

2011 CA

Test Paper Code: CA

Time: 3 Hours

Max. Marks: 300

INSTRUCTIONS**A. General:**

1. This Booklet is your Question Paper. It contains **20** pages and has 100 questions.
2. The Question Booklet **Code** is printed on the right-hand top corner of this page.
3. The Question Booklet contains blank spaces for your rough work. No additional sheets will be provided for rough work.
4. **Clip board, log tables, slide rule, calculator, cellular phone or any other electronic gadget in any form are NOT allowed.**
5. Write your **Name** and **Registration Number** in the space provided at the bottom.
6. All answers are to be marked only on the machine gradable Objective Response Sheet (**ORS**) provided along with this booklet, as per the instructions therein.
7. The Question Booklet along with the Objective Response Sheet (**ORS**) must be handed over to the Invigilator before leaving the examination hall.
8. Refer to **Special Instruction/Useful Data** on reverse of this sheet.

B. Filling-in the ORS:

9. Write your Registration Number in the boxes provided on the upper left-hand-side of the **ORS** and darken the appropriate bubble under each digit of your Registration Number using a **HB pencil**.
10. Ensure that the **code** on the **Question Booklet** and the **code** on the **ORS** are the same. If the codes do not match, report to the Invigilator immediately.
11. On the lower-left-hand-side of the **ORS**, write your Name, Registration Number, and Name of the Test Centre and put your signature in the appropriate box with ball-point pen. Do not write these anywhere else.

C. Marking of Answers on the ORS:

12. Each question has **4 choices** for its answer: (A), (B), (C) and (D). Only **ONE** of them is the correct answer.
13. On the right-hand-side of **ORS**, for each question number, darken with a **HB Pencil** ONLY one bubble corresponding to what you consider to be the most appropriate answer, from among the four choices.
14. There will be **negative marking** for wrong answers.

MARKING SCHEME:

- (a) For each correct answer, you will be awarded **3 (Three)** marks.
- (b) For each wrong answer, you will be awarded **-1 (Negative one)** mark.
- (c) Multiple answers to a question will be treated as a wrong answer.
- (d) For each un-attempted question, you will be awarded **0 (Zero)** mark.

Name							
Registration Number							

Special Instructions/ Useful Data

N denotes the set of natural numbers $\{1, 2, 3, \dots\}$

Q denotes the set of rational numbers

R denotes the set of real numbers

$A \setminus B = \{x \in A \mid x \notin B\}$, for two sets A, B

f' denotes the first derivative of f

f'' denotes the second derivative of f

$f_x = \frac{\partial f}{\partial x}$ denotes the partial derivative of f with respect to x

$f_{xx}, f_{xy}, f_{yx}, f_{yy}$ denote the usual second order partial derivatives of f

∇f denotes the gradient of f

$P(X = n)$ denotes the probability of $X = n$

\bar{x} denotes the complement of a Boolean variable x

LPP denotes Linear Programming Problem

$\max f$ denotes maximum of f

$\min f$ denotes minimum of f

For all C programs, assume that all standard library functions are accessible.

Q.1 Consider the following C program

```
#include <stdio.h>
int main() {
    int x = 01234;
    printf("%d", x);
    return 0;
}
```

The output of the program will be

- (A) 01234 (B) 1234 (C) 567 (D) 668

Q.2 Consider the following C function

```
float f(float a, int m) {
    float x;
    if (m == 0) return 1;
    x = f(a, m/2);
    if (m%2 == 1) return x * x * a;
    else return x * x;
}
```

What will be the return value of the function $f(2, 3)$?

- (A) 20.0 (B) 16.0 (C) 12.0 (D) 8.0

Q.3 When a computer is switched on, the BIOS is loaded from

- (A) Hard Disk (B) RAM (C) ROM (D) CD-ROM

Q.4 In a computer, TFT is related to

- (A) Memory (B) Monitor (C) Input Device (D) Serial Port

Q.5 Consider the following lists:

- | List I | List II |
|---------------|--------------------|
| 1. Pen drive | P. Optical Memory |
| 2. Hard disk | Q. Flash Memory |
| 3. CD-ROM | R. Magnetic Memory |
| 4. Floppy | S. Volatile Memory |

The correct match is

- (A) 1 → P, 2 → R, 3 → P, 4 → S (B) 1 → Q, 2 → R, 3 → P, 4 → R
(C) 1 → S, 2 → P, 3 → R, 4 → Q (D) 1 → Q, 2 → R, 3 → S, 4 → R

Q.6 Consider the following C program

```
#include <stdio.h>
int main(){
    int x = 5;
    int y = 2;
    while (x) {
        y += 2 * x;
        printf("%d", x);
        x--;
    }
    printf("%d", y);
    return 0;
}
```

What is printed when the above program is executed?

