

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

- (A)  $P \rightarrow (ii), Q \rightarrow (iv), R \rightarrow (i), S \rightarrow (iii)$                       (B)  $P \rightarrow (ii), Q \rightarrow (i), R \rightarrow (iv), S \rightarrow (iii)$   
 (C)  $P \rightarrow (ii), Q \rightarrow (iv), R \rightarrow (iii), S \rightarrow (i)$                       (D)  $P \rightarrow (iii), Q \rightarrow (iv), R \rightarrow (i), S \rightarrow (ii)$

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

Match the algorithms with their time complexities:

| <u>Algorithm</u>                                  | <u>Time complexity</u>  |
|---------------------------------------------------|-------------------------|
| (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)  $P \rightarrow (iii), Q \rightarrow (iv), R \rightarrow (i), S \rightarrow (ii)$   
 (B)  $P \rightarrow (iv), Q \rightarrow (iii), R \rightarrow (i), S \rightarrow (ii)$   
 (C)  $P \rightarrow (iii), Q \rightarrow (iv), R \rightarrow (ii), S \rightarrow (i)$   
 (D)  $P \rightarrow (iv), Q \rightarrow (iii), R \rightarrow (ii), S \rightarrow (i)$

**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)  $P \rightarrow (ii)$ ,  $Q \rightarrow (iii)$ ,  $R \rightarrow (iv)$ ,  $S \rightarrow (i)$
- (B)  $P \rightarrow (ii)$ ,  $Q \rightarrow (i)$ ,  $R \rightarrow (iii)$ ,  $S \rightarrow (iv)$
- (C)  $P \rightarrow (iii)$ ,  $Q \rightarrow (iv)$ ,  $R \rightarrow (i)$ ,  $S \rightarrow (ii)$
- (D)  $P \rightarrow (i)$ ,  $Q \rightarrow (iv)$ ,  $R \rightarrow (ii)$ ,  $S \rightarrow (iii)$

