Graduate Aptitude Test in Engineering 2017

Question Paper Name: Computer Science and Information Technology 11th Feb 2017 Session 1
Subject Name: Computer Science and Information Technology
Duration: 180
Total Marks: 100

Organizing Institute:

Indian Institute of Technology Roorkee

Question Number : 1 **Correct : 1 Wrong : -0.33**

The statement $(\neg p) \Rightarrow (\neg q)$ is logically equivalent to which of the statements below?

I. $p \Rightarrow q$

II. $q \Rightarrow p$

III. $(\neg q) \vee p$

IV. $(\neg p) \vee q$

(A) I only (B) I and IV only (C) II only (D) II and III only

Question Number : 2 **Correct : 1 Wrong : -0.33**

Consider the first-order logic sentence $F: \forall x(\exists y R(x, y))$. Assuming non-empty logical domains, which of the sentences below are *implied* by F?

I. $\exists y(\exists x R(x, y))$

II. $\exists y(\forall x R(x, y))$

III. $\forall y(\exists x R(x, y))$

IV. $\neg\exists x(\forall y \neg R(x, y))$

(A) IV only (B) I and IV only (C) II only (D) II and III only

Question Number : 3 **Correct : 1 Wrong : -0.33**

Let $c_1,\ldots,c_n$ be scalars, not all zero, such that $\sum_{i=1}^{n} c_i a_i = 0$ where a_i are column vectors in $\mathbf{R}^n$.

Consider the set of linear equations

$$Ax = b$$

where $A=[a_1,\ldots,a_n]$ and $b=\sum_{i=1}^{n} a_i$. The set of equations has

(A) a unique solution at $x = J_n$ where J_n denotes a n-dimensional vector of all 1

(B) no solution

(C) infinitely many solutions

(D) finitely many solutions

Question Number : 4 **Correct : 1 Wrong : -0.33**

Consider the following functions from positive integers to real numbers:

$$10,\ \sqrt{n},\ n,\ \log_2 n,\ \frac{100}{n}.$$

The CORRECT arrangement of the above functions in increasing order of asymptotic complexity is:

(A) $\log_2 n,\ \frac{100}{n},\ 10,\ \sqrt{n},\ n$

(B) $\frac{100}{n},\ 10,\ \log_2 n,\ \sqrt{n},\ n$

(C) $10,\ \frac{100}{n},\ \sqrt{n},\ \log_2 n,\ n$

(D) $\frac{100}{n},\ \log_2 n,\ 10,\ \sqrt{n},\ n$

Question Number : 5 **Correct : 1 Wrong : -0.33**

Consider the following table:

Algorithms	Design Paradigms
(P) Kruskal	(i) Divide and Conquer
(Q) Quicksort	(ii) Greedy
(R) Floyd-Warshall	(iii) Dynamic Programming

Match the algorithms to the design paradigms they are based on.

(A) (P) ↔ (ii), (Q) ↔ (iii), (R) ↔ (i)

(B) (P) ↔ (iii), (Q) ↔ (i), (R) ↔ (ii)

(C) (P) ↔ (ii), (Q) ↔ (i), (R) ↔ (iii)

(D) (P) ↔ (i), (Q) ↔ (ii), (R) ↔ (iii)

Question Number : 6 **Correct : 1 Wrong : -0.33**

Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are:
Note: The height of a tree with a single node is 0.

(A) 4 and 15 respectively

(B) 3 and 14 respectively

(C) 4 and 14 respectively

(D) 3 and 15 respectively

Question Number : 7 **Correct : 1 Wrong : -0.33**

The n-bit fixed-point representation of an unsigned real number X uses f bits for the fraction part. Let $i = n - f$. The range of decimal values for X in this representation is

(A) 2^{-f} to 2^{i} (B) 2^{-f} to $(2^{i} - 2^{-f})$ (C) 0 to 2^{i} (D) 0 to $(2^{i} - 2^{-f})$

Question Number : 8 **Correct : 1 Wrong : -0.33**

Consider the C code fragment given below.

```
typedef struct node {
  int data;
  node* next;
} node;

void join(node* m, node* n){
  node* p = n;
  while(p->next != NULL) {
    p = p->next;
  }
  p->next = m;
}
```

Assuming that `m` and `n` point to valid `NULL`-terminated linked lists, invocation of `join` will

(A) append list `m` to the end of list `n` for all inputs.

(B) either cause a null pointer dereference or append list `m` to the end of list `n`.

(C) cause a null pointer dereference for all inputs.

(D) append list `n` to the end of list `m` for all inputs.

Question Number : 9 **Correct : 1 Wrong : -0.33**

When two 8-bit numbers $A_7 \cdots A_0$ and $B_7 \cdots B_0$ in 2's complement representation (with A_0 and B_0 as the least significant bits) are added using a **ripple-carry adder**, the sum bits obtained are $S_7 \cdots S_0$ and the carry bits are $C_7 \cdots C_0$. An overflow is said to have occurred if

(A) the carry bit C_7 is 1

(B) all the carry bits $(C_7, \cdots, C_0)$ are 1

(C) $(A_7 \cdot B_7 \cdot \overline{S_7} + \overline{A_7} \cdot \overline{B_7} \cdot S_7)$ is 1

(D) $(A_0 \cdot B_0 \cdot \overline{S_0} + \overline{A_0} \cdot \overline{B_0} \cdot S_0)$ is 1

Question Number : 10 Correct : 1 Wrong : -0.33

Consider the following context-free grammar over the alphabet $\sum = \{a, b, c\}$ with S as the start symbol:

$S \rightarrow abScT \mid abcT$
$T \rightarrow bT \mid b$

Which one of the following represents the language generated by the above grammar?

(A) $\{(ab)^n(cb)^n \mid n \geq 1\}$
(B) $\{(ab)^n cb^{m_1} cb^{m_2} \ldots cb^{m_n} \mid n, m_1, m_2, \ldots, m_n \geq 1\}$
(C) $\{(ab)^n(cb^m)^n \mid m, n \geq 1\}$
(D) $\{(ab)^n(cb^n)^m \mid m, n \geq 1\}$

Question Number : 11 Correct : 1 Wrong : -0.33

Consider the C `struct` defined below:

```
struct data {
   int marks [100];
   char grade;
   int cnumber;
};
struct data student;
```

The base address of `student` is available in register R1. The field `student.grade` can be accessed efficiently using

(A) Post-increment addressing mode, (R1)+
(B) Pre-decrement addressing mode, – (R1)
(C) Register direct addressing mode, R1
(D) Index addressing mode, X(R1), where X is an offset represented in 2's complement 16-bit representation.

Question Number : 12 **Correct : 1 Wrong : -0.33**

Consider the following intermediate program in three address code

```
p = a - b
q = p * c
p = u * v
q = p + q
```

Which one of the following corresponds to a *static single assignment* form of the above code?

(A)
```
p1 = a - b
q1 = p1 * c
p1 = u * v
q1 = p1 + q1
```

(B)
```
p3 = a - b
q4 = p3 * c
p4 = u * v
q5 = p4 + q4
```

(C)
```
p1 = a - b
q1 = p2 * c
p3 = u * v
q2 = p4 + q3
```

(D)
```
p1 = a - b
q1 = p * c
p2 = u * v
q2 = p + q
```

Question Number : 13 **Correct : 1 Wrong : -0.33**

Consider the following C code:

```
#include <stdio.h>
int *assignval(int *x, int val) {
      *x = val;
      return x;
}

void main () {
      int *x = malloc(sizeof(int));
       if(NULL == x) return;
        x = assignval(x,0);
        if(x) {
             x = (int *)malloc(sizeof(int));
             if(NULL == x) return;
              x = assignval(x,10);
        }
      printf("%d\n", *x);
      free(x);
}
```

The code suffers from which one of the following problems:

(A) compiler error as the return of `malloc` is not typecast appropriately

(B) compiler error because the comparison should be made as `x == NULL` and not as shown

(C) compiles successfully but execution may result in dangling pointer

(D) compiles successfully but execution may result in memory leak

Question Number : 14 **Correct : 1 Wrong : -0.33**

Consider a TCP client and a TCP server running on two different machines. After completing data transfer, the TCP client calls **`close`** to terminate the connection and a FIN segment is sent to the TCP server. Server-side TCP responds by sending an ACK, which is received by the client-side TCP. As per the TCP connection state diagram (RFC 793), in which state does the client-side TCP connection wait for the FIN from the server-side TCP?

(A) LAST-ACK
(B) TIME-WAIT
(C) FIN-WAIT-1
(D) FIN-WAIT-2

Question Number : 15 Correct : 1 Wrong : -0.33

A sender S sends a message m to receiver R, which is digitally signed by S with its private key. In this scenario, one or more of the following security violations can take place.

(I) S can launch a birthday attack to replace m with a fraudulent message.
(II) A third party attacker can launch a birthday attack to replace m with a fraudulent message.
(III) R can launch a birthday attack to replace m with a fraudulent message.