- (A) 5432132 (B) 432132 (C) 5432129 (D) 432130

Q.7 If the speed of a computer is 2 GHz, then which one of the following statements must be TRUE?

- (A) Its processor performs 2×10^9 operations per second
(B) Its clock cycles 2×10^9 times per second
(C) Its RAM stores 2×10^9 bytes per second
(D) Its printer prints 2×10^9 characters per second

Q.8 Consider the following lists:

- | List I | List II |
|---------------|----------------------|
| 1. Linux | P. Text File Editor |
| 2. Mozilla | Q. Image File Format |
| 3. Notepad | R. Operating System |
| 4. JPEG | S. Web Browser |

The correct match is

- (A) 1 → R, 2 → S, 3 → P, 4 → Q (B) 1 → S, 2 → R, 3 → Q, 4 → P
(C) 1 → R, 2 → P, 3 → S, 4 → Q (D) 1 → Q, 2 → S, 3 → P, 4 → R

Q.9 If $y = x \cos x$ is a solution of an n -th order linear differential equation

$$\frac{d^n y}{dx^n} + a_1 \frac{d^{n-1} y}{dx^{n-1}} + \dots + a_{n-1} \frac{dy}{dx} + a_n y = 0$$

with real constant coefficients, then the least possible value of n is

- (A) 1 (B) 2 (C) 3 (D) 4

Q.10 The general solution of the differential equation

$$\frac{dy}{dx} = (1+y^2)(e^{-x^2} - 2x \tan^{-1}y)$$

is

- (A) $e^{x^2} \tan^{-1}y = x + c$ (B) $e^{-x^2} \tan y = x + c$
 (C) $e^x \tan y = x^2 + c$ (D) $e^{-x} \tan^{-1}y = x^3 + c$

Q.11 If $g(x, y)dx + (x+y)dy = 0$ is an exact differential equation and if $g(x, 0) = x^2$, then the general solution of the differential equation is

- (A) $2x^3 + 2xy + y^2 = c$ (B) $2x^3 + 6xy + 3y^2 = c$
 (C) $2x + 2xy + y^2 = c$ (D) $x^2 + xy + y^2 = c$

Q.12 The value of $\int_0^1 \frac{dx}{\sqrt{x(1-x)}}$ is

- (A) 0 (B) $\frac{\pi}{2}$ (C) π (D) 2π

Q.13 Let $f(x) = \int_0^x (t-1)(t^2-5t+6)dt$ for all $x \in \mathbf{R}$. Then

- (A) f is continuous but not differentiable on \mathbf{R}
 (B) f' is bounded on \mathbf{R}
 (C) f' has exactly three zeroes
 (D) f is continuous and bounded on \mathbf{R}

Q.14 If $f(x, y) = \frac{1}{x^2} \tan^{-1} \frac{x}{\sqrt{x^2+y^2}} + \frac{x^{10}}{y^{12}} e^{\frac{x^2}{y^2}}$ for $x > 1, y > \frac{\pi}{2}$,

then $x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y} + 1000f$ equals

- (A) $998f$ (B) $999f$ (C) $1000f$ (D) $1002f$

Q.15 The general solution of the differential equation

$$\frac{d^2y}{dx^2} = \left(\frac{dy}{dx} \right)^2$$

is

- (A) $x = c_1 e^{-y} + c_2 e^y$ (B) $x = c_1 e^y + c_2$ (C) $x = c_1 e^{-y} + c_2$ (D) $x = c_1 e^y + c_2 y$

Q.16 Let $f(x, y) = \begin{cases} xy \frac{x^4 - y^4}{x^4 + y^4} & \text{if } (x, y) \neq (0, 0), \\ 0 & \text{if } (x, y) = (0, 0). \end{cases}$

Which of the following is TRUE?

- (A) $f_{xy}(0, 0) \neq f_{yx}(0, 0)$
- (B) $f_{xy}(x, y) = f_{yx}(x, y)$ for all (x, y)
- (C) $f_x(x, 0)$ does not exist for any real x
- (D) $\lim_{(x, y) \rightarrow (0, 0)} f(x, y) = 1$

Q.17 The value of $\int_{1/2}^2 \frac{1}{x} \sin\left(x - \frac{1}{x}\right) dx$ is

- (A) 1
- (B) $\frac{\pi}{2}$
- (C) 0
- (D) $\sin\left(\frac{3}{2}\right)$

Q.18 The area included between the curves $x^2 + y^2 = a^2$ and $b^2x^2 + a^2y^2 = a^2b^2$ ($a > 0, b > 0$), is

- (A) $\frac{\pi a}{2} |a - b|$
- (B) $\pi |a^2 - 3ab + b^2|$
- (C) $\pi a |a - b|$
- (D) $\pi |a^2 - b^2|$

