QUESTION BOOKLET CODE **A**

2012 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

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

$\mathbb{Z}$ denotes the set of integers

$\mathbb{Q}$ denotes the set of rational numbers

$\mathbb{R}$ denotes the set of real numbers

$\mathbb{C}$ denotes the set of complex numbers

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

LPP denotes Linear Programming Problem

Max f denotes the maximum of f

Min f denotes the minimum of f

x' denotes the complement of a Boolean variable x

f' denotes the first derivative of a function f

f_x denotes the partial derivative of $\frac{\partial f}{\partial x}$ of f

f_y denotes the partial derivative of $\frac{\partial f}{\partial y}$ of f

∇f denotes the gradient of a function f

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

A

Q.1 Who created the first free email service on the Internet?

(A) B. W. Kernighan
(B) Bill Gates
(C) N. Karmakar
(D) Sabeer Bhatia

Q.2 Let $S = \{x \in \mathbb{Q} \mid x^2 \in \{1, 20, 21\}\}$. Then the number of elements in the set S is

(A) 1 (B) 2 (C) 4 (D) 6

Q.3 The rank of the matrix $\begin{bmatrix} 1 & 2 & 4 & 1 & -2 \\ 2 & 3 & 7 & 1 & -2 \\ 1 & 0 & 2 & -1 & 2 \\ 1 & -1 & 1 & -2 & 4 \end{bmatrix}$ is

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

Q.4 Mega FLOPS stands for

(A) 10^9 floating point operations per second
(B) 10^5 fixed point operations per second
(C) 10^6 floating point operations per second
(D) 10^{12} fixed point operations per second

Q.5 The set $S = \{(x, y) \in \mathbb{R}^2 \mid x \notin \mathbb{Q} \text{ or } y \notin \mathbb{Z}\}$ is

(A) $(\mathbb{R} \setminus \mathbb{Q}) \times (\mathbb{R} \setminus \mathbb{Z})$ (B) $(\mathbb{R} \times \mathbb{R}) \times (\mathbb{Q} \setminus \mathbb{Z})$ (C) $(\mathbb{R} \setminus \mathbb{Q}) \times \mathbb{R}$ (D) $\mathbb{R} \times (\mathbb{R} \setminus \mathbb{Z})$

Q.6 The number $20^6 - 13^6$ is divisible by

(A) 11 (B) 5 (C) 13 (D) 6

Q.7 The inverse of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 8 & 2 \end{bmatrix}$ is

(A) $\begin{bmatrix} 10 & -6 & 1 \\ -2 & -1 & 0 \\ -7 & -5 & -1 \end{bmatrix}$
(B) $\begin{bmatrix} 10 & -6 & 1 \\ -2 & -1 & 0 \\ -7 & -5 & 1 \end{bmatrix}$
(C) $\begin{bmatrix} 10 & -6 & -1 \\ -2 & 1 & 0 \\ -7 & 5 & 1 \end{bmatrix}$
(D) $\begin{bmatrix} 10 & -6 & 1 \\ -2 & 1 & 0 \\ -7 & 5 & -1 \end{bmatrix}$

Q.8 Let $f:\mathbb{R}\to\mathbb{R}$ be defined by $f(x)=x^2+4x+5$. Then which of the following statements is TRUE?

(A) f is one-one.
(B) f is on-to.
(C) f is one-one and on-to.
(D) f is neither one-one nor on-to.

Q.9 The number of distinct 3 digit numbers greater than 100 where no digit repeats itself is

(A) 504 (B) 648 (C) 326 (D) 210

Q.10 The digit at the unit place of the number 19^{25} is

(A) 1 (B) 3 (C) 5 (D) 9

Q.11 The differential equation

$$\frac{dy}{dx}+(\tan x)\,y=\cos x,\quad x\in\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$$

has the solution

(A) $y=(x+c)\cos x$
(B) $y=(x+c)\sec x$
(C) $y=(x+c)\sin x$
(D) $y=(x+c)\operatorname{cosec} x$

Q.12 Consider the function $f(x)=-x^4+2x^3-1$. What is the absolute truncation error for evaluation of $f'(x)$ at $x=0.5$ by the first order forward difference scheme using a step size, $h=0.5$?

