Section : **Common**

Q.1

If $z = 3x + 4y$ be the objective function of a linear programming problem (LPP) and $(3, 1), (2, 4), (0, 4), (5, 0)$ be corner points of the bounded feasible region.

Then the maximum value of objective function is

1. 13
2. 10
3. 22
4. 14

Options 1. 1
2. 2
3. 3
4. 4

Q.2

If A be a square matrix of order 3 such that $|A| = 2$, then $|\text{adj}(2A)|$ is equal to

1. 16
2. 32
3. 64
4. 256

Options 1. 1
2. 2
3. 3
4. 4

Q.3 Match List-I with List-II

List I	List II
(A) Degree of this differential equation $\frac{d^4y}{dx^4} + 2\log_e\left(\frac{d^3y}{dx^3}\right) = 0$	(I) 1
(B) Order of this differential equation $e^{\left(\frac{dy}{dx}\right)^3} + 3y\left(\frac{d^2y}{dx^2}\right)^3 = 0$	(II) 4
(C) Degree of $\frac{d^4y}{dx^4} + \left(\frac{dy}{dx}\right)^2 = 0$	(III) not defined
(D) Order of the differential equation $2\frac{d^4y}{dx^4} + \left(\frac{d^2y}{dx^2}\right)^5 = 0$	(IV) 2

Choose the correct answer from the options given below:

1. (A) - (II), (B) - (IV), (C) - (III), (D) - (I)
2. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
3. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)
4. (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

Options 1. 1
2. 2
3. 3
4. 4

Q.4

If A and B are symmetric matrices, then $AB - BA$ is

1. Singular matrix
2. Zero matrix
3. Symmetric matrix
4. Skew symmetric matrix

Options 1. 1
2. 2
3. 3
4. 4

Q.5

If A is an invertible matrix, then which of the following statement(s) is/are TRUE?

(A) $|A^{-1}| = |A|$

(B) $(A^{-1})^{-1} = A$

(C) $A^{-1} = \frac{\text{adj } A}{|A|}$

(D) $(A^T)^{-1} = (A^{-1})^T$

Choose the *correct* answer from the options given below:

1. (A), (B) and (C) only
2. (B) and (C) only
3. (C) only
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.6 $\int_0^a \frac{\sqrt{x}}{\sqrt{x}+\sqrt{a-x}}\,dx$ is equal to

1. a
2. $\frac{a}{2}$
3. $\frac{a}{3}$
4. $2a$

Options 1. 1
2. 2
3. 3
4. 4

Q.7 Let X denotes the number of heads in a simultaneous toss of three coins, then $P(0 < X < 3)$ is

1. $\frac{1}{2}$
2. $\frac{3}{4}$
3. $\frac{7}{8}$
4. 1

Options 1. 1
2. 2
3. 3
4. 4

Q.8 The area (in sq. units) of the region bounded by $y = -1$, $y = 2$, $x = y^3$ and $x = 0$ is equal to

1. 4
2. 8
3. $\frac{17}{4}$
4. $\frac{15}{4}$

Options 1. 1
2. 2
3. 3
4. 4

Q.9 The general solution of the differential equation $\frac{dy}{dx} = -4xy^2$ is given by

1. $2x^2 - y = C$: C is an arbitrary constant
2. $2x^2 - \frac{1}{y} = C$: C is an arbitrary constant
3. $2x^2 + \frac{1}{y^2} = C$: C is an arbitrary constant
4. $2x^2 + \frac{1}{y} = C$: C is an arbitrary constant

Options 1. 1
2. 2
3. 3
4. 4

Q.10 Assume A, B and C are matrices of order $m \times n$, $n \times 3$ and $3 \times q$ respectively. The restrictions on m, n and q so that $AB + BC$ is defined are

1. n is arbitrary, $q = 2$
2. $m = n, q = 3$
3. $q = 3, m = 3$
4. q is arbitrary, $n = 2$

Options 1. 1
2. 2
3. 3
4. 4

Q.11 Which of the following terms are associated with a linear programming problem?
(A) Constraints

(B) Independent events
(C) Feasible region
(D) Objective function
Choose the *correct* answer from the options given below:
1. (A) and (C) only
2. (A), (C) and (D) only
3. (B), (C) and (D) only
4. (A), (B) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.12 Which of the following functions has a local minima at $x = 0$?
(A) $f(x) = x^3$
(B) $f(x) = |x|$
(C) $f(x) = x^2$
(D) $f(x) = x^{-2}$
Choose the *correct* answer from the options given below:
1. (A), (B) and (C) only
2. (D) only
3. (B), (C) and (D) only
4. (B) and (C) only