**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)  $1.45 \times 10^1$

(B)  $1.45 \times 10^{-1}$

(C)  $2.27 \times 10^{-1}$

(D)  $2.27 \times 10^1$

**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

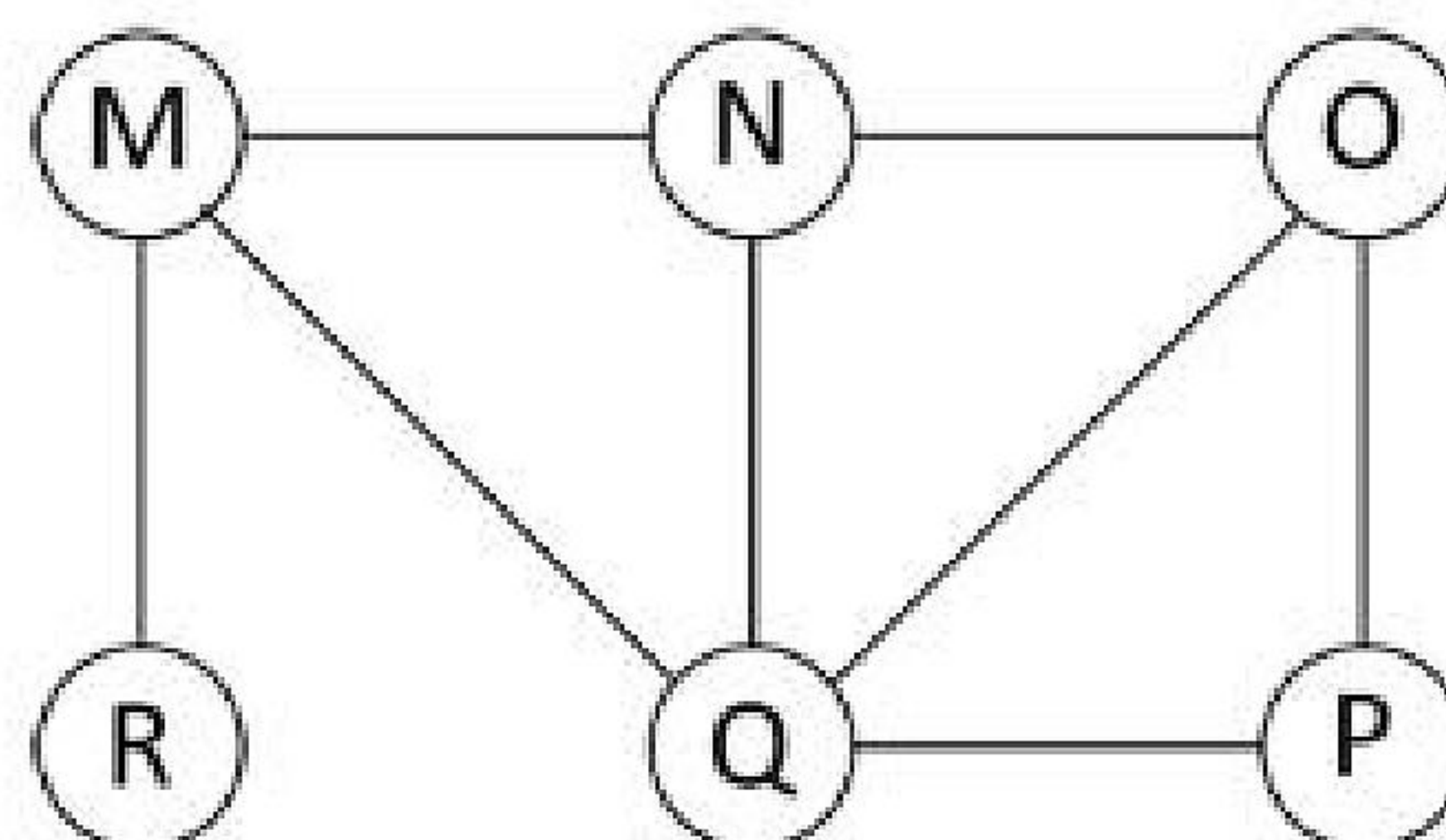
(B) 0,1

(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.

$$\begin{aligned} S &\rightarrow XY \\ X &\rightarrow aX \mid a \\ Y &\rightarrow aYb \mid \epsilon \end{aligned}$$

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

- (B)  $\{a^m b^n \mid m \geq n, n \geq 0\}$   
(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

Consider the following tables T1 and T2.

| T1 |   | T2 |   |
|----|---|----|---|
| P  | Q | R  | S |
| 2  | 2 | 2  | 2 |
| 3  | 8 | 8  | 3 |
| 7  | 3 | 3  | 2 |
| 5  | 8 | 9  | 7 |
| 6  | 9 | 5  | 7 |
| 8  | 5 | 7  | 2 |
| 9  | 8 |    |   |

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 <3,8> from table T1, the number of additional records that need to be deleted from table T1 is \_\_\_\_\_.