(A) $\frac{5}{8}$ (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{8}{5}$

Q.13 Consider the following LPP

$$\text{Max } f=5x+12y$$

subject to

$$x+5y\le 50,$$
$$6x+3y\le 36,$$
$$x\le 5,\ x\ge 0,\ y\ge 0$$

The number of extreme points of the feasible region are

(A) 4 (B) 5 (C) 6 (D) 7

Q.14 Solution of the initial value problem

$$(2\cos y+3x)\,dx-x\sin y\,dy=0,\quad y(1)=0$$

is

(A) $x^2\cos y+y^3=1$
(B) $x^2\sin y+y^3=0$
(C) $x^2\cos y+x^3=2$
(D) $y^2\sin x+y^3=0$

Q.15 Let α be a real number and $G = \{z \in \mathbb{C} \setminus \{0\} \mid |z| = \alpha\}$. Then G is a group under multiplication of complex numbers if

(A) $\alpha = 0$ (B) $\alpha < 1$ (C) $\alpha > 1$ (D) $\alpha = 1$

Q.16 Order the following processors in the increasing order of speed.

M1: 486, M2: 8085, M3: Dual core, M4: Pentium III

(A) M1 M2 M3 M4 (B) M2 M1 M4 M3 (C) M1 M2 M4 M3 (D) M1 M3 M4 M2

Q.17 Which of the following statements is TRUE?

(A) There exists a field with 1000 elements.
(B) There exists a field with 100 elements.
(C) There exists a field with 500 elements.
(D) There exists a field with 9 elements

Q.18 A particular solution of the differential equation

$$\frac{d^5y}{dx^5} - 3\frac{d^4y}{dx^4} + 3\frac{d^3y}{dx^3} - \frac{d^2y}{dx^2} = 2e^x$$

is

(A) $\frac{1}{3}x^3e^x$ (B) $\frac{1}{2}x^3e^x$ (C) $\frac{1}{6}x^3e^x$ (D) $\frac{2}{3}x^3e^x$

Q.19 For an LPP, if the constraints are

$$x + y \le 3,$$
$$-x + 3y \le 5,$$
$$y \ge 0,\ x \ge 0$$

then which one of the following point is NOT a feasible point?

(A) $(3,0)$ (B) $(1,2)$ (C) $(2,4)$ (D) $\left(0, \frac{5}{3}\right)$

Q.20 The volume of the tetrahedron bounded by the planes $z = 0, x = 0, y = 0$ and $y + z - x = 1$ is

(A) 1/6 (B) 6 (C) 1 (D) 1/3

Q.21 Aadhar Unique Identification (UID) number is of

(A) 10 digits (B) 12 digits (C) 14 digits (D) 16 digits

Q.22 The general solution of the nonhomogeneous differential equation

$$\frac{d^2y}{dx^2}+\frac{dy}{dx}-12y=150\cos 3x$$

is

(A) $c_1e^{-3x}+c_2e^{4x}-7\cos 3x-\sin 3x$
(B) $c_1e^{3x}+c_2e^{-4x}-7\cos 3x+\sin 3x$
(C) $c_1e^{3x}+c_2e^{-4x}+7\cos 3x+\sin 3x$
(D) $c_1e^{3x}+c_2e^{-4x}-7\cos 3x-\sin 3x$

Q.23 Which of the following is/are main memory of a computer?

P: RAM, Q: Hard disk, R: CDROM, S: Pen drive

(A) P and Q only (B) Q only (C) P only (D) P, R, and S only

Q.24 The boundary value problem

$$\frac{d^2y}{dx^2}+\pi^2y=0,\quad y(0)=0,\, y(1)=0$$

has

(A) two solutions
(B) no solution
(C) unique solution
(D) infinitely many solutions

Q.25 Suppose $\vec{a}=\hat{i}-2\hat{j}+3\hat{k}$, $\vec{b}=\hat{i}+\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}+3\hat{k}$. Then $\vec{a}\times\left(\vec{b}\times\vec{c}\right)$ is

(A) $8\hat{i}+4\hat{j}$ (B) $8\hat{i}-4\hat{j}$ (C) $8\hat{i}+8\hat{j}$ (D) $8\hat{i}-8\hat{j}$

Q.26 The Newton-Raphson method is used to find a real root of $f(x)=x^3-x+1=0$ with initial approximation $x_0=1$. Then the second approximation x_2 is

(A) $\frac{1}{2}$ (B) $\frac{5}{8}$ (C) 2 (D) 3

Q.27 SMS stands for

(A) Short Message Service
(B) Secured Message Service
(C) Short Mail Service
(D) Secured mail Service

Q.28 What is the probability of getting an even number or a number less than 5, in tossing a fair die?