Which of the following are possible security violations?

(A) (I) and (II) only

(B) (I) only

(C) (II) only

(D) (II) and (III) only

Question Number : 16 Correct : 1 Wrong : -0.33

The following functional dependencies hold true for the relational schema $R\{V, W, X, Y, Z\}$:

$$V \rightarrow W$$
$$VW \rightarrow X$$
$$Y \rightarrow VX$$
$$Y \rightarrow Z$$

Which of the following is irreducible equivalent for this set of functional dependencies?

(A) $V \rightarrow W$, $V \rightarrow X$, $Y \rightarrow V$, $Y \rightarrow Z$

(B) $V \rightarrow W$, $W \rightarrow X$, $Y \rightarrow V$, $Y \rightarrow Z$

(C) $V \rightarrow W$, $V \rightarrow X$, $Y \rightarrow V$, $Y \rightarrow X$, $Y \rightarrow Z$

(D) $V \rightarrow W$, $W \rightarrow X$, $Y \rightarrow V$, $Y \rightarrow X$, $Y \rightarrow Z$

Question Number : 17 **Correct : 1 Wrong : -0.33**

Consider the following grammar:

$P \rightarrow xQRS$
$Q \rightarrow yz \mid z$
$R \rightarrow w \mid \varepsilon$
$S \rightarrow y$

What is FOLLOW(Q)?

(A) $\{R\}$ (B) $\{w\}$ (C) $\{w, y\}$ (D) $\{w, \$\}$

Question Number : 18 **Correct : 1 Wrong : -0.33**

Threads of a process share

(A) global variables but not heap.
(B) heap but not global variables.
(C) neither global variables nor heap.
(D) both heap and global variables.

Question Number : 19 **Correct : 1 Wrong : 0**

Let X be a Gaussian random variable with mean 0 and variance σ^2. Let $Y = max(X, 0)$ where $max(a, b)$ is the maximum of a and b. The median of Y is _____.

Question Number : 20 **Correct : 1 Wrong : 0**

Let T be a tree with 10 vertices. The sum of the degrees of all the vertices in T is _____.

Question Number : 21 **Correct : 1 Wrong : 0**

Consider the Karnaugh map given below, where x represents "*don't care*" and blank represents 0.

dc \ *ba*	00	01	11	10
00		x	x	
01	1			x
11	1			1
10		x	x	

Assume for all inputs (a, b, c, d), the respective complements ($\overline{a}, \overline{b}, \overline{c}, \overline{d}$) are also available. The above logic is implemented using 2-input NOR gates only. The minimum number of gates required is _____.

Question Number : 22 **Correct : 1 Wrong : 0**

Consider the language L given by the regular expression $(a+b)^* b\,(a+b)$ over the alphabet $\{a,b\}$. The smallest number of states needed in a deterministic finite-state automaton (DFA) accepting L is _____.

Question Number : 23 Correct : 1 Wrong : 0

Consider a database that has the relation schema EMP (EmpId, EmpName, and DeptName). An instance of the schema EMP and a SQL query on it are given below.

EMP		
EmpId	EmpName	DeptName
1	XYA	AA
2	XYB	AA
3	XYC	AA
4	XYD	AA
5	XYE	AB
6	XYF	AB
7	XYG	AB
8	XYH	AC
9	XYI	AC
10	XYJ	AC
11	XYK	AD
12	XYL	AD
13	XYM	AE

```
SELECT AVG(EC.Num)
FROM EC
WHERE (DeptName, Num) IN
      (SELECT DeptName, COUNT(EmpId) AS
                                EC(DeptName, Num)
       FROM EMP
       GROUP BY DeptName)
```

The output of executing the SQL query is _____ .

Question Number : 24 Correct : 1 Wrong : 0

Consider the following CPU processes with arrival times (in milliseconds) and length of CPU bursts (in milliseconds) as given below :

Process	Arrival time	Burst time
P1	0	7
P2	3	3
P3	5	5
P4	6	2

If the pre-emptive shortest remaining time first scheduling algorithm is used to schedule the processes, then the average waiting time across all processes is _____ milliseconds.

Question Number : 25 Correct : 1 Wrong : 0

Consider a two-level cache hierarchy with L1 and L2 caches. An application incurs **1.4** memory accesses per instruction on average. For this application, the miss rate of L1 cache is **0.1**; the L2 cache experiences, on average, 7 misses per 1000 instructions. The miss rate of L2 expressed correct to two decimal places is _____.

Question Number : 26 Correct : 2 Wrong : -0.66

Let $G = (V, E)$ be *any* connected undirected edge-weighted graph. The weights of the edges in E are positive and distinct. Consider the following statements:

(I) Minimum Spanning Tree of G is always unique.
(II) Shortest path between any two vertices of G is always unique.

Which of the above statements is/are necessarily true?

(A) (I) only
(B) (II) only
(C) both (I) and (II)
(D) neither (I) nor (II)

Question Number : 27 Correct : 2 Wrong : -0.66

A multithreaded program P executes with x number of threads and uses y number of locks for ensuring mutual exclusion while operating on shared memory locations. All locks in the program are *non-reentrant*, i.e., if a thread holds a lock l, then it cannot re-acquire lock l without releasing it. If a thread is unable to acquire a lock, it blocks until the lock becomes available. The *minimum* value of x and the *minimum* value of y together for which execution of P can result in a deadlock are:

(A) $x = 1, y = 2$
(B) $x = 2, y = 1$
(C) $x = 2, y = 2$
(D) $x = 1, y = 1$

Question Number : 28 **Correct : 2 Wrong : -0.66**

The value of $\lim_{x\to 1}\frac{x^7-2x^5+1}{x^3-3x^2+2}$

(A) is 0
(B) is -1
(C) is 1
(D) does not exist

Question Number : 29 **Correct : 2 Wrong : -0.66**

Let p, q, and r be propositions and the expression $(p \to q) \to r$ be a contradiction. Then, the expression $(r \to p) \to q$ is

(A) a tautology.
(B) a contradiction.
(C) always TRUE when p is FALSE.
(D) always TRUE when q is TRUE.

Question Number : 30 **Correct : 2 Wrong : -0.66**

Let u and v be two vectors in $\mathbf{R}^2$ whose Euclidean norms satisfy $\|u\| = 2\|v\|$. What is the value of α such that $w = u + \alpha v$ bisects the angle between u and v?

(A) 2
(B) 1/2
(C) 1
(D) $-1/2$

Question Number : 31 **Correct : 2 Wrong : -0.66**

Let A be $n \times n$ real valued square symmetric matrix of rank 2 with $\sum_{i=1}^{n}\sum_{j=1}^{n} A_{ij}^2 = 50$. Consider the following statements.

(I) One eigenvalue must be in $[-5, 5]$
(II) The eigenvalue with the largest magnitude must be strictly greater than 5

Which of the above statements about eigenvalues of A is/are necessarily CORRECT?

(A) Both (I) and (II)
(B) (I) only
(C) (II) only
(D) Neither (I) nor (II)

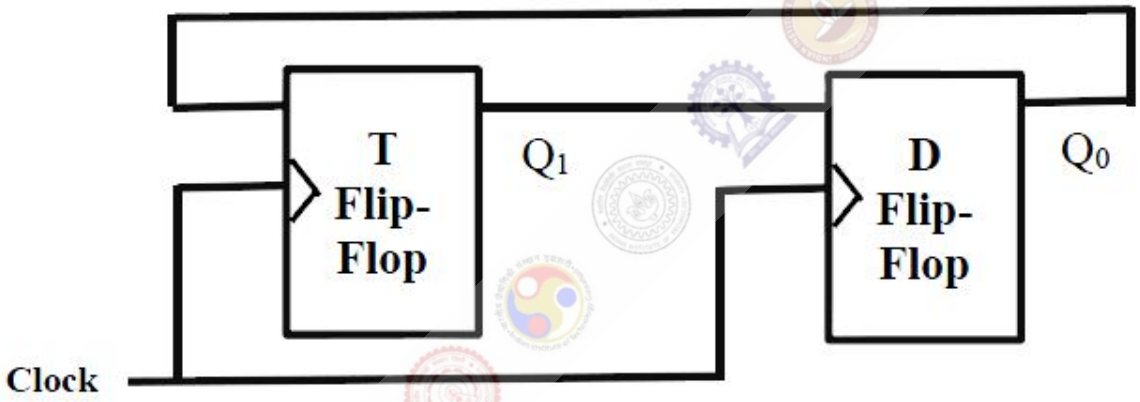
Question Number : 32 Correct : 2 Wrong : -0.66

A computer network uses polynomials over *GF(2)* for error checking with 8 bits as information bits and uses $x^3 + x + 1$ as the generator polynomial to generate the check bits. In this network, the message 01011011 is transmitted as

(A) 01011011010
(B) 01011011011
(C) 01011011101
(D) 01011011100

Question Number : 33 Correct : 2 Wrong : -0.66

Consider a combination of T and D flip-flops connected as shown below. The output of the D flip-flop is connected to the input of the T flip-flop and the output of the T flip-flop is connected to the input of the D flip-flop.