Options 1. 1
2. 2
3. 3
4. 4

Q.13 $\int_0^8 \left(x^{\frac{2}{3}} + 1\right) dx$ is equal to
1. $\frac{28}{3}$
2. $\frac{25}{3}$
3. $\frac{184}{3}$
4. $\frac{136}{5}$

Options 1. 1
2. 2
3. 3
4. 4

Q.14 Function $f(x) = x^x,\ x > 0$ decreases on the interval
1. $\left(0, \frac{1}{e}\right)$
2. $(0, e)$
3. $\left(\frac{1}{e}, \infty\right)$
4. (e, ∞)

Options 1. 1
2. 2
3. 3
4. 4

Q.15 If $x = at^2,\ y = 2at;$ then $\frac{d^2y}{dx^2}$ is equal to
1. 0
2. $\frac{1}{t}$
3. $-\frac{1}{t^2}$
4. $-\frac{1}{2at^3}$

Options 1. 1
2. 2
3. 3
4. 4

Section : **Applied Mathematics**

Q.16 A machine costing Rs.2,00,000 has a useful life of 5 years.The estimated scrap value is Rs.20,000. By using straight line
method, the annual depreciation is

1. Rs.18,000
2. Rs.25,000
3. Rs.36,000
4. Rs.40,000

Options 1. 1
2. 2
3. 3
4. 4

Q.17 The binomial distribution for which the mean is 5 and variance 4 , is

1. $P(X=r)={}^{25}C_r(\frac{4}{5})^r(\frac{1}{5})^{25-r},\ r=0,1,2,3,...,25$
2. $P(X=r)={}^{25}C_r(\frac{1}{5})^r(\frac{4}{5})^{25-r},\ r=0,1,2,3,...,25$
3. $P(X=r)={}^{25}C_r(\frac{1}{5})^{25}(\frac{4}{5})^{25-r},\ r=0,1,2,3,...,25$
4. $P(X=r)={}^{25}C_r(\frac{1}{5})^{25-r}(\frac{4}{5})^{25},\ r=0,1,2,3,...,25$

Options 1. 1
2. 2
3. 3
4. 4

Q.18 The point which provides the optimal solution of the linear programming problem
maximize $z=21x+35y$
$3x+2y\leq 30$
$4x+5y\leq 60$
$x\geq 0, y\geq 0$
has the coordinates
1. $(\frac{30}{7},\frac{60}{7})$
2. $(0,12)$
3. $(10,0)$
4. $(3,8)$

Options 1. 1
2. 2
3. 3
4. 4

Q.19 If the matrix $A=\begin{bmatrix} x & 2 & y \\ -2 & 0 & 3 \\ -1 & z & 0 \end{bmatrix}$ is skew-symmetric, then the value of $2x-3y+5z$ is equal to
(1) 18
(2) 15
(3) -10
(4) -18

Options 1. 1
2. 2
3. 3
4. 4

Q.20 Ram invested Rs. 20,000 in a mutual fund in the year 2012.
The value of the mutual fund increased to Rs. 32,000 in the year 2017.
The compound annual growth rate (CAGR) of his investment is (Given: $(1.6)^{\frac{1}{5}}=1.098$)
1. 10.8\%
2. 7.8\%
3. 9.8\%
4. 6.8\%

Options 1. 1
2. 2
3. 3
4. 4

Q.21 If the system of equations kx + y + z = 0, x + ky - z = 0, x - y + z = 0 has a non-zero solution, then the possible values of k are

1. 1, 3
2. 1, -3
3. 2, 3
4. -1, 3

Options 1. 1
2. 2
3. 3

4. 4

Q.22 Choose the correct statement about Sinking Fund?

1. It is a long term account which can be closed any time.
2. It does not have any specific purpose.
3. In this fund, a fixed amount at regular intervals is deposited for a fixed terms
4. It can be used in any emergency.