(A) $\frac{2}{3}$ (B) $\frac{1}{3}$ (C) $\frac{5}{6}$ (D) $\frac{1}{6}$

Q.29 Rabindranath Tagore won the Nobel prize in Literature for his book entitled

(A) War and Peace
(B) Malgudi Days
(C) Gitanjali
(D) Durgeshnandini

Q.30 Which company is the leader in computer networking?

(A) Wipro (B) Cisco (C) Oracle (D) TCS

Q.31 For the table

x	0	1	2	3
$f(x)$	1	2	9	28

the divided difference $f[1,2,3]$ is

(A) 6 (B) 13 (C) 3 (D) 1

Q.32 Which one of the following is equivalent to 8 Giga bytes?

(A) 2^{23} bytes (B) 2^{33} bytes (C) 2^{43} bytes (D) 2^{53} bytes

Q.33 The decimal value of $(327)_8 \times (25)_8$ is

(A) 5625 (B) 8175 (C) 3267 (D) 4515

Q.34 The value of the integral $\int_0^2 (1+5x-100x^2)dx$ by Simpson's $\frac{1}{3}$rd rule is

(A) -288 (B) $-\frac{764}{3}$ (C) 288 (D) 289

Q.35 Which one of the following stands for LAN?

(A) Local Area Network
(B) Logical Area Network
(C) Large Area Network
(D) Least Area Network

Q.36 The Boolean expression $(x + y)(x + y')$ is equivalent to

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

Q.37 ISP stands for

(A) Internet Security Protocol
(B) Intelligent Service Package
(C) Internet Service Provider
(D) Intelligent Service Provider

Q.38 Let $f(x,y) = cos(xy) + x\,cos\,y$. Then the value of $f_x(2,\pi/2) + f_y(2,\pi/2)$ is

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

Q.39 If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c} = 4\hat{i} - 3\hat{j} + 2\hat{k}$, then the projection of $\vec{a} + \vec{b}$ on the vector $\vec{b}$ is

(A) $\frac{20}{3}$ (B) 20 (C) $\frac{20}{9}$ (D) $\frac{8}{3}$

Q.40 For what value of α, the vectors $2\hat{i} + \hat{j} + \hat{k}$, $\alpha\hat{i} + 2\hat{j} + 2\hat{k}$ and $\hat{i} + \hat{j} - \hat{k}$ are coplanar?

(A) 1 (B) 2 (C) 4 (D) 8

Q.41 The next term in the sequence of ternary number 10, 20, 100, 110, … is

(A) 120 (B) 111 (C) 112 (D) 101

Q.42 The 9′s complement of 123456789 is

(A) 876543211 (B) 876543210 (C) 987654321 (D) 012345678

Q.43 What is the largest unsigned integer that can be expressed with *n* bits?

(A) 2^{n-1} (B) $2^n - 1$ (C) $2^n + 1$ (D) 2^{n+1}

Q.44 Suppose $f(x) = x^3 + 2x^2 + x + 1$. Then the polynomial that interpolates the value of f at $x = -1, 0, 1$ is

(A) $4x^2 + 4x + 1$ (B) $x^2 + x + 1$
(C) $2x^2 + 2x + 1$ (D) $3x^2 + 3x + 1$

Q.45 A search engine is

(A) a machine (B) a web site
(C) a movie (D) a map used for driving

Q.46 The Lagrange form of the interpolating polynomial that fits the data

x	0	1	2
$f(x)$	1	2	5

is

(A) $\frac{1}{2}(x-1)(x-2)-2x(x+2)+\frac{5}{2}x(x-1)$

(B) $\frac{1}{2}(x-1)(x-2)+2x(x+2)+\frac{5}{2}x(x-1)$

(C) $2(x-1)(x-2)+\frac{1}{2}x(x+2)+\frac{2}{5}x(x-1)$

(D) $2(x-1)(x-2)-\frac{1}{2}x(x+2)+\frac{2}{5}x(x-1)$

Q.47 The function $f(x,y)=xy$ defined on $x^2+y^2\le 1$ has

(A) both maximum and minimum values
(B) only maximum value
(C) only minimum value
(D) neither maximum nor minimum value

Q.48 The area of the region enclosed by the parabola $x^2=4ay$ and the line $x=2a$ with x-axis is