Q.19 Changing the order of integration of $\int_1^2 \int_0^x f(x, y) dy dx$ gives

- (A) $\int_0^1 \int_1^2 f(x, y) dx dy + \int_0^1 \int_0^1 f(x, y) dx dy$
- (B) $\int_0^1 \int_1^2 f(x, y) dx dy + \int_1^2 \int_1^2 f(x, y) dx dy$
- (C) $\int_0^1 \int_{y/2}^y f(x, y) dx dy + \int_1^2 \int_y^{2y} f(x, y) dx dy$
- (D) $\int_0^1 \int_y^1 f(x, y) dx dy + \int_1^2 \int_1^y f(x, y) dx dy$

Q.20 The volume of the closed region bounded by the surfaces $x^2 + y^2 = 2x$, $z = -1$ and $z = 1$ is

- (A) 0
- (B) $\frac{\pi}{2}$
- (C) 2π
- (D) π

Q.21 Let $f(x) = \begin{cases} x+1 & \text{if } x < 0, \\ (x-1)^2 & \text{if } x \geq 0. \end{cases}$

Which one of the following is TRUE?

- (A) f is differentiable on \mathbf{R}
- (B) f has neither a local maximum nor a local minimum in \mathbf{R}
- (C) f is bounded on \mathbf{R}
- (D) f is not differentiable at $x = 0$ but has a local maximum at $x = 0$

Q.22 If $p_{ij} = 1$ for $1 \leq i, j \leq m$, then the characteristic equation of the matrix $P = (p_{ij})$ is

- (A) $\lambda^m - \lambda^{m-1} + 1 = 0$
- (B) $\lambda^m - m = 0$
- (C) $\lambda^m - m\lambda^{m-1} = 0$
- (D) $\lambda^m + 1 = 0$

Q.23 If $P = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$, then P^{50} equals

(A) $\begin{bmatrix} 1 & 100 & 500 \\ 0 & 1 & 100 \\ 0 & 0 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 50 & 100 \\ 0 & 1 & 50 \\ 0 & 0 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} 50 & 100 & 150 \\ 0 & 50 & 100 \\ 0 & 0 & 50 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 50 & 1275 \\ 0 & 1 & 50 \\ 0 & 0 & 1 \end{bmatrix}$

Q.24 The dimension of the subspace

$$W = \{(x, y, z, w) \in \mathbf{R}^4 \mid x + y + z + w = 0, \quad x + y + 2z = 0, \quad x + 3y = 0\}$$

is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Q.25 Let P be a matrix of size 3×3 with eigenvalues 1, 2 and 3. Then P is

- (A) neither invertible nor diagonalizable
- (B) both invertible and diagonalizable
- (C) invertible but not diagonalizable
- (D) not invertible but diagonalizable

Q.26 The integral $\int_{-1}^1 |x| dx$ is computed by the trapezoidal rule with step length $h = 0.01$. The absolute error in the computed value is

- (A) 0
- (B) 0.0001
- (C) 0.0025
- (D) 0.005

Q.27 An iteration scheme generates a sequence $\{x_n\}$. For some $\alpha, c \in \mathbf{R}$, $\{x_n\}$ satisfies $|\alpha - x_{n+1}| \leq c |\alpha - x_n|$ for all $n \geq 0$. Which one of the following conditions on c ensures the convergence of $\{x_n\}$?

- (A) $c = 1$ (B) $c > 1$ (C) $c > 0$ (D) $0 < c < 1$

Q.28 The integral $\int_0^1 f(x) dx$ is approximated by the formula

$$\int_0^1 f(x) dx \approx \alpha_1 f(0) + \alpha_2 f(1) + \alpha_3 f'(0) + \alpha_4 f'(1).$$

This approximation is exact for all the polynomials of degree ≤ 3 . Then (α_3, α_4) is

- (A) $\left(\frac{1}{6}, -\frac{1}{6}\right)$ (B) $\left(\frac{1}{12}, \frac{1}{12}\right)$ (C) $\left(\frac{1}{12}, -\frac{1}{12}\right)$ (D) $\left(\frac{1}{6}, \frac{1}{6}\right)$

Q.29 An approximate value of $\sqrt{3}$ is computed by the formula $x_{n+1} = x_n - \frac{1}{4}(x_n^2 - 3)$. If $x_0 = 1.75$, the value of x_1 correct to three decimal places is

- (A) 1.734 (B) 1.733 (C) 1.732 (D) 1.731

Q.30 Consider the following table:

x	1	2	3
y	-10	-6	0

The roots of the corresponding interpolating quadratic polynomial are

- (A) -4, 3 (B) 3, 4 (C) -2, 4 (D) -1, 3

Q.31 The optimal solution of the LPP

$$\max f = 2x + 3y + 20$$

subject to

$$\begin{aligned} x + y &\leq 1, \\ 2x + 5y &\leq 3, \\ x \geq 0, \quad y &\geq 0, \end{aligned}$$

is

- (A) $\left(\frac{1}{3}, \frac{2}{3}\right)$ (B) $\left(\frac{2}{3}, \frac{1}{3}\right)$ (C) $\left(0, \frac{3}{5}\right)$ (D) $\left(\frac{3}{2}, 0\right)$