Options 1. 1
2. 2
3. 3
4. 4

Q.23 If $(t_1, y_1), (t_2, y_2), \ldots\ldots\ldots, (t_n, y_n)$ denote the time series and y_t are the trend values of the variables y, then

1. $\sum_{i=1}^{n}(y_i - y_t) = 0$
2. $\sum_{i=1}^{n}(y_i - y_t) = 1$
3. $\sum_{i=1}^{n}(y_i - y_t) = \infty$
4. $\sum_{i=1}^{n}(y_i - y_t) \neq 0$

Options 1. 1
2. 2
3. 3
4. 4

Q.24 The two positive numbers whose sum is 16 and the sum of whose squares is minimum then the positive numbers are:

1. 6, 10
2. 7, 9
3. 8, 8
4. 5, 11

Options 1. 1
2. 2
3. 3
4. 4

Q.25 The cost of type 1 rice is Rs. 20 per kg and type 2 rice is Rs. 30 per kg. If both Type 1 and Type 2 are mixed in the ratio 2:3, then the price per kg of the mixed variety is

1. Rs. 26
2. Rs. 24
3. Rs. 30
4. Rs. 32

Options 1. 1
2. 2
3. 3
4. 4

Q.26 The corner points of the bounded feasible region determined by the system of linear constraints are (0,8) , (4,4) , (12,12) , (0,20). Let $z = px + qy$, where $p, q > 0$ .Condition on p and q so that the maximum of z occurs at both the points (12,12) , (0,20) is

1. 2p = q
2. p = 3q
3. 2p = 3q
4. 3p = 2q

Options 1. 1
2. 2
3. 3
4. 4

Q.27 A random variable X has the following probability distribution

X	0	1	2
P(X)	1/4	1/2	1/4

then, which of the following is correct?

1. mean = variance
2. 2 mean = variance
3. mean = 2 variance
4. 3 mean = 2 variance

Options 1. 1

2. 2
3. 3
4. 4

Q.28 Assuming the same rate of change continues for the following data:

Year(X)	2019	2020	2021	2022	2023
Profit in Percentage (y)	38	40	65	72	69

The equation of the straight line trend using the least square method is:

1. $y = 9.4x + 18940.6$
2. $y = 9.4x - 18940.6$
3. $y = 9.4x + 56.8$
4. $y = 9.4x - 56.8$

Options 1. 1
2. 2
3. 3
4. 4

Q.29 Which of the following statements are TRUE?
(A) The variable t of t-distribution ranges from $-\infty$ to ∞.
(B) The probability curve of the t-distribution is symmetric about the line t=0
(C) The variance of the t-distribution is greater than one.
(D) As the number of degrees of freedom decreases, the t-distribution curve moves closer to the standard normal probability curve.

Choose the correct answer from the options given below:
1. (A), (B) and (D) only
2. (A), (B) and (C) only
3. (A), (B), (C) and (D)
4. (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.30 If $\frac{3x-5}{6} + 8 \geq 4 + \frac{2x}{3}$, then

1. $x \in (-\infty, 19]$
2. $x \in (-\infty, -19]$
3. $x \in [19, \infty)$
4. $x \in [-19, \infty)$

Options 1. 1
2. 2
3. 3
4. 4

Q.31 The sum of the order and degree of the differential equation representing the family of curves $y = mx + m^4$, where m is arbitrary constant, is

1. 3
2. 4
3. 5
4. 2

Options 1. 1
2. 2
3. 3
4. 4

Q.32 If $A = \begin{bmatrix} 3 & 2a \\ 1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ b & 5 \end{bmatrix}$ are singular matrices, then $a + b$ is:

1. $\frac{6}{65}$
2. $\frac{67}{6}$
3. $\frac{65}{6}$

4. $\frac{1}{66}$

Options 1. 1
2. 2
3. 3
4. 4

Q.33 The value of $\int_2^4 \frac{x}{x^2+1}dx$ is equal to:

1. $\frac{1}{2}\log_e\left(\frac{17}{5}\right)$
2. $\frac{1}{5}\log_e\left(\frac{17}{5}\right)$
3. $\log_e\left(\frac{17}{5}\right)$
4. $2\log_e\left(\frac{17}{5}\right)$

Options 1. 1
2. 2
3. 3
4. 4

Q.34 The least non-negative remainder, when 5^{61} is divided by 7, is

1. 6
2. 4
3. 5
4. 2

Options 1. 1
2. 2
3. 3
4. 4

Q.35 The length of a rectangle is decreasing at the rate of 4 cm/minute and the width is increasing at the rate of 3 cm/minute , then the rate of change of the perimeter is

1. 2 cm/min decreasing
2. 3 cm/min decreasing
3. 2 cm/min increasing
4. 3 cm/min increasing

Options 1. 1
2. 2
3. 3
4. 4

Q.36 The following data are from a random sample: 5, 8, 10, 7, 10, 14, then the point estimate of the population standard deviation is

1. 2.1
2. 4.1
3. 5.6
4. 3.1

Options 1. 1
2. 2
3. 3
4. 4

Q.37 If X is a random variable and a, b are real numbers, which statements are TRUE?