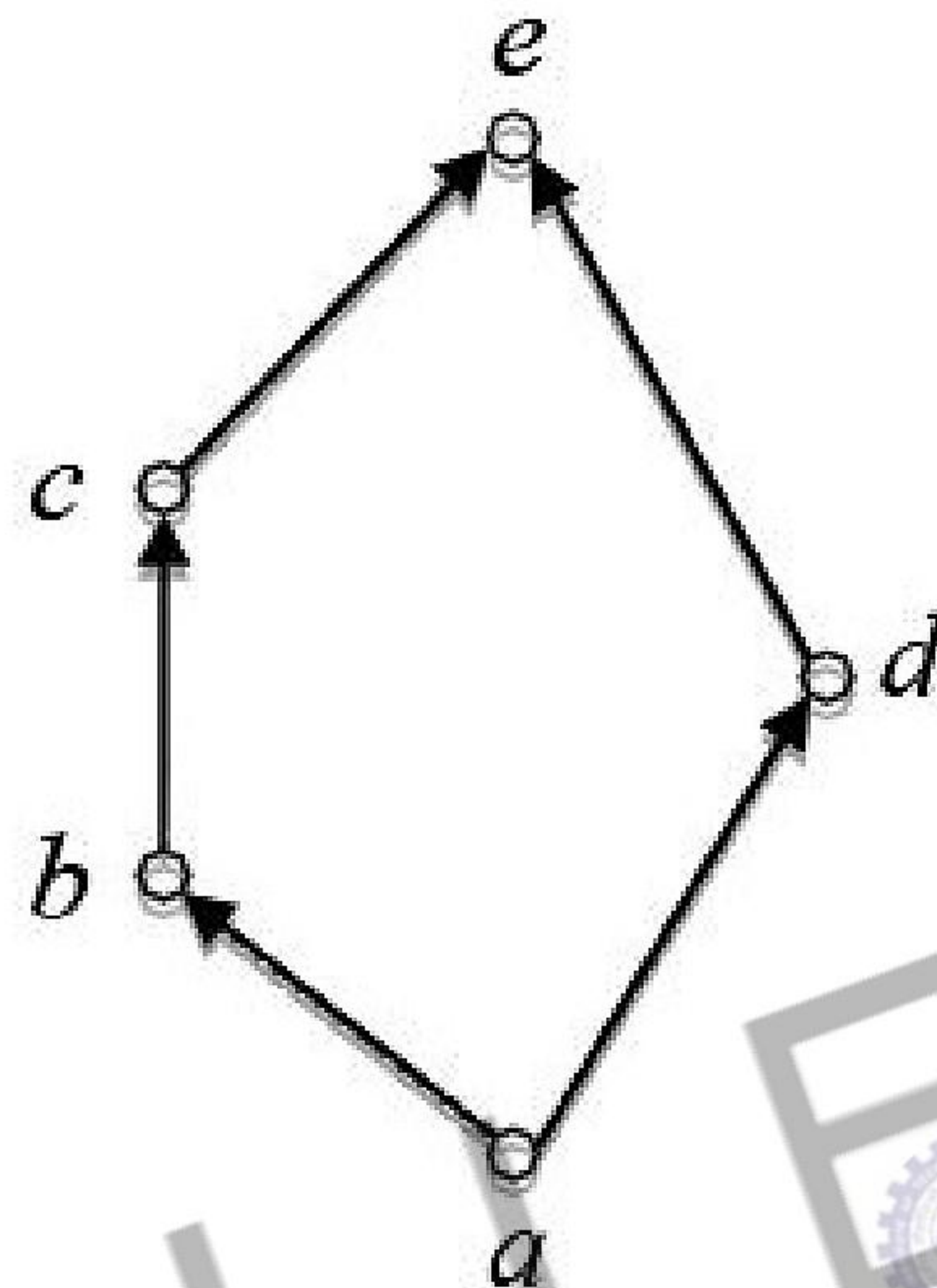
The maximum number of IPv4 router addresses that can be listed in the record route (RR) option field of an IPv4 header is \_\_\_\_\_.

**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  $L = \{w_1aw_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$  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)  $wx + w(x + y) + x(x + y) = x + wy$   
(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  $\Theta$  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

$P(X = j) = p_j, p_j \geq 0, j \in \{0, \dots, N\}$ , 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  $\beta$  alone

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

Consider the following expression grammar  $G$ :

$$\begin{aligned} E &\rightarrow E - T \mid T \\ T &\rightarrow T + F \mid F \\ F &\rightarrow (E) \mid \text{id} \end{aligned}$$

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

(A) 
$$\begin{aligned} E &\rightarrow E - T \mid T \\ T &\rightarrow T + F \mid F \\ F &\rightarrow (E) \mid \text{id} \end{aligned}$$

(B) 
$$\begin{aligned} E &\rightarrow TE' \\ E' &\rightarrow -TE' \mid \epsilon \\ T &\rightarrow T + F \mid F \\ F &\rightarrow (E) \mid \text{id} \end{aligned}$$

(C) 
$$\begin{aligned} E &\rightarrow TX \\ X &\rightarrow -TX \mid \epsilon \\ T &\rightarrow FY \\ Y &\rightarrow +FY \mid \epsilon \\ F &\rightarrow (E) \mid \text{id} \end{aligned}$$

(D) 
$$\begin{aligned} E &\rightarrow TX \mid (TX) \\ X &\rightarrow -TX \mid +TX \mid \epsilon \\ T &\rightarrow \text{id} \end{aligned}$$

**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  $2 \times 10^8$  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  $\Theta$  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  $\delta$  denote the transition function and  $\hat{\delta}$  denote the extended transition function of the  $\epsilon$ -NFA whose transition table is given below:

| $\delta$          | $\epsilon$  | $a$         | $b$         |
|-------------------|-------------|-------------|-------------|
| $\rightarrow q_0$ | $\{q_2\}$   | $\{q_1\}$   | $\{q_0\}$   |
| $q_1$             | $\{q_2\}$   | $\{q_2\}$   | $\{q_3\}$   |
| $q_2$             | $\{q_0\}$   | $\emptyset$ | $\emptyset$ |
| $q_3$             | $\emptyset$ | $\emptyset$ | $\{q_2\}$   |

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.