Initially, both Q_0 and Q_1 are set to 1 (before the 1st clock cycle). The outputs

(A) $Q_1 Q_0$ after the 3rd cycle are 11 and after the 4th cycle are 00 respectively
(B) $Q_1 Q_0$ after the 3rd cycle are 11 and after the 4th cycle are 01 respectively
(C) $Q_1 Q_0$ after the 3rd cycle are 00 and after the 4th cycle are 11 respectively
(D) $Q_1 Q_0$ after the 3rd cycle are 01 and after the 4th cycle are 01 respectively

Question Number : 34 Correct : 2 Wrong : -0.66

If G is a grammar with productions

$$S \rightarrow SaS \mid aSb \mid bSa \mid SS \mid \epsilon$$

where S is the start variable, then which one of the following strings is not generated by G?

(A) *abab* (B) *aaab* (C) *abbaa* (D) *babba*

Question Number : 35 **Correct : 2 Wrong : -0.66**

Consider the following two functions.

```
void fun1(int n) {
        if(n == 0) return;
        printf("%d", n);
        fun2(n - 2);
        printf("%d", n);
}
```

```
void fun2(int n) {
        if(n == 0) return;
        printf("%d", n);
        fun1(++n);
        printf("%d", n);
}
```

The output printed when `fun1(5)` is called is

(A) 53423122233445
(B) 53423120112233
(C) 53423122132435
(D) 53423120213243

Question Number : 36 **Correct : 2 Wrong : -0.66**

Consider the C functions `foo` and `bar` given below:

```
int foo(int val) {
   int x = 0;
   while(val > 0) {
      x = x + foo(val--);
   }
   return val;
}

int bar(int val) {
   int x = 0;
   while(val > 0) {
       x = x + bar(val-1);
   }
   return val;
}
```

Invocations of `foo(3)` and `bar(3)` will result in :

(A) Return of 6 and 6 respectively.
(B) Infinite loop and abnormal termination respectively.
(C) Abnormal termination and infinite loop respectively.
(D) Both terminating abnormally.

Question Number : 37 Correct : 2 Wrong : -0.66

Consider the context-free grammars over the alphabet $\{a,b,c\}$ given below. S and T are non-terminals.

$G_1: S \rightarrow aSb|T,\ T \rightarrow cT|\epsilon$

$G_2: S \rightarrow bSa|T,\ T \rightarrow cT|\epsilon$

The language $L(G_1) \cap L(G_2)$ is

(A) Finite.

(B) Not finite but regular.

(C) Context-Free but not regular.

(D) Recursive but not context-free.

Question Number : 38 Correct : 2 Wrong : -0.66

Consider the following languages over the alphabet $\sum = \{a,b,c\}$.
Let $L_1 = \{ a^n b^n c^m \mid m,n \geq 0\}$ and $L_2 = \{ a^m b^n c^n \mid m,n \geq 0 \}$.

Which of the following are context-free languages?

I. $L_1 \cup L_2$
II. $L_1 \cap L_2$

(A) I only

(B) II only

(C) I and II

(D) Neither I nor II

Question Number : 39 Correct : 2 Wrong : -0.66

Let A and B be finite alphabets and let $\#$ be a symbol outside both A and B. Let f be a total function from A^* to B^*. We say f is *computable* if there exists a Turing machine M which given an input x in A^*, always halts with $f(x)$ on its tape. Let L_f denote the language $\{x\#f(x) \mid x \in A^*\}$. Which of the following statements is true:

(A) f is computable if and only if L_f is recursive.

(B) f is computable if and only if L_f is recursively enumerable.

(C) If f is computable then L_f is recursive, but not conversely.

(D) If f is computable then L_f is recursively enumerable, but not conversely.

Question Number : 40 Correct : 2 Wrong : -0.66

Recall that Belady's anomaly is that the page-fault rate may *increase* as the number of allocated frames increases. Now, consider the following statements:

S1: *Random page replacement* algorithm (where a page chosen at random is replaced) suffers from Belady's anomaly
S2: *LRU page replacement* algorithm suffers from Belady's anomaly

Which of the following is CORRECT?

(A) S1 is true, S2 is true
(B) S1 is true, S2 is false
(C) S1 is false, S2 is true
(D) S1 is false, S2 is false

Question Number : 41 Correct : 2 Wrong : -0.66

Consider a database that has the relation schemas EMP(EmpId, EmpName, DeptId), and DEPT(DeptName, DeptId). Note that the DeptId can be permitted to be NULL in the relation EMP. Consider the following queries on the database expressed in tuple relational calculus.

(I) $\{t \mid \exists u \in \text{EMP}(t[\text{EmpName}] = u[\text{EmpName}] \wedge \forall v \in \text{DEPT}(t[\text{DeptId}] \neq v[\text{DeptId}]))\}$

(II) $\{t \mid \exists u \in \text{EMP}(t[\text{EmpName}] = u[\text{EmpName}] \wedge \exists v \in \text{DEPT}(t[\text{DeptId}] \neq v[\text{DeptId}]))\}$

(III) $\{t \mid \exists u \in \text{EMP}(t[\text{EmpName}] = u[\text{EmpName}] \wedge \exists v \in \text{DEPT}(t[\text{DeptId}] = v[\text{DeptId}]))\}$

Which of the above queries are safe?

(A) (I) and (II) only
(B) (I) and (III) only
(C) (II) and (III) only
(D) (I), (II) and (III)

Question Number : 42 Correct : 2 Wrong : -0.66

In a database system, unique timestamps are assigned to each transaction using Lamport's logical clock. Let $TS(T_1)$ and $TS(T_2)$ be the timestamps of transactions T_1 and T_2 respectively. Besides, T_1 holds a lock on the resource R, and T_2 has requested a conflicting lock on the same resource R. The following algorithm is used to prevent deadlocks in the database system assuming that a killed transaction is restarted with the same timestamp.

if $TS(T_2) < TS(T_1)$ then
    T_1 is killed
else T_2 waits.

Assume any transaction that is not killed terminates eventually. Which of the following is TRUE about the database system that uses the above algorithm to prevent deadlocks?

(A) The database system is both deadlock-free and starvation-free.

(B) The database system is deadlock-free, but not starvation-free.

(C) The database system is starvation-free, but not deadlock-free.

(D) The database system is neither deadlock-free nor starvation-free.

Question Number : 43 Correct : 2 Wrong : 0

Consider the following grammar:

```
stmt   -> if expr then expr else expr; stmt | ò
expr   -> term relop term | term
term   -> id | number
id     -> a | b | c
number -> [0-9]
```

where **relop** is a relational operator (e.g., <, >, ...). ò refers to the empty statement, and **if**, **then**, **else** are terminals.

Consider a program P following the above grammar containing ten **if** terminals. The number of control flow paths in P is _____. For example, the program

```
if e1 then e2 else e3
```

has 2 control flow paths, $e_1 \rightarrow e_2$ and $e_1 \rightarrow e_3$.

Question Number : 44 **Correct : 2 Wrong : 0**

In a RSA cryptosystem, a participant A uses two prime numbers $p = 13$ and $q = 17$ to generate her public and private keys. If the public key of A is 35, then the private key of A is _____.

Question Number : 45 **Correct : 2 Wrong : 0**

The values of parameters for the Stop-and-Wait ARQ protocol are as given below:

Bit rate of the transmission channel = 1 Mbps.
Propagation delay from sender to receiver = 0.75 ms.
Time to process a frame = 0.25 ms.
Number of bytes in the information frame = 1980.
Number of bytes in the acknowledge frame = 20.
Number of overhead bytes in the information frame = 20.

Assume that there are no transmission errors. Then, the transmission efficiency (expressed in percentage) of the Stop-and-Wait ARQ protocol for the above parameters is _____ (correct to 2 decimal places).

Question Number : 46 Correct : 2 Wrong : 0

Consider a database that has the relation schema CR(StudentName, CourseName). An instance of the schema CR is as given below.

CR	
StudentName	CourseName
SA	CA
SA	CB
SA	CC
SB	CB
SB	CC
SC	CA
SC	CB
SC	CC
SD	CA
SD	CB
SD	CC
SD	CD
SE	CD
SE	CA
SE	CB
SF	CA
SF	CB
SF	CC

The following query is made on the database.

$$T1 \leftarrow \pi_{CourseName}(\sigma_{StudentName='SA'}(\text{CR}))$$
$$T2 \leftarrow CR \div T1$$

The number of rows in $T2$ is _____.

Question Number : 47 Correct : 2 Wrong : 0

The number of integers between 1 and 500 (both inclusive) that are divisible by 3 or 5 or 7 is _____.

Question Number : 48 Correct : 2 Wrong : 0

Let A be an array of 31 numbers consisting of a sequence of 0's followed by a sequence of 1's. The problem is to find the smallest index i such that $A[i]$ is 1 by probing the minimum number of locations in A. The *worst case* number of probes performed by an *optimal* algorithm is _____.