(A) $Var(aX+b) = a^2Var(X)$

(B) $E(aX+b) = aE(X)+b$

(C) $E(aX+b) = aE(X) - E(b)$

(D) $Var(aX+b) = aVar(X)+b$

Choose the correct answer:

1. (A) and (B) only
2. (A) and (C) only

3. (B) and (D) only
4. (A), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.38 Pipe A and B can fill a tank in 20 hours and 25 hours respectively, and pipe C can empty it in 40 hours. If all the pipes are opened together, then how much time will be needed to make the tank full?

1. $15\frac{1}{13}$ hours
2. $15\frac{4}{13}$ hours
3. $15\frac{5}{13}$ hours
4. $15\frac{3}{13}$ hours

Options 1. 1
2. 2
3. 3
4. 4

Q.39 Question: Choose the correct statement about CAGR (compound annual growth rate)?

1. CAGR is the average annualized return of an investment.
2. CAGR is calculated by taking arithmetic mean of series of returns.
3. CAGR is linear measure that does not account for the effects of compounding.
4. CAGR is calculated by using the final and beginning value of an investment.

Options 1. 1
2. 2
3. 3
4. 4

Q.40 The break-even point is the level of production where
1. the revenue from sales is less then the cost of production and marketing.
2. the revenue from sales is equal to the cost of production and marketing.
3. the revenue from sales is greater then the cost of production and marketing.
4. the sum of revenue from sales and the cost of production and marketing is zero

Options 1. 1
2. 2
3. 3
4. 4

Q.41 Question: If $A = \begin{bmatrix} 5 & 2 \\ 4 & 3 \end{bmatrix}$ is a given matrix, then which statements are correct?

(A) $|A| = 7$

(B) minor of $3 = -5$

(C) co-factor of $2 = -4$

(D) $adj(A) = \begin{bmatrix} 3 & -2 \\ -4 & 5 \end{bmatrix}$

1. (A), (C) and (D) only
2. (A), (B) and (C) only
3. (B), (C) and (D) only
4. (A), (B) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.42 Question: For the following data:

	Size	Mean	Standard Deviation
Sample 1	4	40	8
Sample 2	5	50	10

The sample statistic t follows t-distribution with 'm' degrees of freedom, then m is equal to:

1. 11
2. 10
3. 7
4. 9

Options 1. 1
2. 2
3. 3
4. 4

Q.43 If A is a square matrix such that $A^2 = A$ and I is the identity matrix of the same order as A, then $(I + 2A)^2 - 5A$ is equal to:

1. $I + 2A$
2. $I + 3A$
3. $I + A$
4. I

Options 1. 1
2. 2
3. 3
4. 4

Q.44 The curve y = f(x) is normal probability curve, then which of the following statements are correct?

(A) mean, median and mode of the distribution coincide.

(B) the area bounded by the curve y = f(x) and x-axis is one unit.

(C) The curve is symmetrical about the line x = μ , where μ is the mean.

(D) y-axis is an asymptote to the curve.

Choose the correct answer from the options given below:

1. (A), (B) and (C) only
2. (A), (C) and (D) only
3. (B) and (D) only
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.45 In a kilometer race , A beats B by 50 meters or by 5 seconds, then the time taken by A to complete the race is

1. 85 seconds
2. 90 seconds
3. 95 seconds
4. 120 seconds

Options 1. 1
2. 2
3. 3
4. 4

Q.46 The demand for a certain product is represented by the function

$p = 150 + 10x - x^2$ (in Rs.)

where x is the number of units demanded and p is the price per unit, then the value of marginal revenue , when 10 units are sold, is

1. Rs.50
2. Rs.100
3. Rs.150
4. Rs.200

Options 1. 1
2. 2
3. 3
4. 4

Q.47 Mr. Vishnu has an initial investment of Rs. 80,000 in an investment plan. After 3 years, it has grown to Rs. 1,00,000, then his rate of return is

1. 30\%
2. 25\%
3. 20\%
4. 10\%

Options 1. 1
2. 2

3. 3
4. 4

Q.48 Which of the following statements are TRUE ?