(A) $\frac{4}{3}a^2$ (B) $\frac{3}{2}a^2$ (C) $\frac{3}{4}a^2$ (D) $\frac{2}{3}a^2$

Q.49 Consider the system of linear equations

$$\begin{aligned} x-2y+z&=3\\ 2x+\alpha z&=-2\\ -2x+2y+\alpha z&=1 \end{aligned}$$

In order to have unique solution to this linear system of equations the value of α should not be equal to

(A) $-\frac{2}{3}$ (B) $\frac{2}{3}$ (C) $\frac{4}{3}$ (D) $-\frac{4}{3}$

Q.50 The quadratic approximation of $f(x,y)=\cos x\cos y$ about the point $(0,0)$ is

(A) $1+\frac{1}{2}\left(x^2-y^2\right)$ (B) $1+\frac{1}{2}\left(x^2+y^2\right)$

(C) $1-\frac{1}{2}\left(x^2-y^2\right)$ (D) $1-\frac{1}{2}\left(x^2+y^2\right)$

Q.51 Consider the following two lists:

List I	**List II**
1: Mouse	P: Input device
2: Modem	Q: External memory
3: Pen drive	R: Web browser
4: Opera	S: Network device

The correct match is

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

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

Q.52 The matrix $\begin{bmatrix} -1 & 2 & 2 \\ 2 & 2 & -1 \\ 2 & -1 & 2 \end{bmatrix}$ has

(A) all positive eigenvalues
(B) all negative eigenvalues
(C) some positive eigenvalues and some negative eigenvalues
(D) one zero eigenvalue

Q.53 An integrating factor of the differential equation

$$2\sinh x\cos y\,dx-\cosh x\sin y\,dy=0$$

is

(A) $\cosh x$ (B) $\sinh x$ (C) $\sin x$ (D) $\cos x$

Q.54 The random variable **X** follows the Poisson distribution with variance 4. The mean of this Poisson distribution is

(A) 2 (B) 4 (C) 16 (D) 8

Q.55 Two balls are drawn in succession from a box containing 30 red, 20 white, 10 blue and 15 orange balls; replacement being made after each draw. The probability that neither is orange is

(A) $\frac{16}{25}$ (B) $\frac{9}{25}$ (C) $\frac{1}{25}$ (D) $\frac{24}{25}$

Q.56 Let the function f has the values f_0, f_1, f_2 at equidistant nodal points x_0, x_1, x_2 where $x_i = x_0 + ih,\ i = 1, 2$. Then, the divided difference $f[x_0, x_1, x_2]$ is equal to

(A) $\frac{\nabla f_2}{2h}$ (B) $\frac{\Delta f_0}{2h}$ (C) $\frac{\Delta^2 f_0}{2h^2}$ (D) $\frac{\nabla f_1}{2h}$

Q.57 Let $\sigma = (1,3,5,7,9,10)(2,4,6,8)$ be a permutation in S_{10}. Then the smallest positive integer m such that $\sigma^m = Id$, the identity permutation, is

(A) 24 (B) 6 (C) 4 (D) 12

Q.58 Consider the following two lists:

List I	List II
1: TFT	P: Visual display unit
2: RAM	Q: Volatile memory
3: ROM	R: Non-volatile memory
4: CRT	S: Non-writable memory

The correct match is

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

Q.59 A base 12 number system is called duodecimal. It uses the symbols 0, 1, 2, ..., 9, A, and B, where A and B are the symbols used to represent 10 and 11 respectively. What is the duodecimal equivalent of the decimal number 1594?

(A) A09 (B) A0A (C) B0A (D) B0B

Q.60 A particular solution of the differential equation

$$\frac{d^2y}{dx^2} - \frac{dy}{dx} = xe^x$$

is

(A) $-\frac{x^2}{2}e^x + (x-1)e^x$ (B) $-\frac{x^2}{2}e^{-x} + (x-1)e^{-x}$
(C) $\frac{x^2}{2}e^x - (x-1)e^x$ (D) $\frac{x^2}{2}e^{-x} - (x-1)e^{-x}$

Q.61 The equation for the tangent plane to the surface $2x^3y - xz^2 = -3$ at the point $(1,-1,1)$ is

(A) $7x - 2y + 2z = 11$ (B) $2x - 7y + 2z = 11$
(C) $2x + 7y - 2z = 11$ (D) $7x + 2y - 2z = 11$

Q.62 The minimum distance from the origin to the plane $x+3y-z=11$ *in* $\mathbb{R}^3$ is