Question Number : 49 Correct : 2 Wrong : 0

Consider a RISC machine where each instruction is exactly 4 bytes long. Conditional and unconditional branch instructions use PC-relative addressing mode with Offset specified in bytes to the target location of the branch instruction. Further the Offset is always with respect to the address of the next instruction in the program sequence. Consider the following instruction sequence

```
Instr. No.        Instruction
     i    :     add   R2, R3, R4
     i+1  :     sub   R5, R6, R7
     i+2  :     cmp   R1, R9, R10
     i+3  :     beq   R1,  Offset
```

If the target of the branch instruction is `i`, then the decimal value of the `Offset` is _____ .

Question Number : 50 Correct : 2 Wrong : 0

Instruction execution in a processor is divided into 5 stages, *Instruction Fetch* (IF), *Instruction Decode* (ID), *Operand Fetch* (OF), *Execute* (EX), and *Write Back* (WB). These stages take **5, 4, 20, 10,** and **3 nanoseconds (ns)** respectively. A pipelined implementation of the processor requires buffering between each pair of consecutive stages with a delay of **2 ns**. Two pipelined implementations of the processor are contemplated:

(i) a naive pipeline implementation (NP) with 5 stages and
(ii) an efficient pipeline (EP) where the OF stage is divided into stages OF1 and OF2 with execution times of **12 ns** and **8 ns** respectively.

The speedup (correct to two decimal places) achieved by EP over NP in executing 20 independent instructions with no hazards is _____ .

Question Number : 51 Correct : 2 Wrong : 0

Consider a 2-way set associative cache with 256 blocks and uses LRU replacement. Initially the cache is empty. Conflict misses are those misses which occur due to contention of multiple blocks for the same cache set. Compulsory misses occur due to first time access to the block. The following sequence of accesses to memory blocks

```
(0,128,256,128,0,128,256,128,1,129,257,129,1,129,257,129)
```

is repeated 10 times. The number of *conflict misses* experienced by the cache is _____ .

Question Number : 52 Correct : 2 Wrong : 0

Consider the expression $(a-1)*(((b+c)/3)+d\ ))$. Let X be the minimum number of registers required by an *optimal* code generation (without any register spill) algorithm for a load/store architecture, in which *(i) only load and store instructions can have memory operands* and *(ii) arithmetic instructions can have only register or immediate operands.* The value of X is _____ .

Question Number : 53 Correct : 2 Wrong : 0

Consider the following C program.

```
#include <stdio.h>
#include <string.h>

void printlength(char *s, char *t) {
   unsigned int c = 0;
   int len = ((strlen(s) - strlen(t)) > c) ? strlen(s): strlen(t);
   printf("%d\n", len);
}

void main() {
   char *x = "abc";
   char *y = "defgh";
   printlength(x,y);
}
```

Recall that `strlen` is defined in `string.h` as returning a value of type `size_t`, which is an `unsigned int`. The output of the program is _____.

Question Number : 54 Correct : 2 Wrong : 0

A cache memory unit with capacity of N words and block size of B words is to be designed. If it is designed as a direct mapped cache, the length of the TAG field is 10 bits. If the cache unit is now designed as a 16-way set-associative cache, the length of the TAG field is _____ bits.

Question Number : 55 Correct : 2 Wrong : 0

The output of executing the following C program is _____ .

```
#include <stdio.h>

int total(int v) {
   static int count = 0;
   while(v) {
      count += v&1;
      v >>= 1;
   }
   return count;
}

void main() {
   static int x = 0;
   int i = 5;
   for(; i > 0; i--) {
      x = x + total(i);
   }
   printf("%d\n", x);
}
```

Question Number : 56 **Correct : 1 Wrong : -0.33**

After Rajendra Chola returned from his voyage to Indonesia, he _____ to visit the temple in Thanjavur.

(A) was wishing (B) is wishing (C) wished (D) had wished

Question Number : 57 **Correct : 1 Wrong : -0.33**

Research in the workplace reveals that people work for many reasons _____.

(A) money beside (B) beside money (C) money besides (D) besides money

Question Number : 58 **Correct : 1 Wrong : -0.33**

Rahul, Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?

(A) Rahul and Murali
(B) Srinivas and Arul
(C) Srinivas and Murali
(D) Srinivas and Rahul

Question Number : 59 **Correct : 1 Wrong : -0.33**

Find the smallest number y such that $y \times 162$ is a perfect cube.

(A) 24 (B) 27 (C) 32 (D) 36

Question Number : 60 **Correct : 1 Wrong : -0.33**

The probability that a k-digit number does NOT contain the digits 0, 5, or 9 is

(A) 0.3^k (B) 0.6^k (C) 0.7^k (D) 0.9^k

Question Number : 61 **Correct : 2 Wrong : -0.66**

"The hold of the nationalist imagination on our colonial past is such that anything inadequately or improperly nationalist is just not history."

Which of the following statements best reflects the author's opinion?

(A) Nationalists are highly imaginative.
(B) History is viewed through the filter of nationalism.
(C) Our colonial past never happened.
(D) Nationalism has to be both adequately and properly imagined.

Question Number : 62 **Correct : 2 Wrong : -0.66**

Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is

(A) 2 (B) 3 (C) 4 (D) Cannot be determined

Question Number : 63 **Correct : 2 Wrong : -0.66**

The expression $\frac{(x+y)-|x-y|}{2}$ is equal to

(A) the maximum of x and y
(B) the minimum of x and y
(C) 1
(D) none of the above

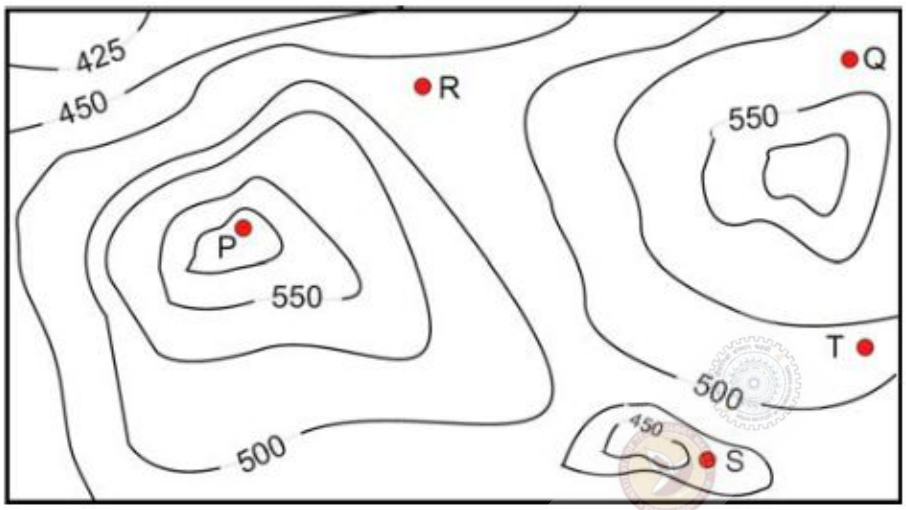
Question Number : 64 **Correct : 2 Wrong : -0.66**

Arun, Gulab, Neel and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?

(A) 21 (B) 18 (C) 16 (D) 14

Question Number : 65 **Correct : 2 Wrong : -0.66**

A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. If in a flood, the water level rises to 525 m, which of the villages P, Q, R, S, T get submerged?



(A) P, Q (B) P, Q, T (C) R, S, T (D) Q, R, S

Q. No.	Type	Section	Key	Marks
1	MCQ	CS-1	D	1
2	MCQ	CS-1	B	1
3	MCQ	CS-1	C	1
4	MCQ	CS-1	B	1
5	MCQ	CS-1	C	1
6	MCQ	CS-1	B	1
7	MCQ	CS-1	D	1
8	MCQ	CS-1	B	1
9	MCQ	CS-1	C	1
10	MCQ	CS-1	B	1
11	MCQ	CS-1	D	1
12	MCQ	CS-1	B	1
13	MCQ	CS-1	D	1
14	MCQ	CS-1	D	1
15	MCQ	CS-1	B	1
16	MCQ	CS-1	A	1
17	MCQ	CS-1	C	1
18	MCQ	CS-1	D	1
19	NAT	CS-1	0.0 to 0.0	1
20	NAT	CS-1	18.0 to 18.0	1
21	NAT	CS-1	1.0 to 1.0	1
22	NAT	CS-1	4.0 to 4.0	1
23	NAT	CS-1	2.6 to 2.6	1
24	NAT	CS-1	3.0 to 3.0	1
25	NAT	CS-1	0.05 to 0.05	1
26	MCQ	CS-1	A	2
27	MCQ	CS-1	D	2
28	MCQ	CS-1	C	2
29	MCQ	CS-1	D	2
30	MCQ	CS-1	A	2
31	MCQ	CS-1	B	2
32	MCQ	CS-1	C	2
33	MCQ	CS-1	B	2
34	MCQ	CS-1	D	2
35	MCQ	CS-1	A	2
36	MCQ	CS-1	C	2