(A) The sales of woolen clothes, gold , silver etc. exhibit seasonal trends.

(B) The price of stocks in the share market repeats after a definite time interval.

(C) The rise and fall of the share market is an example of a cyclic trend.

(D) The rise in prices before festivals is an example of a irregular trend.

Choose the correct answer from the options given below:

1. (A) and (D) only
2. (A), (B) and (C) only
3. (A) and (C) only
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.49 For the given five values, 16, 25, 19, 34, 43, the three year moving averages are

1. 20, 26, 32
2. 20, 26, 33
3. 20, 27, 32
4. 20, 26, 31

Options 1. 1
2. 2
3. 3
4. 4

Q.50 A man rows downstream 30 km and upstream 20 km. If he takes 5 hours to cover each distance, then the speed of stream is

1. 5 km/hr
2. 1 km/hr
3. 4 km/hr
4. 6 km/hr

Options 1. 1
2. 2
3. 3
4. 4

Section : **Core Mathematics**

Q.51 The number of arbitrary constants in the particular solution of a differential equation of order 4 and degree 3 is

1. 0
2. 1
3. 3
4. 4

Options 1. 1
2. 2
3. 3
4. 4

Q.52 If $A = \begin{bmatrix} 1 & 5 \\ 7 & 12 \end{bmatrix}$, $B = \begin{bmatrix} 9 & 1 \\ 7 & 8 \end{bmatrix}$ and C are three matrices such that $3A + 5B + 2C = 0$, then the matrix C is equal to

1. $\begin{bmatrix} -48 & -20 \\ -56 & -76 \end{bmatrix}$
2. $\begin{bmatrix} -24 & -10 \\ -28 & -38 \end{bmatrix}$
3. $\begin{bmatrix} -48 & 20 \\ 56 & -76 \end{bmatrix}$
4. $\begin{bmatrix} 24 & 10 \\ 28 & 38 \end{bmatrix}$

Options 1. 1
2. 2
3. 3

4. 4

Q.53 Let θ be the angle between two vectors $\vec{a}$ and $\vec{b}$. Then match List-I with List-II

List-I	List-II
(A) $\sin\theta$	(I) $\frac{\vec{a}\cdot\vec{b}}{\lvert\vec{a}\rvert\lvert\vec{b}\rvert}$
(B) $\cos\theta$	(II) $\lvert\vec{a}\times\vec{b}\rvert$
(C) Area of the parallelogram with adjacent sides represented by $\vec{a}$ and $\vec{b}$	(III) $\frac{\vec{a}\cdot\vec{b}}{\lvert\vec{a}\rvert}$
(D) Projection of $\vec{a}$ on $\vec{b}$	(IV) $\frac{\lvert\vec{a}\times\vec{b}\rvert}{\lvert\vec{a}\rvert\lvert\vec{b}\rvert}$

Choose the correct answer from the options given below:

1. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)
2. (A) - (I), (B) - (IV), (C) - (II), (D) - (III)
3. (A) - (IV), (B) - (I), (C) - (III), (D) - (II)
4. (A) - (I), (B) - (IV), (C) - (III), (D) - (II)

Options 1. 1
2. 2
3. 3
4. 4

Q.54 If $\vec{a}$ is any vector, then $|\vec{a}\times\hat{i}|^2+|\vec{a}\times\hat{j}|^2+|\vec{a}\times\hat{k}|^2$ is equal to

1. $|\vec{a}|^2$
2. $2|\vec{a}|^2$
3. $3|\vec{a}|^2$
4. $4|\vec{a}|^2$

Options 1. 1
2. 2
3. 3
4. 4

Q.55 A bag contains 4 red and 6 black balls. Two balls are drawn in succession without replacement. The probability that the first is red and the second is black is

1. $\frac{2}{5}$
2. $\frac{2}{3}$
3. $\frac{4}{15}$
4. $\frac{6}{25}$

Options 1. 1
2. 2
3. 3
4. 4

Q.56 $\int e^{2x}\left(\sin x+\frac{1}{2}\cos x\right)dx$ is equal to

1. $-\frac{1}{2}e^{2x}\cos x+C$, C is an arbitrary constant
2. $\frac{1}{2}e^{2x}\sin x+C$, C is an arbitrary constant
3. $e^{2x}\sin x+C$, C is an arbitrary constant
4. $-e^{2x}\cos x+C$, C is an arbitrary constant

Options 1. 1
2. 2
3. 3
4. 4

Q.57 Let $f(x)=\begin{cases}|x|+3 & \text{if } x\le -3\\ -2x & \text{if } -3<x<3\\ 6x+2 & \text{if } x\ge 3\end{cases}$, then which of the following is true?

