foo(x, y-q, q);
    if (y <= 0)
        return foo(x-q, y, q);
    return foo(x, y-q, q) + foo(x-q, y, q);
}

int main()
{
    int r = foo(15,15,10);
    printf("%d", r);
    return 0;
}
```

The output of the program upon execution is _____.

Answer: 60

Q.30 Choose the correct choice(s) regarding the following propositional logic assertion S:

$$S : ((P \wedge Q) \to R) \to ((P \wedge Q) \to (Q \to R))$$

Options 1. The antecedent of S is logically equivalent to the consequent of S.

2. S is neither a tautology nor a contradiction.

3. S is a contradiction.

4. S is a tautology.

Answer: 1 and 4

Q.31

Let S be the following schedule of operations of three transactions T_1, T_2 and T_3 in a relational database system:

$$R_2(Y), R_1(X), R_3(Z), R_1(Y), W_1(X), R_2(Z), W_2(Y), R_3(X), W_3(Z)$$

Consider the statements P and Q below:

P: S is conflict-serializable.
Q: If T_3 commits before T_1 finishes, then S is recoverable.

Which one of the following choices is correct?

Options

1. P is true and Q is false.

2. Both P and Q are true.

3. P is false and Q is true.

4. Both P and Q are false.

Answer: 1

Q.32

Which one of the following circuits implements the Boolean function given below?

$$f(x, y, z) = m_0 + m_1 + m_3 + m_4 + m_5 + m_6, \text{ where } m_i \text{ is the } i^{th} \text{ minterm.}$$

Options

1.

2.

3.

4.
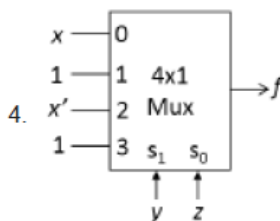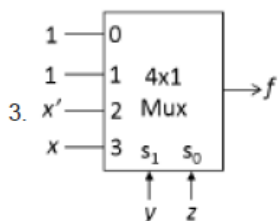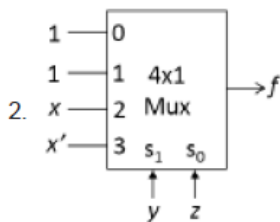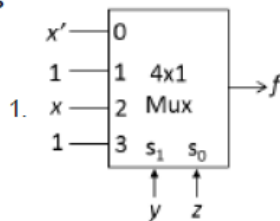
Answer: 2

Q.33 If the numerical value of a 2-byte unsigned integer on a little endian computer is 255 more than that on a big endian computer, which of the following choices represent(s) the unsigned integer on a little endian computer?

Options
1. 0x6665

2. 0x4243

3. 0x0100

4. 0x0001

Answer: 1 and 3

Q.34 Assume a two-level inclusive cache hierarchy, L1 and L2, where L2 is the larger of the two. Consider the following statements.

S_1 : Read misses in a write through L1 cache do not result in writebacks of dirty lines to the L2.

S_2 : Write allocate policy *must* be used in conjunction with write through caches and no-write allocate policy is used with writeback caches.

Which of the following statements is correct?

Options
1. S_1 is false and S_2 is false

2. S_1 is true and S_2 is true

3. S_1 is true and S_2 is false

4. S_1 is false and S_2 is true

Answer: 3

Q.35 In the context of compilers, which of the following is/are NOT an intermediate representation of the source program?

Options
1. Symbol table

2. Abstract Syntax Tree (AST)

3. Three address code

4. Control Flow Graph (CFG)

Answer: 1

Q.36 Which of the following regular expressions represent(s) the set of all binary numbers that are divisible by three? Assume that the string ϵ is divisible by three.

Options

1. $(0^*(1(01^*0)^*1)^*)^*$

2. $(0 + 11 + 11(1 + 00)^*00)^*$

3. $(0 + 1(01^*0)^*1)^*$

4. $(0 + 11 + 10(1 + 00)^*01)^*$

Answer: 1, 3 and 4

Q.37

Which of the following statement(s) is/are correct in the context of CPU scheduling?

Options 1.

The goal is to only maximize CPU utilization and minimize throughput.

2. Turnaround time includes waiting time.

3.

Round-robin policy can be used even when the CPU time required by each of the processes is not known apriori.

4.

Implementing preemptive scheduling needs hardware support.

Answer: 2, 3 and 4

Q.38

Consider the following ANSI C program:

```c
#include <stdio.h>
#include <stdlib.h>
struct  Node{
        int value;
        struct Node *next;};
int main(){
    struct Node  *boxE, *head, *boxN; int index - 0;
    boxE - head - (struct Node *) malloc(sizeof(struct Node));
    head->value - index;
    for (index = 1; index <= 3; index++){
        boxN = (struct Node *) malloc(sizeof(struct Node));
        boxE->next =  boxN;
        boxN->value = index;
        boxE = boxN; }
    for (index = 0; index <= 3;  index++) {
        printf("Value at index  %d is %d\n", index, head->value);
        head = head->next;
        printf("Value at index %d is %d\n", index+1, head->value); } }
```

Which one of the statements below is correct about the program?

Options 1.

It dereferences an uninitialized pointer that may result in a run-time error.

2. Upon execution, the program goes into an infinite loop.

3.

It has a missing **return** which will be reported as an error by the compiler.

4.

Upon execution, the program creates a linked-list of five nodes.

Answer: 1

Q.39 The relation scheme given below is used to store information about the employees of a company, where empId is the key and deptId indicates the department to which the employee is assigned. Each employee is assigned to exactly one department.

$$emp(\underline{empId}, \ name, \ gender, \ salary, \ deptId)$$

Consider the following SQL query:

```
select deptId, count(*)
from emp
where gender = "female" and salary > (select avg(salary) from emp)
group by deptId;
```

The above query gives, for each department in the company, the number of female employees whose salary is greater than the average salary of

1. female employees in the department.

2. employees in the company.

3. female employees in the company.

4. employees in the department.

Answer: 2

Q.40 Consider a network using the pure ALOHA medium access control protocol, where each frame is of length 1,000 bits. The channel transmission rate is 1 Mbps ($= 10^6$ bits per second). The aggregate number of transmissions across all the nodes (including new frame transmissions and retransmitted frames due to collisions) is modelled as a Poisson process with a rate of 1,000 frames per second. Throughput is defined as the average number of frames successfully transmitted per second. The throughput of the network (rounded to the nearest integer) is _____.

Answer: 135

Q.41 Consider a computer system with DMA support. The DMA module is transferring one 8-bit character in one CPU cycle from a device to memory through *cycle stealing* at regular intervals. Consider a 2 MHz processor. If 0.5% processor cycles are used for DMA, the data transfer rate of the device is _____ bits per second.

Answer: 80000

Q.42 Consider the three-way handshake mechanism followed during TCP connection establishment between hosts P and Q. Let X and Y be two random 32-bit starting sequence numbers chosen by P and Q respectively. Suppose P sends a TCP connection request message to Q with a TCP segment having SYN bit = 1, SEQ number = X, and ACK bit = 0. Suppose Q accepts the connection request. Which one of the following choices represents the information present in the TCP segment header that is sent by Q to P?

Options 1.

SYN bit = 0, SEQ number = X+1, ACK bit = 0, ACK number = Y, FIN bit = 1

2.

SYN bit = 1, SEQ number = X+1, ACK bit = 0, ACK number = Y, FIN bit = 0

3.

SYN bit = 1, SEQ number = Y, ACK bit = 1, ACK number = X+1, FIN bit = 0

4.

SYN bit = 1, SEQ number = Y, ACK bit = 1, ACK number = X, FIN bit = 0

Answer: 3

Q.43 Let H be a binary min-heap consisting of n elements implemented as an array. What is the worst case time complexity of an optimal algorithm to find the maximum element in H?

Options 1. $\Theta(\log n)$

2. $\Theta(1)$

3. $\Theta(n \log n)$

4. $\Theta(n)$

Answer: 4

Q.44 Suppose that $f: \mathbb{R} \to \mathbb{R}$ is a continuous function on the interval [-3, 3] and a differentiable function in the interval (-3, 3) such that for every x in the interval, $f'(x) \leq 2$. If $f(-3) = 7$, then $f(3)$ is at most _____.

Answer: 19

Q.45

The format of the single-precision floating-point representation of a real number as per the IEEE 754 standard is as follows:

| sign | exponent | mantissa |

Which one of the following choices is correct with respect to the *smallest* normalized positive number represented using the standard?

Options 1.

exponent = 00000000 and mantissa = 00000000000000000000001

2.

exponent = 00000001 and mantissa = 00000000000000000000001

3.

exponent = 00000000 and mantissa = 00000000000000000000000

4.

exponent = 00000001 and mantissa = 00000000000000000000000

Answer: 4

Q.46

Consider the following ANSI C function:

```
int SomeFunction(int x, int y)
{
   if ((x == 1) || (y == 1)) return 1;
   if (x == y) return x;
   if (x > y) return SomeFunction(x - y, y);
   if (y > x) return SomeFunction(x, y - x);
}
```

The value returned by SomeFunction(15, 255) is _____.

Answer: 15

Q.47

A data file consisting of 1,50,000 student-records is stored on a hard disk with block size of 4096 bytes. The data file is sorted on the primary key RollNo. The size of a record pointer for this disk is 7 bytes. Each student-record has a candidate key attribute called ANum of size 12 bytes. Suppose an index file with records consisting of two fields, ANum value and the record pointer to the corresponding student record, is built and stored on the same disk. Assume that the records of data file and index file are not split across disk blocks. The number of blocks in the index file is _____.

Answer: 698

Q.48

Let S be a set consisting of 10 elements. The number of tuples of the form (A, B) such that A and B are subsets of S, and $A \subseteq B$ is _____.

Answer: 59049
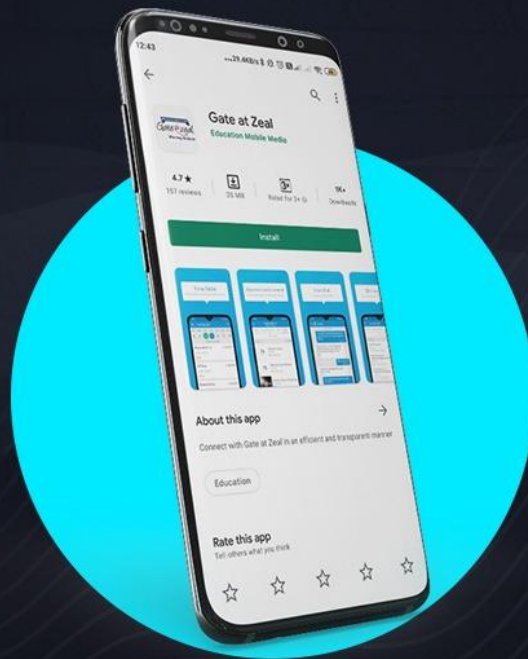
Q.49 What is the worst-case number of arithmetic operations performed by recursive binary search on a sorted array of size n?

Options

1. $\Theta(\sqrt{n})$

2. $\Theta(n)$

3. $\Theta(n^2)$

4. $\Theta(\log_2(n))$

Answer: 4

Consider the following ANSI C program.

```
#include <stdio.h>
int main(){
    int arr[4][5];
    int i, j;
    for (i=0; i<4; i++){
        for (j=0; j<5; j++){
            arr[i][j] = 10*i + j;
        }
    }
    printf("%d", *(arr[1] + 9));
    return 0;
}
```

What is the output of the above program?

Options
1. 20

2. 30

3. 14

4. 24

Answer: 4

Q.51

For constants $a \geq 1$ and $b > 1$, consider the following recurrence defined on the non-negative integers:

$$T(n) = a \cdot T\left(\frac{n}{b}\right) + f(n)$$

Which one of the following options is correct about the recurrence $T(n)$?

Options
1. If $f(n)$ is $n \log_2(n)$, then $T(n)$ is $\Theta(n \log_2(n))$.

2.

If $f(n)$ is $O(n^{\log_b(a)-\epsilon})$ for some $\epsilon > 0$, then $T(n)$ is $\Theta(n^{\log_b(a)})$.

3. If $f(n)$ is $\dfrac{n}{\log_2(n)}$, then $T(n)$ is $\Theta(\log_2(n))$.

4. If $f(n)$ is $\Theta(n^{\log_b(a)})$, then $T(n)$ is $\Theta(n^{\log_b(a)})$.

Answer: 2

Q.52 Suppose we want to design a synchronous circuit that processes a string of 0's and 1's. Given a string, it produces another string by replacing the first 1 in any subsequence of consecutive 1's by a 0. Consider the following example.

Input sequence: 0010001100011100
Output sequence: 0000000100001100

A *Mealy Machine* is a state machine where both the next state and the output are functions of the present state and the current input.

The above mentioned circuit can be designed as a two-state Mealy machine. The states in the Mealy machine can be represented using Boolean values 0 and 1. We denote the current state, the next state, the next incoming bit, and the output bit of the Mealy machine by the variables s, t, b and y respectively.

Assume the initial state of the Mealy machine is 0.

What are the Boolean expressions corresponding to t and y in terms of s and b?

Options

1. $t = b$
    $y = sb$

2. $t = b$
    $y = s\overline{b}$

3. $t = s + b$
    $y = s\overline{b}$

4. $t = s + b$
    $y = sb$

Answer: 1

Q.53 Consider a complete binary tree with 7 nodes. Let A denote the set of first 3 elements obtained by performing Breadth-First Search (BFS) starting from the root. Let B denote the set of first 3 elements obtained by performing Depth-First Search (DFS) starting from the root.

The value of $|A - B|$ is _____.

Answer: 1

Q.54 Let $L \subseteq \{0,1\}^*$ be an arbitrary regular language accepted by a minimal DFA with k states. Which one of the following languages must necessarily be accepted by a minimal DFA with k states?

Options

1. $L - \{01\}$

2. $L \cup \{01\}$

3. $L \cdot L$

4. $\{0,1\}^* - L$

Answer: 4

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Q.55 Let G be a connected undirected weighted graph. Consider the following two statements.

S_1 : There exists a minimum weight edge in G which is present in every minimum spanning tree of G.

S_2 : If every edge in G has distinct weight, then G has a unique minimum spanning tree.

Which one of the following options is correct?

Options

1. S_1 is false and S_2 is true.

2. Both S_1 and S_2 are false.

3. S_1 is true and S_2 is false.

4. Both S_1 and S_2 are true.

Answer: 1