37	MCQ	CS-1	B	2
38	MCQ	CS-1	A	2
39	MCQ	CS-1	A	2
40	MCQ	CS-1	B	2
41	MCQ	CS-1	D	2
42	MCQ	CS-1	A	2
43	NAT	CS-1	1024.0 to 1024.0	2
44	NAT	CS-1	11.0 to 11.0	2
45	NAT	CS-1	86.5 to 89.5	2
46	NAT	CS-1	4.0 to 4.0	2
47	NAT	CS-1	271.0 to 271.0	2
48	NAT	CS-1	5.0 to 5.0	2
49	NAT	CS-1	-16.0 to -16.0	2
50	NAT	CS-1	1.49 to 1.52	2
51	NAT	CS-1	76.0 to 76.0	2
52	NAT	CS-1	2.0 to 2.0	2
53	NAT	CS-1	3.0 to 3.0	2
54	NAT	CS-1	14.0 to 14.0	2
55	NAT	CS-1	23.0 to 23.0	2
56	MCQ	GA	C	1
57	MCQ	GA	D	1
58	MCQ	GA	C	1
59	MCQ	GA	D	1
60	MCQ	GA	C	1
61	MCQ	GA	B	2
62	MCQ	GA	A	2
63	MCQ	GA	B	2
64	MCQ	GA	D	2
65	MCQ	GA	C	2

Graduate Aptitude Test in Engineering 2017

Question Paper Name: Computer Science and Information Technology 11th Feb 2017 session 2
Subject Name: Computer Science and Information Technology
Duration: 180
Total Marks: 100

Organizing Institute:

Indian Institute of Technology Roorkee

Question Number : 1 Correct : 1 Wrong : -0.33

The representation of the value of a 16-bit unsigned integer X in hexadecimal number system is BCA9. The representation of the value of X in octal number system is

(A) 571244 (B) 736251 (C) 571247 (D) 136251

Question Number : 2 Correct : 1 Wrong : -0.33

Match the following:

(P) `static char var;`	(i) Sequence of memory locations to store addresses
(Q) `m = malloc(10); m = NULL;`	(ii) A variable located in data section of memory
(R) `char *ptr[10];`	(iii) Request to allocate a CPU register to store data
(S) `register int var1;`	(iv) A lost memory which cannot be freed

(A) P → (ii), Q → (iv), R → (i), S → (iii)
(B) P → (ii), Q → (i), R → (iv), S → (iii)
(C) P → (ii), Q → (iv), R → (iii), S → (i)
(D) P → (iii), Q → (iv), R → (i), S → (ii)

Question Number : 3 Correct : 1 Wrong : -0.33

Match the algorithms with their time complexities:

Algorithm	Time complexity
(P) Towers of Hanoi with n disks	(i) $\Theta(n^2)$
(Q) Binary search given n sorted numbers	(ii) $\Theta(n \log n)$
(R) Heap sort given n numbers at the worst case	(iii) $\Theta(2^n)$
(S) Addition of two $n \times n$ matrices	(iv) $\Theta(\log n)$

(A) P → (iii), Q → (iv), R → (i), S → (ii)
(B) P → (iv), Q → (iii), R → (i), S → (ii)
(C) P → (iii), Q → (iv), R → (ii), S → (i)
(D) P → (iv), Q → (iii), R → (ii), S → (i)

Question Number : 4 **Correct : 1 Wrong : -0.33**

Let L_1, L_2 be any two context-free languages and R be any regular language. Then which of the following is/are CORRECT?

I. $L_1 \cup L_2$ is context-free.
II. $\overline{L_1}$ is context-free.
III. $L_1 - R$ is context-free.
IV. $L_1 \cap L_2$ is context-free.

(A) I, II and IV only (B) I and III only (C) II and IV only (D) I only

Question Number : 5 **Correct : 1 Wrong : -0.33**

Match the following according to input (from the left column) to the compiler phase (in the right column) that processes it:

(P) Syntax tree	(i) Code generator
(Q) Character stream	(ii) Syntax analyzer
(R) Intermediate representation	(iii) Semantic analyzer
(S) Token stream	(iv) Lexical analyzer

(A) P → (ii), Q → (iii), R → (iv), S → (i)
(B) P → (ii), Q → (i), R → (iii), S → (iv)
(C) P → (iii), Q → (iv), R → (i), S → (ii)
(D) P → (i), Q → (iv), R → (ii), S → (iii)

Question Number : 6 **Correct : 1 Wrong : -0.33**

Which of the following statements about parser is/are CORRECT?

I. Canonical LR is more powerful than SLR.
II. SLR is more powerful than LALR.
III. SLR is more powerful than Canonical LR.

(A) I only (B) II only (C) III only (D) II and III only

Question Number : 7 **Correct : 1 Wrong : -0.33**

Which of the following is/are shared by all the threads in a process?

I. Program counter
II. Stack
III. Address space
IV. Registers

(A) I and II only (B) III only (C) IV only (D) III and IV only

Question Number : 8 **Correct : 1 Wrong : -0.33**

In a file allocation system, which of the following allocation scheme(s) can be used if no external fragmentation is allowed?

I. Contiguous
II. Linked
III. Indexed

(A) I and III only (B) II only (C) III only (D) II and III only

Question Number : 9 **Correct : 1 Wrong : -0.33**

Consider the following statements about the routing protocols, Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) in an IPv4 network.

I: RIP uses distance vector routing
II: RIP packets are sent using UDP
III: OSPF packets are sent using TCP
IV: OSPF operation is based on link-state routing

Which of the statements above are CORRECT?

(A) I and IV only
(B) I, II and III only
(C) I, II and IV only
(D) II, III and IV only

Question Number : 10 **Correct : 1 Wrong : -0.33**

If $f(x) = R\ sin\left(\frac{\pi x}{2}\right) + S$, $f'\left(\frac{1}{2}\right) = \sqrt{2}$ and $\int_0^1 f(x)dx = \frac{2R}{\pi}$, then the constants R and S are, respectively

(A) $\frac{2}{\pi}$ and $\frac{16}{\pi}$

(B) $\frac{2}{\pi}$ and 0

(C) $\frac{4}{\pi}$ and 0

(D) $\frac{4}{\pi}$ and $\frac{16}{\pi}$

Question Number : 11 **Correct : 1 Wrong : -0.33**

Let p, q, r denote the statements "*It is raining*", "*It is cold*", and "*It is pleasant*", respectively. Then the statement "*It is not raining and it is pleasant, and it is not pleasant only if it is raining and it is cold*" is represented by

(A) $(\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q))$

(B) $(\neg p \wedge r) \wedge ((p \wedge q) \rightarrow \neg r)$

(C) $(\neg p \wedge r) \vee ((p \wedge q) \rightarrow \neg r)$

(D) $(\neg p \wedge r) \vee (r \rightarrow (p \wedge q))$

Question Number : 12 **Correct : 1 Wrong : -0.33**

Given the following binary number in 32-bit (single precision) IEEE-754 format:

00111110011011010000000000000000

The decimal value closest to this floating-point number is

(A) 1.45×10^{1} (B) 1.45×10^{-1} (C) 2.27×10^{-1} (D) 2.27×10^{1}

Question Number : 13 **Correct : 1 Wrong : -0.33**

A circular queue has been implemented using a singly linked list where each node consists of a value and a single pointer pointing to the next node. We maintain exactly two external pointers **FRONT** and **REAR** pointing to the front node and the rear node of the queue, respectively. Which of the following statements is/are CORRECT for such a circular queue, so that insertion and deletion operations can be performed in $O(1)$ time?

I. Next pointer of front node points to the rear node.
II. Next pointer of rear node points to the front node.

(A) I only

(B) II only

(C) Both I and II

(D) Neither I nor II

Question Number : 14 **Correct : 1 Wrong : -0.33**

Consider the following function implemented in C:

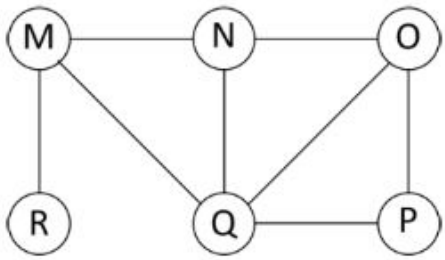
```
void printxy(int x, int y) {
        int *ptr;
        x = 0;
        ptr = &x;
        y = *ptr;
        *ptr = 1;
        printf("%d,%d",x,y);
}
```

The output of invoking `printxy(1,1)` is

(A) 0,0 (B) 0,1 (C) 1,0 (D) 1,1

Question Number : 15 **Correct : 1 Wrong : -0.33**

The Breadth First Search (BFS) algorithm has been implemented using the queue data structure. Which one of the following is a possible order of visiting the nodes in the graph below?