1. $f(x)$ is discontinuous at both $x=3$ and $x=-3$
2. $f(x)$ is continuous at both $x=3$ and $x=-3$
3. $f(x)$ is discontinuous at $x=-3$
4. $f(x)$ is discontinuous at $x=3$

Options 1. 1

2. 2
3. 3
4. 4

Q.58 The system of equations

$x + y + z = 4$

$x + 2y + 3z = 12$

$x + 3y + \lambda z = \mu$

has a unique solution if

1. $\lambda = 5$, μ can be any real number
2. $\lambda = 5$, $\mu \neq 20$
3. $\lambda \neq 5$, μ can be any real number
4. $\lambda = 5$, $\mu = 20$

Options 1. 1
2. 2
3. 3
4. 4

Q.59 If $\begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ 4 & -8 \end{vmatrix}$, then value(s) of x is/are

1. 3
2. $2\sqrt{2}$
3. $\pm 2\sqrt{2}$
4. 8

Options 1. 1
2. 2
3. 3
4. 4

Q.60 The probabilities of occurrence of two events E and F are 0.25 and 0.50 respectively. The probability of their simultaneous occurrence is 0.14. The probability that neither E nor F occurs is

1. 0
2. 1
3. 0.39
4. 0.61

Options 1. 1
2. 2
3. 3
4. 4

Q.61 The probability distribution of a random variable X is

X	0	1	2	3	4
P(X)	0.2	k	k	2k	k

Match List-I with List-II

List I	List II
(A) value of k	$(I)\frac{16}{25}$
(B) $P(X \geq 2)$	$(II)\frac{9}{25}$
(C) $P(X = 3)$	$(III)\frac{4}{25}$
(D) $P(X < 2)$	$(IV)\frac{8}{25}$

Choose the correct answer from the options given below:

1. (A) - (III), (B) - (II), (C) - (I), (D) - (IV)
2. (A) - (III), (B) - (I), (C) - (II), (D) - (IV)
3. (A) - (II), (B) - (III), (C) - (I), (D) - (IV)
4. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

Options 1. 1
2. 2
3. 3
4. 4

Q.62 The relation R on the set of real numbers defined by $R = \{(a, b) : a \leq b^2\}$ is

1. neither reflexive nor symmetric nor transitive
2. reflexive but not symmetric
3. symmetric but not transitive
4. transitive but neither reflexive nor symmetric

Options 1. 1

2. 2
3. 3
4. 4

Q.63 The angle at which the line $\frac{x-1}{0} = \frac{2-y}{-1} = \frac{2z-3}{-2}$ is inclined with the positive direction of z-axis is

1. $\frac{\pi}{4}$
2. $\frac{\pi}{2}$
3. $\frac{2\pi}{3}$
4. $\frac{3\pi}{4}$

Options 1. 1
2. 2
3. 3
4. 4

Q.64 Which of the following statement is/are correct?

(A) A square matrix $A = [a_{ij}]$ is called a symmetric matrix if $a_{ij} = a_{ji}$ for all i, j.

(B) $A = [a_{ij}]_{m\times m}$ is a diagonal matrix if $a_{ij} = 0$ when $i = j$.

(C) A square matrix $A = [a_{ij}]$ is called a skew symmetric matrix if $a_{ij} = -a_{ji}$ for all i, j.

(D) The multiplication of diagonal matrices of same order is commutative.

Choose the *correct* answer from the options given below:

1. (A), (B) and (C) only
2. (B), (C) and (D) only
3. (A), (C) and (D) only
4. (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.65 If A and B are two square matrices of same order such that $AB = A$ and $BA = B$, then the value of $A^{2024} + B^{2024}$ is equal to

1. $2024A + 2024B$
2. O
3. $A + B$
4. $A - B$

Options 1. 1
2. 2
3. 3
4. 4

Q.66 Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, $\vec{c} = 3\hat{i} + \hat{j}$ be three vectors. If $(\vec{a} + \lambda\vec{b})$ is perpendicular to $\vec{c}$, then the value of λ is