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

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  $\Sigma$ ?
- 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)  $T_1 = \bar{Q}_1 Q_0$ ,       $T_0 = Q_1 + Q_0$

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

$$\begin{aligned}T_1 &: r_1(X)w_1(X)r_1(Y)w_1(Y) \\ T_2 &: r_2(Y)w_2(Y)r_2(Z)w_2(Z)\end{aligned}$$

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<br>(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 \_\_\_\_\_.

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 \_\_\_\_\_.

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  $3 \times 3$  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 \_\_\_\_\_.

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 \_\_\_\_\_.

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

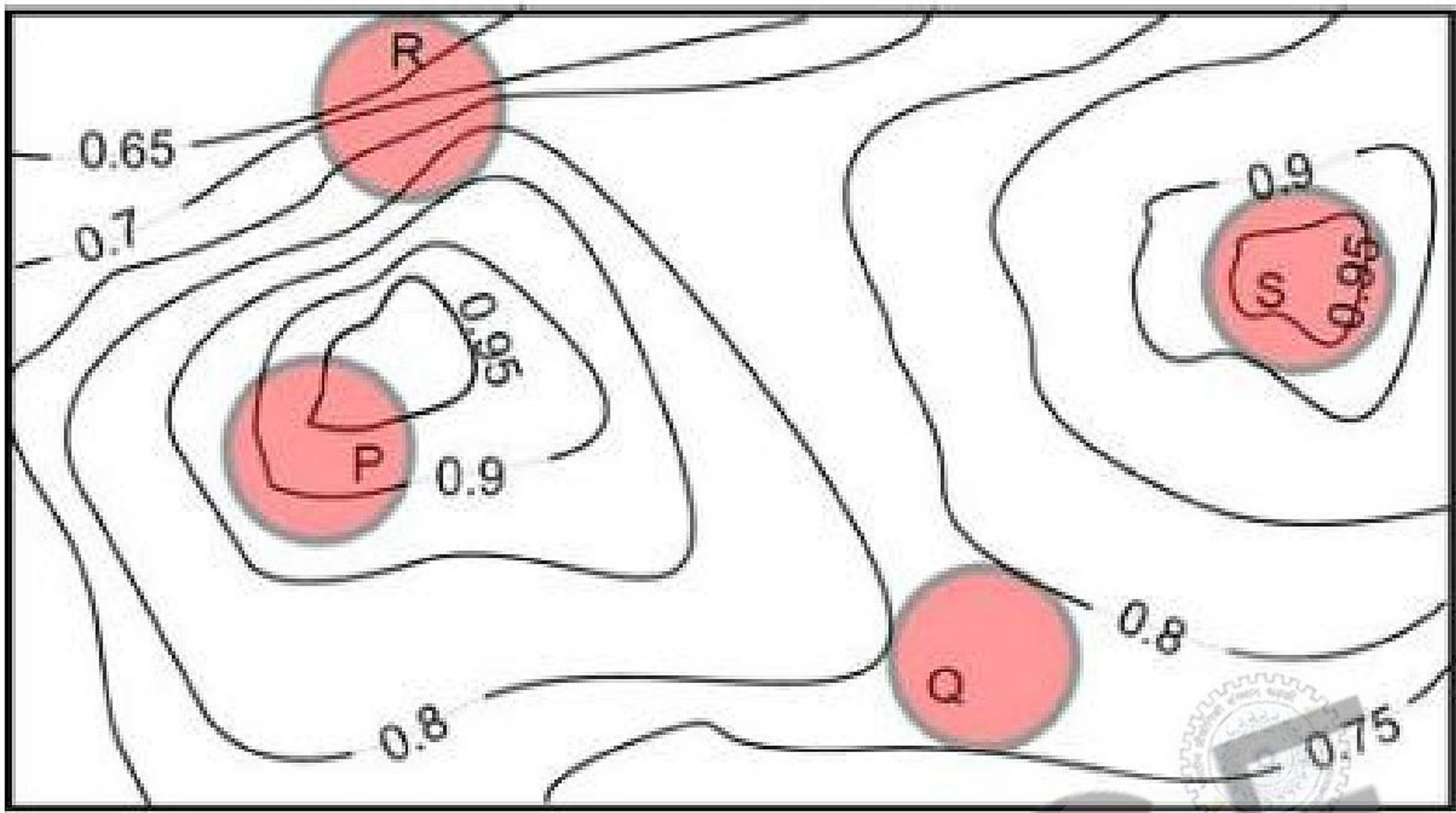
- (A) 90 digits (B) 91 digits (C) 92 digits (D) 93 digits

**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

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 |