(A) 10 (B) 1 (C) $\sqrt{11}$ (D) 11

Q.63 Let σ be a 6-cycle in S_{12}. Then σ^i is also 6-cycle if the value of i is

(A) 2 (B) 3 (C) 5 (D) 12

Q.64 The book entitled, 'The Discovery of India' was written by

(A) Abul Kalam Azad
(B) Jawaharlal Nehru
(C) Rajendra Prasad
(D) Sarvepalli Radhakrishnan

Q.65 Consider the following two lists:

List I	**List II**
1: Functional programming	P: C language
2: Logical programming	Q: Prolog
3: Procedural programming	R: C++
4: Object oriented programming	S: Lisp

Which one of the following is correct match?

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

Q.66 What is the octal equivalent of the hexadecimal number ABC?

(A) 5674 (B) 5314 (C) 5275 (D) 5274

Q.67 The fourth order linear differential equation having $e^{-x}, xe^{-x}, \cos 2x, \sin 2x$ as solutions is

(A) $\frac{d^4y}{dx^4}+2\frac{d^3y}{dx^3}+5\frac{d^2y}{dx^2}+8\frac{dy}{dx}+4y=0$

(B) $\frac{d^4y}{dx^4}+2\frac{d^3y}{dx^3}+8\frac{d^2y}{dx^2}+5\frac{dy}{dx}+4y=0$

(C) $\frac{d^4y}{dx^4}+2\frac{d^3y}{dx^3}+3\frac{d^2y}{dx^2}+4\frac{dy}{dx}+2y=0$

(D) $\frac{d^4y}{dx^4}+2\frac{d^3y}{dx^3}+4\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=0$

Q.68 The probability of getting a total of 9 at least once in two tosses of a pair of fair dice is

(A) $\frac{600}{729}$ (B) $\frac{128}{729}$ (C) $\frac{601}{729}$ (D) $\frac{64}{81}$

Q.69 If the matrix $\begin{bmatrix} a & b \\ b & 2 \end{bmatrix}$ has eigenvalues 1 and 3, then the value of (a,b) is

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

Q.70 The value of the integral $\int_0^9 \frac{dy}{\sqrt{y}\sqrt{1+\sqrt{y}}}$ is

(A) 4 (B) $4(\sqrt{10}-1)$ (C) 8 (D) 12

Q.71 The truth table of a binary operator $\odot$ is given below:

x	y	$x \odot y$
0	0	0
0	1	0
1	0	1
1	1	0

Which one of the following is equivalent to $x \odot y$?

(A) $x'y'$ (B) xy (C) $x'y$ (D) xy'

Q.72 Suppose $\vec{a}+\vec{b} = 2\hat{i}+2\hat{j}+3\hat{k}$, $\vec{a}-\vec{b} = \hat{i}-2\hat{j}+3\hat{k}$ represent diagonals of a parallelogram whose sides are $\vec{a}$ and $\vec{b}$. Then the area of the triangle formed by the sides $\vec{a}, \vec{b}$ and $\vec{a}+\vec{b}$ is

(A) $\frac{1}{4}\sqrt{189}$ (B) $\frac{1}{4}\sqrt{198}$ (C) $\frac{1}{4}\sqrt{179}$ (D) $\frac{1}{4}\sqrt{197}$

Q.73 What is the characteristic equation of the T flip-flop, if Q and Q^+ denote the output during the current and next clock cycle?

(A) $Q^+ = T + Q$ (B) $Q^+ = T'Q' + TQ$
(C) $Q^+ = TQ' + T'Q$ (D) $Q^+ = T' + Q'$

Q.74 The integral $\int_{-1}^{1} f(x)\,dx$ where f is continuous on [-1,1], is approximated by the formula

$$\int_{-1}^{1} f(x)\,dx \simeq \alpha f\left(-\frac{1}{\sqrt{2}}\right) + \beta f\left(\frac{1}{\sqrt{2}}\right).$$

Suppose the approximation is exact for all polynomials of degree ≤ 1. Then the value of α is

(A) -1 (B) 1 (C) $\frac{1}{\sqrt{2}}$ (D) $-\frac{1}{\sqrt{2}}$

Q.75 Let $g(x)=\dfrac{1}{1-x+x^2}$ and $a_o+a_1x+a_2x^2+a_3x^3+\ldots$ be the Taylor series of the function g around 0. Then the value of a_3 is

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

Q.76 Which of the following is/are forbidden input(s) for SR flip-flip?