1. 3
2. 5
3. 2
4. -3

Options 1. 1
2. 2
3. 3
4. 4

Q.67 The sides of an equilateral triangle are increasing at the rate of 5 cm/sec. The rate at which the area increases when the side is 20 cm, is

1. $25\sqrt{3}$ cm^2/sec
2. $50\sqrt{3}$ cm^2/sec
3. $100\sqrt{3}$ cm^2/sec
4. $15\sqrt{3}$ cm^2/sec

Options 1. 1
2. 2
3. 3
4. 4

Q.68 The region represented by the system of inequalities $x, y \geq 0$, $y \leq 6$, $x + y \leq 3$

1. is a bounded region in the first quadrant
2. is an unbounded region in the first and second quadrant
3. is an unbounded region in the first quadrant
4. has no point which satisfies all the inequalities

Options 1. 1

2. 2
3. 3
4. 4

Q.69 The vector equation of line passing through $(-1, 3, -2)$ and perpendicular to the lines $\frac{x+4}{1} = \frac{y}{2} = \frac{z-3}{3}$ and $\frac{x+2}{-3} = \frac{y+5}{2} = \frac{z-6}{5}$ is

1. $\vec{r} = (-3\hat{i} + 4\hat{j} + 15\hat{k}) + \lambda(-\hat{i} + 3\hat{j} - 2\hat{k})$
2. $\vec{r} = (-\hat{i} + 3\hat{j} - 2\hat{k}) + \lambda(-3\hat{i} + 4\hat{j} + 15\hat{k})$
3. $\vec{r} = 2\hat{i} - 7\hat{j} + 4\hat{k} + \lambda(-\hat{i} + 3\hat{j} - 2\hat{k})$
4. $\vec{r} = (-\hat{i} + 3\hat{j} - 2\hat{k}) + \lambda(2\hat{i} - 7\hat{j} + 4\hat{k})$

Options 1. 1
2. 2
3. 3
4. 4

Q.70 Let $f(x) = x^3 - 6x^2 + 9x - 8$ be a function, then which of the following statements are TRUE?

(A) $f'(x) = 3(x-1)(x-3)$
(B) The critical points of the function are $x = 1$ and $x = 3$
(C) $x = 1$ is the point of local minimum
(D) The local maximum value is -4

Choose the correct answer from the options below:

1. (A), (B) and (C) only
2. (A), (B) and (D) only
3. (B), (C) and (D) only
4. (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.71 If $x^m y^n = (x+y)^{m+n}$, then $\frac{d^2y}{dx^2}$ is equal to:

1. $\frac{y^2}{x^2}$
2. $-\frac{y}{x}$
3. $\frac{y}{x}$
4. 0

Options 1. 1
2. 2
3. 3
4. 4

Q.72 $\int \frac{\sqrt{1-x}}{\sqrt{1+x}} dx = \alpha\sqrt{1-x^2} + \beta \sin^{-1} x + C$, where C is an arbitrary constant, then which of the following are TRUE?

(A) $\alpha = 1$
(B) $\alpha = -1$
(C) $\beta = 1$
(D) $\beta = -1$

Choose the correct answer from the options given below:

1. (B) and (D) only
2. (A) and (C) only
3. (A) and (D) only
4. (B) and (C) only

Options 1. 1
2. 2
3. 3
4. 4

Q.73 Let $f(x) = \log_e(\sin x), x \in (0, \pi)$, then which of the following statements is/are TRUE?

(A) $f(x)$ is increasing on $(0, \pi/2)$
(B) $f(x)$ is decreasing on $(\pi/2, \pi)$
(C) $f(x)$ is increasing on $(0, \pi)$
(D) $f(x)$ is decreasing on $(0, \pi)$

Choose the \textbf{correct} answer from the options given below:

1. (C) and (D) only
2. (A) and (B) only
3. (A) only
4. (B) only

Options 1. 1
2. 2
3. 3
4. 4

Q.74 The value of $\tan^{-1}(2) + \tan^{-1}(3)$ is equal to

1. $\frac{\pi}{4}$
2. $-\frac{\pi}{4}$
3. $\frac{3\pi}{4}$
4. $-\frac{3\pi}{4}$

Options 1. 1
2. 2
3. 3
4. 4

Q.75 If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}| = 10$, $|\vec{b}| = 2$ and $\vec{a} \cdot \vec{b} = 12$, then $|\vec{a} \times \vec{b}|$ is equal to