Q.32 The number of optimal solutions of the LPP

$$\max f = 2x + 3y$$

subject to

$$4x + 6y \leq 5,$$

$$2x + 2y \geq 1,$$

$$x \geq 0, \quad y \geq 0,$$

is

- | | |
|----------|--------------|
| (A) zero | (B) one |
| (C) two | (D) infinite |

Q.33 The value of x in the sequence 2, 4, 10, 28, 82, x, \dots is

- | | | | |
|---------|---------|---------|---------|
| (A) 102 | (B) 168 | (C) 252 | (D) 244 |
|---------|---------|---------|---------|

Q.34 Consider the following segment of a C program

```
int x = 2;
if (x = 3) printf("%d", x++);
else printf("%d", --x);
```

The output of the program segment will be

- | | | | |
|-------|-------|-------|-------|
| (A) 0 | (B) 2 | (C) 3 | (D) 4 |
|-------|-------|-------|-------|

Q.35 Four different weights W_1, W_2, W_3, W_4 can take only integral values. They can be used on one or both the pans of a balance to weigh objects having all possible integral weights from unit weight to W , where, $W = W_1 + W_2 + W_3 + W_4$. The vector (W_1, W_2, W_3, W_4) which maximizes W is

- | | | | |
|-------------------|-------------------|------------------|--------------------|
| (A) (1, 2, 5, 10) | (B) (1, 3, 9, 27) | (C) (1, 2, 4, 8) | (D) (1, 3, 15, 25) |
|-------------------|-------------------|------------------|--------------------|

Q.36 In a C program, variables x and y are declared to be of type `int`. Consider the following four statements

S1: $y = x \& 1;$	S2: $y = x \% 2;$
S3: $y = x / 2;$	S4: $y = x \ll 1;$

Which of the statements will result in the same value of y for every value of x ?

- | | | | |
|---------------|---------------|---------------|---------------|
| (A) S3 and S4 | (B) S1 and S3 | (C) S1 and S2 | (D) S2 and S4 |
|---------------|---------------|---------------|---------------|

Q.37 IBM stands for

- (A) Indian Business Machine
- (B) International Business Manufacturer
- (C) Indian Business Manufacturer
- (D) International Business Machine

Q.38 Consider the following fragment of a C program

```
int x = 20;
int y = 25;
int z = x ^ y;
```

where ^ denotes bit-wise XOR operation. Then the value assigned to z will be

- (A) 20 (B) 25 (C) 23 (D) 13

Q.39 An ASCII code contains

- (A) 8 bits (B) 4 bits (C) 7 bits (D) 6 bits

Q.40 Who among the following developed Linux ?

- (A) Bill Gates (B) Sabeer Bhatia (C) Narayan Murthy (D) Linus Torvalds

Q.41 IPR stands for

- (A) Intelligence Performance Ratio
- (B) Intellectual Property Rights
- (C) Intelligence Production Rights
- (D) Intellectual Performance Research

Q.42 A software is termed an open source software if

- (A) the developer company is open 24 hours
- (B) its source code is available to share, study and modify
- (C) it can be downloaded from the Internet
- (D) it is available free of cost

Q.43 The rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 \\ 4 & 5 & 6 & 7 \end{bmatrix}$ is

- (A) 1 (B) 2 (C) 3 (D) 4

Q.44 Consider the following LPP

$$\min f = 4x + 3y$$

subject to

$$x + y \geq 12,$$

$$4x + 3y \geq 36,$$

$$x \geq 2, \quad y \geq 2.$$

The minimum value of f is

- (A) 36 (B) 48 (C) 46 (D) 38

Q.45 An LPP has the following constraints:

$$\begin{aligned} 2x + 5y &\geq 10, \\ 3x + 4y &\leq 24, \\ x &\geq y, \\ x &\geq 0, \quad y \geq 0. \end{aligned}$$

Which of the following is **NOT** a feasible solution to the LPP ?