P: S = 1, R = 1 Q: S = 0, R = 0

(A) P only (B) Q only (C) both P and Q (D) neither P nor Q

Q.77 The iteration formula

$$x_{n+1}=x_n-(\cos x_n)(\sin x_n)+R\cos x_n$$

where R is a positive constant, is used to find a real root of some function $f(x)$. What is $f(x)$, assuming the iteration method is convergent with an initial approximation x_0?

(A) $\tan x-R$ (B) $\cot x-R$ (C) $\sin x-R$ (D) $\cos x-R$

Q.78 The area of the surface generated by rotating the hypocycloid

$$x=a\cos^3\theta,\quad y=a\sin^3\theta,\quad 0\le\theta\le\pi$$

about y-axis is

(A) $\dfrac{12}{5}\pi a^2$ (B) $\dfrac{5}{12}\pi a^2$ (C) $\dfrac{6}{5}\pi a^2$ (D) $\dfrac{5}{6}\pi a^2$

Q.79 What is the output of a JK flip-flop during next clock cycle, when J = 1, K = 1? Assume, Q is the output during the current clock cycle.

(A) 1 (B) 0 (C) Q (D) Q′

Q.80 What are the values of the variables `i`, `j`, and `k` after execution of the following program segment?

```
int i=1, j=2, k=3;
i += j += k;
```

(A) `i`= 3, `j` = 5, `k` = 6 (B) `i`= 3, `j` = 6, `k` = 5
(C) `i`= 6, `j` = 3, `k` = 5 (D) `i`= 6, `j` = 5, `k` = 3

Q.81 What is the content of the array after execution of the following program segment?

```
int a[] = {1, 2, 3, 4}, i;
for (i=1; i<4; ++i) a[i] = a[i] + a[i-1];
```

(A) `{0, 1, 2, 3}` (B) `{1, 2, 3, 4}`
(C) `{1, 3, 6, 10}` (D) `{4, 3, 2, 1}`

Q.82 The eigenvectors of the matrix $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ are

(A) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

(B) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$

(C) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$

(D) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$

Q.83 Consider the following C function:

```
void fun2(int n) {
     while (n > 0) {
          printf("%d", n%10);
          n = n/10;
     }
}
```

What is the output of `fun2(475)`?

(A) 475 (B) 543 (C) 754 (D) 574

Q.84 Consider the following algorithm:

```
(1)  for i = 1 to p do
(2)      for j = 1 to q do
(3)          for k = 1 to r do
(4)            c[i,j] = c[i,j] + a[i,k] * b[k,j];
```

How many times line (4) is executed?

(A) `3` (B) `p + q + r` (C) `pqr` (D) `ijk`

Q.85 Consider the following C function:

```
int fun1(int n) {
        int x=0;
        while (n > 1) {
              n = n/2;
              ++x;
        }
        return (x);
}
```

What is the return value of `fun1(31)`?

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

Q.86 Let A be a 3×3 matrix whose sum of the diagonal elements is $\frac{1}{2}$ and the determinant is $-\frac{1}{2}$. If 1 is an eigenvalue of A, then the eigenvalues of $\left(A^{-1}\right)^2$ are

(A) $1,1,4$ (B) $\frac{1}{4},1,1$ (C) $1,1,2$ (D) $\frac{1}{2},1,1$

Q.87 Let $S_1=\left\{(x,y,z)\in\mathbb{R}^3 \middle| x+y+z=0\right\}$ and $S_2=\left\{(x,y,z)\in\mathbb{R}^3 \middle| x^2+y^2-z^2\le 1\right\}$. Then the set $S_1\cap S_2$ is

(A) convex but not bounded.
(B) bounded but not convex.
(C) bounded and convex.
(D) neither bounded nor convex.