1. 16
2. 256
3. 20
4. 240

Options 1. 1
2. 2
3. 3
4. 4

Q.76 If the area of a triangle whose vertices are $(-2, 4), (2, -6)$ and $(k, 4), k > 0$, is 35 sq.units, then the value of k is

1. 3
2. 5
3. 6
4. 7

Options 1. 1
2. 2
3. 3
4. 4

Q.77 The corner points of the feasible region of a LPP with the constraints $x + 2y \leq 40, 3x + y \geq 30, 4x + 3y \geq 60, x, y \geq 0$ are

1. $(0, 0), (10, 0), (6, 12), (0, 20)$
2. $(0, 20), (0, 30), (4, 18)$
3. $(0, 20), (6, 12), (4, 18)$
4. $(15, 0), (40, 0), (4, 18), (6, 12)$

Options 1. 1
2. 2
3. 3
4. 4

Q.78 The function $f : [-1, 1] \to \mathbb{R}$ is given by $f(x) = \frac{x}{x+2}$

1. onto only
2. both one-one and onto
3. one-one only
4. neither one-one nor onto

Options 1. 1
2. 2
3. 3
4. 4

Q.79 The area (in sq.units) of region bounded by $y^2 = 9x, x = 2, x = 4$ and the x-axis in the first quadrant is

1. $3[4 - \sqrt{2}]$
2. $2[4 + \sqrt{2}]$
3. $8[4 - \sqrt{2}]$

4. $4[4-\sqrt{2}]$

Options 1. 1
2. 2
3. 3
4. 4

Q.80 The direction ratios of the line perpendicular to the lines $\frac{x-5}{2}=\frac{y+11}{-3}=\frac{z+3}{1}$ and $\frac{x-7}{1}=\frac{y+2}{2}=\frac{z-4}{-2}$ are proportional to:

1. $(4,5,-7)$
2. $(-4,5,7)$
3. $(4,-5,7)$
4. $(4,5,7)$

Options 1. 1
2. 2
3. 3
4. 4

Q.81 Three students, A, B and C can respectively solve 50\%, 25\% and 20\% of the problems in a book. A particular problem is selected at random from the book. The probability that at least one of them will solve the problem is

1. $\frac{3}{20}$
2. $\frac{17}{20}$
3. $\frac{7}{10}$
4. $\frac{3}{10}$

Options 1. 1
2. 2
3. 3
4. 4

Q.82 The area (in sq. units) of the region enclosed by the curve $9x^2+4y^2=36$ is

1. 10π
2. 8π
3. 6π
4. 4π

Options 1. 1
2. 2
3. 3
4. 4

Q.83 Match List-I with List-II

List-I	List-II
(A) $\int \frac{dx}{x^2-16}$	(I) $\frac{1}{8}\log\left\|\frac{4+x}{4-x}\right\|+c$
(B) $\int \frac{dx}{x^2+16}$	(II) $\log\left\|x+\sqrt{x^2-16}\right\|+c$
(C) $\int \frac{dx}{16-x^2}$	(III) $\frac{1}{8}\log\left\|\frac{x-4}{x+4}\right\|+c$
(D) $\int \frac{dx}{\sqrt{x^2-16}}$	(IV) $\frac{1}{4}\tan^{-1}\left(\frac{x}{4}\right)+c$

Choose the correct answer from the options given below:

1. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
2. (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
3. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
4. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Options 1. 1
2. 2
3. 3
4. 4

Q.84 For the differential equation $x\frac{dy}{dx}+2y=x^2\log_e x$

(A) Integrating factor is $2x$

(B) Integrating factor is x^2

(C) General Solution is $y = \frac{x^2}{16}(4\log_e|x| - 1) + Cx^{-2}$, where C is an arbitrary constant.

(D) General Solution is $y = \frac{x^4}{16}(4\log_e|x| - 1) + C$, where C is an arbitrary constant.

Choose the correct answer from the options given below:

1. (A) and (C) only
2. (B) and (D) only
3. (B) and (C) only
4. (A) and (D only

Options 1. 1
2. 2
3. 3
4. 4

Q.85

If $\sin y = x\cos(a + y)$, then $\frac{dy}{dx}$ is equal to

1. $\frac{\cos^2(a+y)}{\cos a}$
2. $\frac{\cos a}{\cos^2(a+y)}$
3. $\frac{\sin^2 y}{\cos a}$
4. $\frac{\sin^2 y}{\cos^2(a+y)}$

Options 1. 1
2. 2
3. 3
4. 4