- (A) (8, 0) (B) (5, 0) (C) $\left(\frac{10}{7}, \frac{10}{7}\right)$ (D) (5, 3)

Q.46 Consider the following LPP:

$$\begin{aligned} \max f &= 2x + 5y \\ \text{subject to} \\ 5x + 6y &\geq 15, \\ 6x + 15y &\leq 90, \\ x &\leq 10, \\ x &\geq 0, \quad y \geq 0. \end{aligned}$$

The number of extreme points of the feasible region of the LPP is

- (A) 3 (B) 4 (C) 5 (D) 6

Q.47 A particular integral of the differential equation $\frac{d^2y}{dx^2} - 16y = 4\sinh^2 2x$ is

- (A) $\frac{1}{8}(xe^{4x} + xe^{-4x} - 1)$ (B) $\frac{1}{8}(xe^{4x} - xe^{-4x} + 1)$
 (C) $\frac{1}{4}\left(e^{4x} - xe^{-4x} + \frac{1}{2}\right)$ (D) $\frac{1}{4}\left(xe^{4x} + e^{-4x} + \frac{1}{2}\right)$

Q.48 The general solution of the differential equation $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 4y = 0$ is

- (A) $y = c_1e^x + c_2e^{2x} + c_3xe^{2x}$ (B) $y = c_1e^{-x} + c_2e^{2x} + c_3xe^{2x}$
 (C) $y = c_1e^{-x} + c_2xe^{-x} + c_3e^{2x}$ (D) $y = c_1e^{-x} + c_2e^x + c_3e^{4x}$

Q.49 The area bounded by the curves $x^2 = 4 - 2y$ and $x^2 = y + 4$ is

- (A) 16 (B) 24 (C) 30 (D) 36

Q.50 The volume of the region in \mathbf{R}^3 given by $3|x| + 4|y| + 3|z| \leq 12$ is

- (A) 64 (B) 48 (C) 32 (D) 24

- Q.51 Let $F(x, y, z) = x^2 + y^2 + z^2 + xy + yz + zx$. The value of $F_x + F_y + F_z$ at $(1, 1, 1)$ is
 (A) 12 (B) 10 (C) 16 (D) 8
- Q.52 Three unbiased dice of different colours are rolled. The probability that the same number appears on at least two of the three dice is
 (A) $\frac{5}{36}$ (B) $\frac{1}{2}$ (C) $\frac{5}{12}$ (D) $\frac{4}{9}$
- Q.53 An unbiased coin is tossed eight times. The probability of obtaining at least one head and at least one tail is
 (A) $\frac{255}{256}$ (B) $\frac{127}{128}$ (C) $\frac{63}{64}$ (D) $\frac{31}{32}$
- Q.54 Suppose the sum and the product of the mean and the variance of a binomial random variable are 10 and 24 respectively. Then the probability of success in a single trial is
 (A) $\frac{1}{4}$ (B) $\frac{3}{4}$ (C) $\frac{2}{3}$ (D) $\frac{1}{3}$
- Q.55 A Poisson random variable X has unit mean. Then $P(X = \text{odd})$ is
 (A) $\frac{1}{2} \left(1 - \frac{1}{e} \right)$ (B) $1 - \frac{1}{e^2}$ (C) $\frac{1}{2} - \frac{1}{e^2}$ (D) $\frac{1}{2} \left(1 - \frac{1}{e^2} \right)$
- Q.56 The order of the permutation $(12)(546)(3978)$ in the symmetric group S_9 is
 (A) 6 (B) 9 (C) 12 (D) 24
- Q.57 If $\alpha = (13)(254)$ in the symmetric group S_5 , then α^{65} equals
 (A) $(13)(254)$ (B) $(12)(345)$ (C) $(32)(154)$ (D) $(31)(245)$
- Q.58 Let S be a set with 10 elements. The number of subsets of S having odd number of elements is
 (A) 256 (B) 512 (C) 752 (D) 1024
- Q.59 If $\vec{a}, \vec{b}, \vec{c}$ are three vectors in \mathbf{R}^3 , then $(\vec{a} - \vec{b} + \vec{c}) \cdot ((\vec{b} - \vec{c} + \vec{a}) \times (\vec{c} - \vec{a} + \vec{b}))$ equals
 (A) 0 (B) $\vec{a} \cdot (\vec{b} \times \vec{c})$ (C) $4 \vec{a} \cdot (\vec{b} \times \vec{c})$ (D) $6 \vec{a} \cdot (\vec{b} \times \vec{c})$