(A) MNOPQR
(B) NQMPOR
(C) QMNROP
(D) POQNMR

Question Number : 16 Correct : 1 Wrong : -0.33

Identify the language generated by the following grammar, where S is the start variable.

$$S \rightarrow XY$$
$$X \rightarrow aX \mid a$$
$$Y \rightarrow aYb \mid \epsilon$$

(A) $\{a^m b^n \mid m \geq n,\ n > 0\}$
(B) $\{a^m b^n \mid m \geq n,\ n \geq 0\}$
(C) $\{a^m b^n \mid m > n,\ n \geq 0\}$
(D) $\{a^m b^n \mid m > n,\ n > 0\}$

Question Number : 17 Correct : 1 Wrong : -0.33

An ER model of a database consists of entity types A and B. These are connected by a relationship R which does not have its own attribute. Under which one of the following conditions, can the relational table for R be merged with that of A?

(A) Relationship R is one-to-many and the participation of A in R is total.

(B) Relationship R is one-to-many and the participation of A in R is partial.

(C) Relationship R is many-to-one and the participation of A in R is total.

(D) Relationship R is many-to-one and the participation of A in R is partial.

Question Number : 18 Correct : 1 Wrong : -0.33

Consider socket API on a Linux machine that supports connected UDP sockets. A connected UDP socket is a UDP socket on which `connect` function has already been called. Which of the following statements is/are CORRECT?

I. A connected UDP socket can be used to communicate with multiple peers simultaneously.

II. A process can successfully call `connect` function again for an already connected UDP socket.

(A) I only
(B) II only
(C) Both I and II
(D) Neither I nor II

Question Number : 19 Correct : 1 Wrong : 0

Consider the following tables T1 and T2.

T1

P	Q
2	2
3	8
7	3
5	8
6	9
8	5
9	8

T2

R	S
2	2
8	3
3	2
9	7
5	7
7	2

In table T1, **P** is the primary key and **Q** is the foreign key referencing **R** in table T2 with on-delete cascade and on-update cascade. In table T2, **R** is the primary key and **S** is the foreign key referencing **P** in table T1 with on-delete set NULL and on-update cascade. In order to delete record $\langle 3, 8 \rangle$ from table T1, the number of additional records that need to be deleted from table T1 is _____.

Question Number : 20 Correct : 1 Wrong : 0

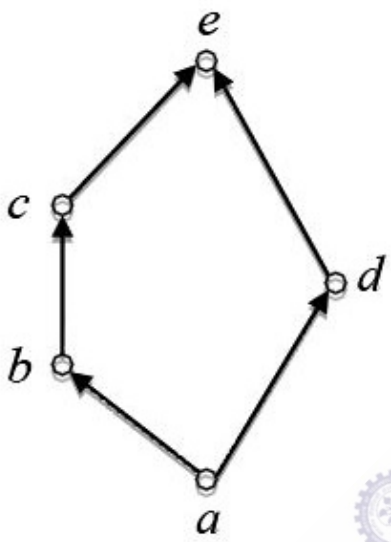
The maximum number of IPv4 router addresses that can be listed in the record route (RR) option field of an IPv4 header is _____.

Question Number : 21 **Correct : 1 Wrong : 0**

Consider the set $X=\{a,b,c,d,e\}$ under the partial ordering

$R=\{(a,a),(a,b),(a,c),(a,d),(a,e),(b,b),(b,c),(b,e),(c,c),(c,e),(d,d),(d,e),(e,e)\}$.

The Hasse diagram of the partial order (X,R) is shown below.



The minimum number of ordered pairs that need to be added to R to make (X,R) a lattice is _____ .

Question Number : 22 **Correct : 1 Wrong : 0**

Let $P=\begin{bmatrix}1 & 1 & -1\\ 2 & -3 & 4\\ 3 & -2 & 3\end{bmatrix}$ and $Q=\begin{bmatrix}-1 & -2 & -1\\ 6 & 12 & 6\\ 5 & 10 & 5\end{bmatrix}$ be two matrices.

Then the rank of $P+Q$ is _____.

Question Number : 23 **Correct : 1 Wrong : 0**

G is an undirected graph with n vertices and 25 edges such that each vertex of G has degree at least 3. Then the maximum possible value of n is _____.

Question Number : 24 **Correct : 1 Wrong : 0**

Consider a quadratic equation $x^2 - 13x + 36 = 0$ with coefficients in a base b. The solutions of this equation in the same base b are $x = 5$ and $x = 6$. Then $b =$ _____.

Question Number : 25 **Correct : 1 Wrong : 0**

The minimum possible number of states of a deterministic finite automaton that accepts the regular language $L = \{w_1 a w_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$ is _____.

Question Number : 26 **Correct : 2 Wrong : -0.66**

P and Q are considering to apply for a job. The probability that P applies for the job is $\frac{1}{4}$, the probability that P applies for the job given that Q applies for the job is $\frac{1}{2}$, and the probability that Q applies for the job given that P applies for the job is $\frac{1}{3}$. Then the probability that P does not apply for the job given that Q does not apply for the job is

(A) $\frac{4}{5}$ (B) $\frac{5}{6}$ (C) $\frac{7}{8}$ (D) $\frac{11}{12}$

Question Number : 27 **Correct : 2 Wrong : -0.66**

If w, x, y, z are Boolean variables, then which one of the following is INCORRECT?

(A) $\overline{wx + w(x + y) + x(x + y)} = x + wy$
(B) $w\bar{x}(y + \bar{z}) + \bar{w}x = \bar{w} + x + \bar{y}z$
(C) $(w\bar{x}(y + x\bar{z}) + \bar{w}\bar{x})y = x\bar{y}$
(D) $(w + y)(wxy + wyz) = wxy + wyz$

Question Number : 28 **Correct : 2 Wrong : -0.66**

Given $f(w,x,y,z) = \sum_m(0,1,2,3,7,8,10) + \sum_d(5,6,11,15)$, where d represents the *don't-care* condition in Karnaugh maps. Which of the following is a minimum product-of-sums (POS) form of $f(w,x,y,z)$?

(A) $f = (\bar{w} + \bar{z})(\bar{x} + z)$
(B) $f = (\bar{w} + z)(x + z)$
(C) $f = (w + z)(\bar{x} + z)$
(D) $f = (w + \bar{z})(\bar{x} + z)$

Question Number : 29 **Correct : 2 Wrong : -0.66**

In a two-level cache system, the access times of L_1 and L_2 caches are 1 and 8 clock cycles, respectively. The miss penalty from the L_2 cache to main memory is 18 clock cycles. The miss rate of L_1 cache is twice that of L_2. The average memory access time (AMAT) of this cache system is 2 cycles. The miss rates of L_1 and L_2 respectively are:

(A) 0.111 and 0.056
(B) 0.056 and 0.111
(C) 0.0892 and 0.1784
(D) 0.1784 and 0.0892

Question Number : 30 **Correct : 2 Wrong : -0.66**

Consider the recurrence function

$$T(n) = \begin{cases} 2T(\sqrt{n}) + 1, & n > 2 \\ 2, & 0 < n \leq 2 \end{cases}$$

Then $T(n)$ in terms of Θ notation is

(A) $\Theta(\log \log n)$
(B) $\Theta(\log n)$
(C) $\Theta(\sqrt{n})$
(D) $\Theta(n)$

Question Number : 31 **Correct : 2 Wrong : -0.66**

For any discrete random variable X, with probability mass function $P(X=j)=p_j,\ p_j \geq 0,\ j \in \{0,\ldots,N\}$, and $\sum_{j=0}^{N} p_j = 1$, define the polynomial function $g_X(z)=\sum_{j=0}^{N} p_j z^j$. For a certain discrete random variable Y, there exists a scalar $\beta \in [0,1]$ such that $g_Y(z)=(1-\beta+\beta z)^N$. The expectation of Y is

(A) $N\beta(1-\beta)$

(B) $N\beta$

(C) $N(1-\beta)$

(D) Not expressible in terms of N and β alone

Question Number : 32 **Correct : 2 Wrong : -0.66**

Consider the following expression grammar G :

```
E -> E - T | T
T -> T + F | F
F -> (E) | id
```

Which of the following grammars is not left recursive, but is equivalent to G?

(A)
```
E -> E - T | T
T -> T + F | F
F -> (E) | id
```

(B)
```
E -> TE'
E' -> -TE' | ϵ
T -> T + F | F
F -> (E) | id
```

(C)
```
E -> TX
X -> -TX |ϵ
T -> FY
Y -> +FY |ϵ
F -> (E) | id
```

(D)
```
E -> TX | (TX)
X -> -TX | +TX | ϵ
T -> id
```

Question Number : 33 Correct : 2 Wrong : -0.66

A system shares 9 tape drives. The current allocation and maximum requirement of tape drives for three processes are shown below:

Process	Current Allocation	Maximum Requirement
P1	3	7
P2	1	6
P3	3	5

Which of the following best describes current state of the system?