Q.88 The number of different Boolean functions with 3 inputs and 4 outputs is

(A) 64 (B) 127 (C) 128 (D) 144

Q.89 What is the output of the following program fragment?

```
int x = 123, y= -123, z=0;
if (x) { if (z) printf("aaa\n"); }
        else if (y) printf("bbb\n");
             else printf("ccc\n");
```

(A) `aaa` (B) `bbb` (C) `ccc` (D) outputs nothing

Q.90 The solution of the following LPP

$$\text{Max } f = x + 5y$$

subject to

$$2x + y \geq 10,$$
$$4x + 3y \leq 24,$$
$$y \leq 2x,\ y \geq 0$$

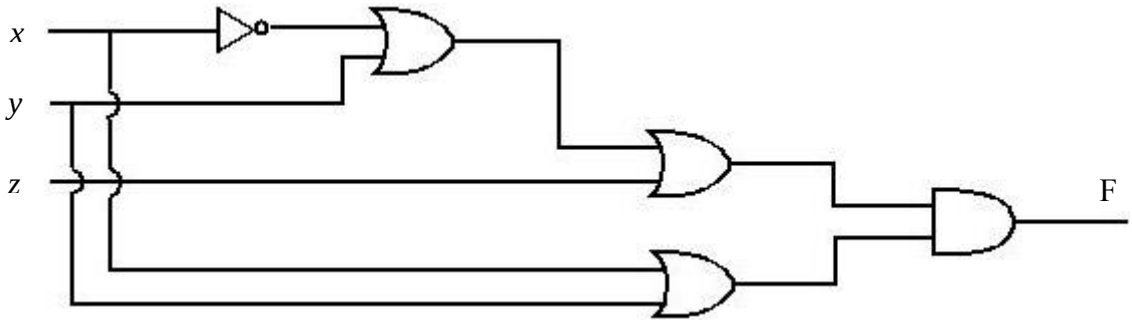
is

(A) 27.5 (B) 26.4 (C) 23 (D) 6

Q.91 Let $f : \mathbb{R} \to \mathbb{R}$ be the function defined by $f(x) = \begin{cases} x^2 & \text{if } x \in \mathbb{Q} \\ x & \text{if } x \notin \mathbb{Q} \end{cases}$. Then the function f is

(A) differentiable on $\mathbb{R}$.
(B) differentiable only at 0.
(C) differentiable only at 1.
(D) is continuous at 0 but NOT differentiable at 0.

Q.92 Consider the following logic circuit:



What is the output F?

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

Q.93 Suppose ϕ_1 and ϕ_2 are two linearly independent solutions of the differential equation

$$\frac{d^2y}{dx^2} + a_1\frac{dy}{dx} + a_2 y = 0$$

where a_1 and a_2 are constants. Then ϕ_1 and ϕ_2 have

(A) odd number of common zeros
(B) exactly one common zero
(C) no common zeros
(D) at most two common zeros

Q.94 Which one is equivalent to $xyz + xyz' + xy'z + xy'z'$?

(A) x (B) x' (C) $y + z$ (D) yz

Q.95 In the following segment of C program

```
int x;
scanf("%d",&x);
if(x&1)printf("%s",STAMENT);
```

STAMENT represents a missing string. Which one of the following is an appropriate string?

(A) "x is a prime number" (B) "x is an even number"
(C) "x is an odd number" (D) "the value of x is 1"

Q.96 Let $W_1 = \{(x, y, z, w) \in \mathbb{R}^4 \mid x + y + z = 0 \text{ and } 6x + 7y + 8z = 0\}$ and $W_2 = \{(x, y, z, w) \in \mathbb{R}^4 \mid x + 2y + 3z = 0 \text{ and } 2x + 3y + 4z = 0\}$. Then the dimension of the subspace $W_1 + W_2$ is

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

Q.97 The composite Trapezoidal rule is used to compute $\int_0^1 e^{-x} dx$ with an error of at most $\frac{1}{12} \times 10^{-2}$. How many points should be used?

(A) 11 (B) 9 (C) 8 (D) 7

Q.98 Consider the following C function:

```
float f(float x)
{ float sum=1.0,term=1.;
  int n=1;
  while(n<50)
  { term=x*term/n;
    sum+=term;
    n++;
  }
return sum;
}
```

The return value of the function `f(1.0)` is the approximate value of

(A) 0.0 (B) sin (1.0) (C) cos (1.0) (D) e

Q.99 The length of the one arc of the cycloid

$$x = a(t - \sin t), \quad y = a(1 - \cos t)$$

is

(A) $8a$ (B) $4a$ (C) $4\sqrt{2}\,a$ (D) $2\sqrt{2}\,a$

Q.100 Consider the following C function:

```
void f(int x,int y)
{ int d;
  if(x>0)
  { d=x%y;
    f(x/y,y);
    printf("%d",d);
  }
  else return;
}
```

The output for `f(100,16)` is

(A) 11 (B) 64 (C) 82 (D) 110

End of the paper

SPACE FOR ROUGH WORK

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