- Q.60 If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then $\nabla |\vec{r}|^4$ equals
- (A) $4|\vec{r}|$ (B) $4|\vec{r}|^2\vec{r}$ (C) $4|\vec{r}|\vec{r}$ (D) $4|\vec{r}|^3$
- Q.61 The area of the parallelogram in \mathbf{R}^2 whose diagonals are $3\hat{i} + \hat{j}$ and $\hat{i} - 3\hat{j}$ is
- (A) 2.5 (B) 5 (C) $\sqrt{2.5}$ (D) $\sqrt{5}$
- Q.62 Let $a_0 + a_1x + a_2x^2 + a_3x^3 + \dots$ be the Taylor series for the function $\sin(x^2 + 3x)$ about $x = 0$. Then a_3 equals
- (A) $-\frac{9}{2}$ (B) $\frac{9}{2}$ (C) $\frac{27}{2}$ (D) $-\frac{27}{2}$
- Q.63 The number of real values of a for which the set $\{(a, a^2), (a^2, a)\}$ is **NOT** a basis of \mathbf{R}^2 , is
- (A) 1 (B) 2 (C) 3 (D) 4
- Q.64 The set $(\mathbf{Q} \times \mathbf{Q}) \setminus (\mathbf{N} \times \mathbf{N})$ equals
- (A) $(\mathbf{Q} \setminus \mathbf{N}) \times (\mathbf{Q} \setminus \mathbf{N})$ (B) $[(\mathbf{Q} \setminus \mathbf{N}) \times \mathbf{Q}] \cup [\mathbf{Q} \times (\mathbf{Q} \setminus \mathbf{N})]$
 (C) $[(\mathbf{N} \times \mathbf{Q}) \setminus (\mathbf{Q} \times \mathbf{N})] \cup [(\mathbf{Q} \times \mathbf{N}) \setminus (\mathbf{N} \times \mathbf{Q})]$ (D) $(\mathbf{Q} \times \mathbf{N}) \setminus (\mathbf{N} \times \mathbf{Q})$
- Q.65 Let $f(x) = \frac{2}{1+x^2}$ for all $x \in \mathbf{R}$. Then $\lim_{n \rightarrow \infty} \frac{1}{n} \left(f'\left(\frac{1}{n}\right) + f'\left(\frac{2}{n}\right) + \dots + f'\left(\frac{n}{n}\right) \right)$ equals
- (A) -2 (B) -1 (C) 1 (D) 2
- Q.66 Let $f(x) = \begin{cases} x+x^2 & \text{if } x \geq 0, \\ x^2 & \text{if } x < 0. \end{cases}$
- Which one of the following is TRUE?
- (A) $f'(0) = 1$ and $f''(0) = 2$
 (B) $f'(0) = 1$ but $f''(0)$ is not defined
 (C) $f'(0)$ does not exist
 (D) f is not continuous at $x = 0$
- Q.67 Let $f(x) = 2x^3 + 3x^2 - 12x + 4$ for all $x \in \mathbf{R}$. Then
- (A) f is not one-one on $[-1, 1]$
 (B) f is one-one on $[-1, 1]$ but not one-one on $[-2, 2]$
 (C) f is one-one on $[0, 2]$ but not one-one on $[-2, 0]$
 (D) f is one-one on $[-2, 2]$

Q.68 Let $f(x, y) = x^3 + y^3$ for all $(x, y) \in \mathbf{R}^2$. Then

- (A) f has a local maximum at $(0, 0)$
- (B) f has a local minimum at $(0, 0)$
- (C) f has neither a local maximum nor a local minimum at $(0, 0)$
- (D) f has both a local maximum and a local minimum at $(0, 0)$

Q.69 Let F be a field with five elements and let $K = \{(a, b) \mid a, b \in F\}$ with the binary operations defined component-wise. Then

- | | |
|-------------------------------------|-------------------------------------|
| (A) K is not a field | (B) K is a field with 5 elements |
| (C) K is a field with 25 elements | (D) K is a field with 32 elements |

Q.70 Let $f(x, y) = \begin{cases} \frac{x}{|x|} \sqrt{x^2 + y^2} & \text{if } x \neq 0, \\ 0 & \text{if } x = 0. \end{cases}$

Then $f_x(0, 0) + f_y(0, 0)$ equals

- | | | | |
|----------|----------|---------|---------|
| (A) -2 | (B) -1 | (C) 0 | (D) 1 |
|----------|----------|---------|---------|

Q.71 Let a_1, a_2, \dots, a_n be a finite sequence of numbers with the property $a_i \leq a_{i+2}$ for all $i \in \{1, \dots, n-2\}$. Which one of the following is always TRUE?

- (A) The sequence is sorted
- (B) First $(n-2)$ elements of the sequence are sorted
- (C) The first element of the sequence is the minimum
- (D) Either a_{n-1} or a_n is the maximum of the sequence

Q.72 Order the following memory types in increasing order of access time

M1: Cache, M2: CD-ROM, M3: Hard disk, M4: RAM, M5: Register

- | | |
|--------------------|--------------------|
| (A) M5 M1 M4 M3 M2 | (B) M5 M1 M3 M4 M2 |
| (C) M1 M5 M4 M3 M2 | (D) M1 M4 M5 M3 M2 |

Q.73 Consider the following statements about terminating (finite number of digits to the right of the point) representations

X: If the binary representation of a number terminates then its corresponding decimal representation also terminates.

Y: If the decimal representation of a number terminates then its corresponding binary representation also terminates.