(A) Safe, Deadlocked
(B) Safe, Not Deadlocked
(C) Not Safe, Deadlocked
(D) Not Safe, Not Deadlocked

Question Number : 34 Correct : 2 Wrong : -0.66

Consider a binary code that consists of only four valid codewords as given below:

$$00000, 01011, 10101, 11110$$

Let the minimum Hamming distance of the code be p and the maximum number of erroneous bits that can be corrected by the code be q. Then the values of p and q are

(A) p=3 and q=1
(B) p=3 and q=2
(C) p=4 and q=1
(D) p=4 and q=2

Question Number : 35 Correct : 2 Wrong : -0.66

Consider two hosts X and Y, connected by a single direct link of rate 10^6 bits/sec. The distance between the two hosts is 10,000 km and the propagation speed along the link is 2×10^8 m/sec. Host X sends a file of 50,000 bytes as one large message to host Y continuously. Let the transmission and propagation delays be p milliseconds and q milliseconds, respectively. Then the values of p and q are

(A) p=50 and q=100
(B) p=50 and q=400
(C) p=100 and q=50
(D) p=400 and q=50

Question Number : 36 Correct : 2 Wrong : -0.66

The pre-order traversal of a binary search tree is given by 12, 8, 6, 2, 7, 9, 10, 16, 15, 19, 17, 20. Then the post-order traversal of this tree is:

(A) 2, 6, 7, 8, 9, 10, 12, 15, 16, 17, 19, 20
(B) 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12
(C) 7, 2, 6, 8, 9, 10, 20, 17, 19, 15, 16, 12
(D) 7, 6, 2, 10, 9, 8, 15, 16, 17, 20, 19, 12

Question Number : 37 Correct : 2 Wrong : -0.66

Consider the C program fragment below which is meant to divide `x` by `y` using repeated subtractions. The variables `x`, `y`, `q` and `r` are all `unsigned int`.

```
while (r >= y) {
  r = r - y;
  q = q + 1;
}
```

Which of the following conditions on the variables `x`, `y`, `q` and `r` before the execution of the fragment will ensure that the loop terminates in a state satisfying the condition `x == (y*q + r)`?

(A) `(q == r) && (r == 0)`

(B) `(x > 0) && (r == x) && (y > 0)`

(C) `(q == 0) && (r == x) && (y > 0)`

(D) `(q == 0) && (y > 0)`

Question Number : 38 Correct : 2 Wrong : -0.66

Consider the following C function.

```
int fun(int n) {
        int i, j;
        for(i = 1; i <= n; i++) {
                for(j = 1; j < n; j += i) {
                        printf(" %d %d",i,j);
                }
        }
}
```

Time complexity of `fun` in terms of Θ notation is

(A) $\Theta(n\sqrt{n})$ (B) $\Theta(n^2)$ (C) $\Theta(n \log n)$ (D) $\Theta(n^2 \log n)$

Question Number : 39 **Correct : 2 Wrong : -0.66**

Let δ denote the transition function and $\hat{\delta}$ denote the extended transition function of the ϵ-NFA whose transition table is given below:

δ	ϵ	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
q_2	$\{q_0\}$	$\emptyset$	$\emptyset$
q_3	$\emptyset$	$\emptyset$	$\{q_2\}$

Then $\hat{\delta}(q_2, aba)$ is

(A) $\emptyset$ (B) $\{q_0, q_1, q_3\}$ (C) $\{q_0, q_1, q_2\}$ (D) $\{q_0, q_2, q_3\}$

Question Number : 40 **Correct : 2 Wrong : -0.66**

Consider the following languages.

$L_1 = \{a^p \mid p \text{ is a prime number}\}$
$L_2 = \{a^n b^m c^{2m} \mid n \geq 0, m \geq 0\}$
$L_3 = \{a^n b^n c^{2n} \mid n \geq 0\}$
$L_4 = \{a^n b^n \mid n \geq 1\}$

Which of the following are CORRECT?

I. L_1 is context-free but not regular.
II. L_2 is not context-free.
III. L_3 is not context-free but recursive.
IV. L_4 is deterministic context-free.

(A) I, II and IV only (B) II and III only (C) I and IV only (D) III and IV only

Question Number : 41 Correct : 2 Wrong : -0.66

Let $L(R)$ be the language represented by regular expression R. Let $L(G)$ be the language generated by a context free grammar G. Let $L(M)$ be the language accepted by a Turing machine M. Which of the following decision problems are undecidable?

I. Given a regular expression R and a string w, is $w \in L(R)$?
II. Given a context-free grammar G, is $L(G) = \emptyset$?
III. Given a context-free grammar G, is $L(G) = \Sigma^*$ for some alphabet Σ ?
IV. Given a Turing machine M and a string w, is $w \in L(M)$?

(A) I and IV only (B) II and III only (C) II, III and IV only (D) III and IV only

Question Number : 42 Correct : 2 Wrong : -0.66

The next state table of a 2-bit saturating up-counter is given below.

Q_1	Q_0	Q_1^+	Q_0^+
0	0	0	1
0	1	1	0
1	0	1	1
1	1	1	1

The counter is built as a synchronous sequential circuit using T flip-flops. The expressions for T_1 and T_0 are

(A) $T_1 = Q_1 Q_0$, $T_0 = \bar{Q}_1 \bar{Q}_0$

(B) $T_1 = \bar{Q}_1 Q_0$, $T_0 = \bar{Q}_1 + \bar{Q}_0$

(C) $T_1 = Q_1 + Q_0$, $T_0 = \bar{Q}_1 + \bar{Q}_0$

(D) $T_1 = \bar{Q}_1 Q_0$, $T_0 = Q_1 + Q_0$

Question Number : 43 **Correct : 2 Wrong : 0**

Consider the following snippet of a C program. Assume that `swap(&x, &y)` exchanges the contents of `x` and `y`.

```
int main() {
      int array[] = {3, 5, 1, 4, 6, 2};
      int done = 0;
      int i;

      while (done == 0) {
            done = 1;
            for (i=0; i<=4; i++) {
                  if (array[i] < array[i+1]) {
                        swap(&array[i], &array[i+1]);
                        done = 0;
                  }
            }
            for (i=5; i>=1; i--) {
                  if (array[i] > array[i-1]) {
                        swap(&array[i], &array[i-1]);
                        done = 0;
                  }
            }

      }
      printf("%d",array[3]);
}
```

The output of the program is _____.

Question Number : 44 Correct : 2 Wrong : 0

Two transactions T_1 and T_2 are given as

$$T_1: r_1(X)w_1(X)r_1(Y)w_1(Y)$$
$$T_2: r_2(Y)w_2(Y)r_2(Z)w_2(Z)$$

where $r_i(V)$ denotes a *read* operation by transaction T_i on a variable V and $w_i(V)$ denotes a *write* operation by transaction T_i on a variable V. The total number of conflict serializable schedules that can be formed by T_1 and T_2 is _____.

Question Number : 45 Correct : 2 Wrong : 0

The read access times and the hit ratios for different caches in a memory hierarchy are as given below.

Cache	Read access time (in nanoseconds)	Hit ratio
I-cache	2	0.8
D-cache	2	0.9
L2-cache	8	0.9

The read access time of main memory is 90 nanoseconds. Assume that the caches use the referred-word-first read policy and the write back policy. Assume that all the caches are direct mapped caches. Assume that the dirty bit is always 0 for all the blocks in the caches. In execution of a program, 60% of memory reads are for instruction fetch and 40% are for memory operand fetch. The average read access time in nanoseconds (up to 2 decimal places) is _____.

Question Number : 46 **Correct : 2 Wrong : 0**

Consider the following database table named *top_scorer*.

top_scorer

player	country	goals
Klose	Germany	16
Ronaldo	Brazil	15
G Müller	Germany	14
Fontaine	France	13
Pelé	Brazil	12
Klinsmann	Germany	11
Kocsis	Hungary	11
Batistuta	Argentina	10
Cubillas	Peru	10
Lato	Poland	10
Lineker	England	10
T Müller	Germany	10
Rahn	Germany	10

Consider the following SQL query:

```
SELECT ta.player FROM top_scorer AS ta
WHERE ta.goals >ALL (SELECT tb.goals
             FROM top_scorer AS tb
             WHERE tb.country = 'Spain')
AND ta.goals >ANY (SELECT tc.goals
             FROM top_scorer AS tc
             WHERE tc.country = 'Germany')
```

The number of tuples returned by the above SQL query is _____.

Question Number : 47 **Correct : 2 Wrong : 0**

If the ordinary generating function of a sequence $\{a_n\}_{n=0}^{\infty}$ is $\frac{1+z}{(1-z)^3}$, then $a_3 - a_0$ is equal to _____.

Question Number : 48 Correct : 2 Wrong : 0

If a random variable X has a Poisson distribution with mean 5, then the expectation $E[(X+2)^2]$ equals _____.

Question Number : 49 Correct : 2 Wrong : 0

In a B+ tree, if the search-key value is 8 bytes long, the block size is 512 bytes and the block pointer size is 2 bytes, then the maximum order of the B+ tree is _____.