Then

- | | |
|------------------------------|------------------------------|
| (A) X is true but Y is false | (B) Y is true but X is false |
| (C) both X and Y are true | (D) neither X nor Y is true |

Q.74 The octal equivalent of decimal 204 is

- | | | | |
|---------|---------|---------|---------|
| (A) 304 | (B) 306 | (C) 314 | (D) 316 |
|---------|---------|---------|---------|

Q.75 Consider the following C program

```
int main() {
    char str[] = "leap";
    int len = strlen(str)-1;
    int i = 0;
    while (i <= len) {
        str[i] = str[len-i];
        i++;
    }
    printf("%s", str);
    return 0;
}
```

The output of the program will be

- | | | | |
|----------|----------|----------|----------|
| (A) paal | (B) pael | (C) papa | (D) paap |
|----------|----------|----------|----------|

Q.76 Let $f(A, B, C, D) = ABC + B(\overline{C} + \overline{D})$ be a Boolean function. The complement of $f(A, B, C, D)$ is

- | | |
|---|---|
| (A) $\overline{B} + \overline{A} CD$ | (B) $A \overline{B} + \overline{A} \overline{C} \overline{D} + \overline{B} \overline{C}$ |
| (C) $B \overline{A} + \overline{B} \overline{A} \overline{D} + \overline{A} \overline{C}$ | (D) $\overline{C} \overline{D} + \overline{A} \overline{B} \overline{C}$ |

Q.77 The number of three digit numbers greater than 100 in which digits appear in strictly increasing order is

- | | | | |
|--------|--------|--------|---------|
| (A) 36 | (B) 84 | (C) 90 | (D) 120 |
|--------|--------|--------|---------|

Q.78 Consider the following C function

```

int oddeven(int n) {
    int i = 0;
    while(n>1) {
        if (n%2)
            n = 3*n+1;
        else
            n = n/2;
        i++;
    }
    return i;
}

```

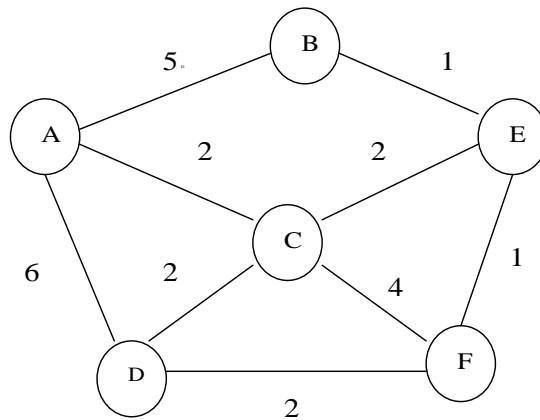
If $n = 12$ is given as input, what is the return value?

- (A) 8 (B) 9 (C) 10 (D) 12

Q.79 The next number in the sequence of binary numbers 0, 10, 100, 110, ... is

- (A) 101 (B) 1000 (C) 1001 (D) 1010

Q.80 Following graph shows distances between six cities A through F.



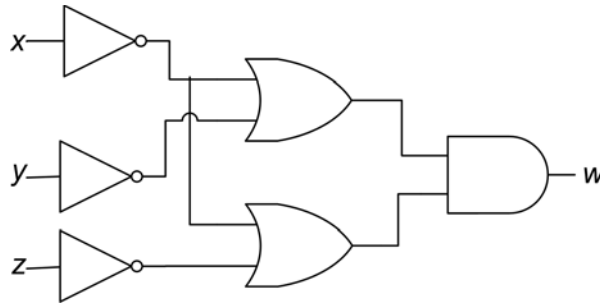
If x and y are minimum and maximum distances from A to F where no city is visited more than once, then (x, y) is

- (A) (6, 11) (B) (5, 12) (C) (4, 13) (D) (6, 12)

Q.81 The number of reflexive relations on a set with four elements is

- (A) 10 (B) 1024 (C) 4096 (D) 8192

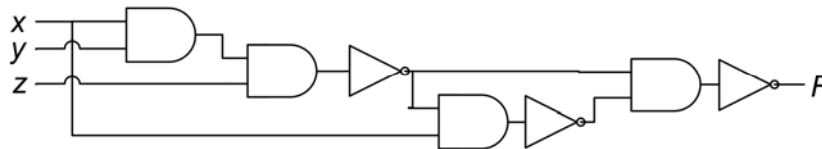
Q.82 Consider the following logic circuit:



The output w is

- (A) $\bar{y} + \bar{x}\bar{z}$ (B) $\bar{x} + \bar{y}\bar{z}$ (C) $\bar{z} + \bar{x}\bar{y}$ (D) $\bar{x}(\bar{y} + \bar{z})$

Q.83 Consider the following logic circuit:



The output F is

- (A) x (B) xy (C) $x + y$ (D) xz

Q.84 WWW stands for

- (A) World Wide Wire (B) World With Web
(C) World Wide Web (D) World Wise Web

Q.85 The first Prime Minister of India was

- (A) Indira Gandhi (B) Lal Bahadur Shastri
(C) Rajendra Prasad (D) Jawaharlal Nehru

Q.86 Consider the following two lists:

List I

1. DOS
2. P4
3. Java
4. PC

List II

- P. Sun Microsystems
- Q. Microsoft Corporation
- R. IBM
- S. Intel Corporation

The correct match is

- (A) $1 \rightarrow Q, 2 \rightarrow S, 3 \rightarrow P, 4 \rightarrow R$ (B) $1 \rightarrow Q, 2 \rightarrow R, 3 \rightarrow S, 4 \rightarrow P$
(C) $1 \rightarrow S, 2 \rightarrow P, 3 \rightarrow Q, 4 \rightarrow R$ (D) $1 \rightarrow R, 2 \rightarrow P, 3 \rightarrow Q, 4 \rightarrow S$

- Q.87 The song “Vande Mataram” was written by
- (A) Bankim Chandra Chatterjee (B) Rabindranath Tagore
(C) A. R. Rahman (D) Satyajit Ray
- Q.88 The number of gold medals won by India in the commonwealth games held in New Delhi in 2010 is
- (A) 36 (B) 37 (C) 38 (D) 40
- Q.89 When $28^{30} - 15^{30}$ is divided by 13, the remainder is
- (A) 0 (B) 1 (C) 11 (D) 12
- Q.90 Let H be a subgroup of order 60 of a group G of order 120. If $a \in G \setminus H$, then which of the following is **NOT** a subgroup of G ?
- (A) $\{ah \mid h \in H\}$ (B) $\{h^{-1} \mid h \in H\}$
(C) $\{aha^{-1} \mid h \in H\}$ (D) $H \cup \{a^{-1}h \mid h \in H\}$
- Q.91 Consider the following system of equations
- $$\begin{aligned} 2x + 3y + 4z &= 13 \\ 5x + 7y + 7z &= 26 \\ 9x + 13y + 15z &= 13\lambda \end{aligned}$$
- The value of λ for which the system has infinitely many solutions is
- (A) 1 (B) 2 (C) 3 (D) 4
- Q.92 Let $x * y = 3xy$ for all $x, y \in \mathbf{R} \setminus \{0\}$. The inverse of the element 2 in the group $(\mathbf{R} \setminus \{0\}, *)$ is
- (A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{1}{6}$ (D) $\frac{1}{18}$
- Q.93 The number of subsets of $\{1, 2, \dots, 10\}$ which are disjoint from $\{3, 7, 8\}$ is
- (A) 128 (B) 1021 (C) 1016 (D) 7
- Q.94 If Q and Q^+ denote the outputs during the current and the next clock cycles of a JK flip-flop, which one of the following is its characteristic equation?
- (A) $Q^+ = J\bar{Q} + \bar{K}Q$ (B) $Q^+ = JQ + \bar{K}\bar{Q}$ (C) $Q^+ = \bar{J}Q + \bar{K}Q$ (D) $Q^+ = \bar{J}\bar{Q} + KQ$

Q.95 The number of functions taking two Boolean variables as input and providing three Boolean variables as output is

- (A) 12 (B) 32 (C) 4096 (D) 65536

Q.96 The Boolean expression $(X + Y)(\bar{X} + Z)$ equals

- (A) $X Y + \bar{X} Z$ (B) $Z Y + Z \bar{X}$ (C) $\bar{X} Z + Y \bar{Z}$ (D) $X Z + \bar{X} Y$

Q.97 Consider the following algorithm

```

gcd(a, b)
begin
  if b equals 0 then return a
  else return gcd(b, X)
end

```

Which of the following expressions for X returns the gcd of positive integers a and b ?

- (A) a / b (B) b / a (C) $a \text{ mod } b$ (D) $b \text{ mod } a$

Q.98 Let P, Q, R and S be statements, each of which can be either true or false. It is known that if P is true or Q is true then R is true and S is false. Suppose it is given that R is false. Then which one of the following will certainly be TRUE?

- (A) Both P and Q are true
 (B) P is true and Q is false
 (C) P is false and Q is true
 (D) Both P and Q are false

Q.99 A JK flip-flop runs on a clock of period 20 KHz. If we set $J = K = 1$, the output Q is a

- (A) constant LOW (B) constant HIGH
 (C) 10 KHz wave (D) 20 KHz wave

Q.100 HIV stands for

- (A) Human Immunodeficiency Virus
 (B) Hypersensitive Internal Vein
 (C) Human Interactive Virus
 (D) Human Immune Virus



SPACE FOR ROUGH WORK



SPACE FOR ROUGH WORK



SPACE FOR ROUGH WORK