Question Number : 50 Correct : 2 Wrong : 0

A message is made up entirely of characters from the set $X = \{P, Q, R, S, T\}$. The table of probabilities for each of the characters is shown below:

Character	Probability
P	0.22
Q	0.34
R	0.17
S	0.19
T	0.08
Total	1.00

If a message of 100 characters over X is encoded using Huffman coding, then the expected length of the encoded message in bits is _____.

Question Number : 51 Correct : 2 Wrong : 0

Consider the set of processes with arrival time (in milliseconds), CPU burst time (in milliseconds), and priority (0 is the highest priority) shown below. None of the processes have I/O burst time.

Process	Arrival Time	Burst Time	Priority
P_1	0	11	2
P_2	5	28	0
P_3	12	2	3
P_4	2	10	1
P_5	9	16	4

The average waiting time (in milliseconds) of all the processes using preemptive priority scheduling algorithm is _____.

Question Number : 52 Correct : 2 Wrong : 0

If the characteristic polynomial of a 3×3 matrix M over $\mathbb{R}$ (the set of real numbers) is $\lambda^3 - 4\lambda^2 + a\lambda + 30$, $a \in \mathbb{R}$, and one eigenvalue of M is 2, then the largest among the absolute values of the eigenvalues of M is _____.

Question Number : 53 Correct : 2 Wrong : 0

Consider a machine with a byte addressable main memory of 2^{32} bytes divided into blocks of size 32 bytes. Assume that a direct mapped cache having 512 cache lines is used with this machine. The size of the tag field in bits is _____.

Question Number : 54 **Correct : 2 Wrong : 0**

Consider the following C Program.

```
#include<stdio.h>
int main() {
        int m = 10;
        int n, n1;
        n = ++m;
        n1 = m++;
        n--;
        --n1;
        n -= n1;
        printf("%d", n);
        return 0;
}
```

The output of the program is _____.

Question Number : 55 **Correct : 2 Wrong : 0**

Consider the following C Program.

```
#include<stdio.h>
#include<string.h>
int main() {
        char* c = "GATECSIT2017";
        char* p = c;
        printf("%d", (int)strlen(c+2[p]-6[p]-1));
        return 0;
}
```

The output of the program is _____.

Question Number : 56 **Correct : 1 Wrong : -0.33**

Choose the option with words that are not synonyms.

(A) aversion, dislike
(B) luminous, radiant
(C) plunder, loot
(D) yielding, resistant

Question Number : 57 **Correct : 1 Wrong : -0.33**

Saturn is _____ to be seen on a clear night with the naked eye.

(A) enough bright (B) bright enough (C) as enough bright (D) bright as enough

Question Number : 58 **Correct : 1 Wrong : -0.33**

There are five buildings called V, W, X, Y and Z in a row (not necessarily in that order). V is to the West of W. Z is to the East of X and the West of V. W is to the West of Y. Which is the building in the middle?

(A) V (B) W (C) X (D) Y

Question Number : 59 **Correct : 1 Wrong : -0.33**

A test has twenty questions worth 100 marks in total. There are two types of questions. Multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?

(A) 12 (B) 15 (C) 18 (D) 19

Question Number : 60 **Correct : 1 Wrong : -0.33**

There are 3 red socks, 4 green socks and 3 blue socks. You choose 2 socks. The probability that they are of the same colour is

(A) 1/5 (B) 7/30 (C) 1/4 (D) 4/15

Question Number : 61 **Correct : 2 Wrong : -0.66**

"We lived in a culture that denied any merit to literary works, considering them important only when they were handmaidens to something seemingly more urgent – namely ideology. This was a country where all gestures, even the most private, were interpreted in political terms."

The author's belief that ideology is not as important as literature is revealed by the word:

(A) 'culture' (B) 'seemingly' (C) 'urgent' (D) 'political'

Question Number : 62 **Correct : 2 Wrong : -0.66**

There are three boxes. One contains apples, another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labelled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes?

(A) The box labelled 'Apples'
(B) The box labelled 'Apples and Oranges'
(C) The box labelled 'Oranges'
(D) Cannot be determined

Question Number : 63 **Correct : 2 Wrong : -0.66**

X is a 30 digit number starting with the digit 4 followed by the digit 7. Then the number X^3 will have

(A) 90 digits (B) 91 digits (C) 92 digits (D) 93 digits

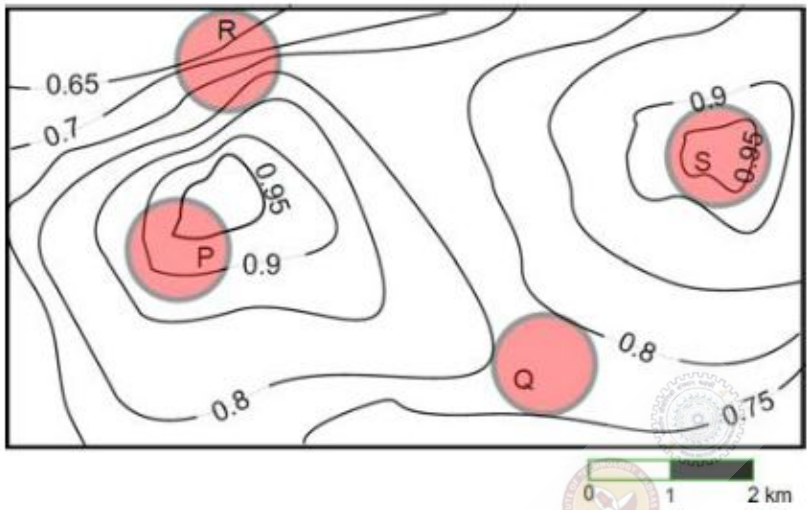
Question Number : 64 **Correct : 2 Wrong : -0.66**

The number of roots of $e^x + 0.5x^2 - 2 = 0$ in the range $[-5, 5]$ is

(A) 0 (B) 1 (C) 2 (D) 3

Question Number : 65 **Correct : 2 Wrong : -0.66**

An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air pressure contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.



If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region, which of the following regions is most likely to have a thunderstorm?

(A) P (B) Q (C) R (D) S

Q. No.	Type	Section	Key	Marks
1	MCQ	CS-2	D	1
2	MCQ	CS-2	A	1
3	MCQ	CS-2	C	1
4	MCQ	CS-2	B	1
5	MCQ	CS-2	C	1
6	MCQ	CS-2	A	1
7	MCQ	CS-2	B	1
8	MCQ	CS-2	D	1
9	MCQ	CS-2	C	1
10	MCQ	CS-2	C	1
11	MCQ	CS-2	A	1
12	MCQ	CS-2	C	1
13	MCQ	CS-2	B	1
14	MCQ	CS-2	C	1
15	MCQ	CS-2	D	1
16	MCQ	CS-2	C	1
17	MCQ	CS-2	C	1
18	MCQ	CS-2	B	1
19	NAT	CS-2	0.0 to 0.0	1
20	NAT	CS-2	9.0 to 9.0	1
21	NAT	CS-2	-0.01 to 0.01	1
22	NAT	CS-2	2.0 to 2.0	1
23	NAT	CS-2	16.0 to 16.0	1
24	NAT	CS-2	8.0 to 8.0	1
25	NAT	CS-2	8.0 to 8.0	1
26	MCQ	CS-2	A	2
27	MCQ	CS-2	C	2
28	MCQ	CS-2	A	2
29	MCQ	CS-2	A	2
30	MCQ	CS-2	B	2
31	MCQ	CS-2	B	2
32	MCQ	CS-2	C	2
33	MCQ	CS-2	B	2
34	MCQ	CS-2	A	2
35	MCQ	CS-2	D	2
36	MCQ	CS-2	B	2

37	MCQ	CS-2	C	2
38	MCQ	CS-2	C	2
39	MCQ	CS-2	C	2
40	MCQ	CS-2	D	2
41	MCQ	CS-2	D	2
42	MCQ	CS-2	B	2
43	NAT	CS-2	3.0 to 3.0	2
44	NAT	CS-2	54.0 to 54.0	2
45	NAT	CS-2	4.72 to 4.72	2
46	NAT	CS-2	7.0 to 7.0	2
47	NAT	CS-2	15.0 to 15.0	2
48	NAT	CS-2	54.0 to 54.0	2
49	NAT	CS-2	52.0 to 52.0	2
50	NAT	CS-2	225.0 to 225.0	2
51	NAT	CS-2	29.0 to 29.0	2
52	NAT	CS-2	5.0 to 5.0	2
53	NAT	CS-2	18.0 to 18.0	2
54	NAT	CS-2	0.0 to 0.0	2
55	NAT	CS-2	2.0 to 2.0	2
56	MCQ	GA	D	1
57	MCQ	GA	B	1
58	MCQ	GA	A	1
59	MCQ	GA	B	1
60	MCQ	GA	D	1
61	MCQ	GA	B	2
62	MCQ	GA	B	2
63	MCQ	GA	A	2
64	MCQ	GA	C	2
65	MCQ	GA	C	2