Section : **Common**

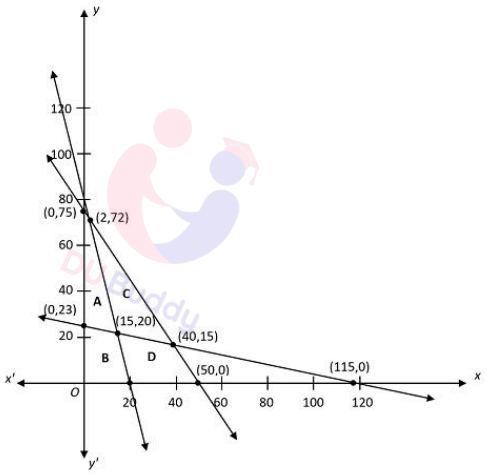
Q.1 If $\begin{bmatrix} 2a+b & a-2b \\ 5c-d & 4c+3d \end{bmatrix} = \begin{bmatrix} 4 & -3 \\ 11 & 24 \end{bmatrix}$, then the value of $a+2b-3c+4d$ is equal to

1. 4
2. 12
3. 24
4. 30

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

Q.2

In the given figure, feasible region represented by the constraints $4x+y \geq 80$, $x+5y \geq 115$, $3x+2y \leq 150$, $x, y \geq 0$ is



1. Region A
2. Region B
3. Region C
4. Region D

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

Q.3

Let the degree and order of the differential equation $2x^3\frac{dy}{dx} - 5\left(\frac{d^2y}{dx^2}\right)^2 = 6\left(\frac{dy}{dx}\right)^3$ be m and n respectively. Then

(A) $m=2$
(B) $n=3$
(C) $m=3$
(D) $mn=4$

Choose the correct answer from the options given below:

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

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

Q.4 A random variable X has the following probability distribution:

X	0	1	2	3	4	5	6	7
P(X)	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2+k$

The value of $P(4 < X < 7)$ is equal to

1. $\frac{3}{100}$
2. $\frac{1}{2}$
3. $\frac{5}{100}$
4. $\frac{7}{100}$

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

Q.5 If $f(x) = x^3 \log_e x$, Then $f''(e^2)$ is equal to

1. $5e^4 + 12e^2$
2. $17e^2$
3. $12e^4 + 5e^2$
4. $17e^4$

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

Q.6 If A and B are invertible matrices of same order, then which one of the following is \textbf{NOT} true?

1. $(AB)^{-1} = B^{-1}A^{-1}$
2. adj$(AB) =$ (adj A)(adj B)
3. adj $A^T =$ (adj $A)^T$
4. $|A^{-1}| = (|A|)^{-1}$

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

Q.7 If the system of equations

$x + 2y + 3z = 10$

$-x + y + \lambda z = 20$

$2x + 3y + \lambda z = 0$

does not possess a unique solution, then λ is equal to

1. 1
2. $\frac{15}{4}$
3. $\frac{4}{15}$
4. -1

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

Q.8 The value of which of the following integrals is zero?

(A) $\int_0^1 x\,dx$

(B) $\int_{-1}^1 x\,dx$

(C) $\int_{-1}^1 x^2\,dx$

(D) $\int_0^1 \log\left(\frac{x}{1-x}\right)dx$

Choose the correct answer from the options given below:

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

Options 1. 1

2. 2
3. 3
4. 4

Q.9 The function $f(x) = x^4 - 2x^2$ is increasing on

1. $(-1, 0) \cup (1, \infty)$
2. $(-\infty, -1) \cup (0, 1)$
3. $(-\infty, \infty)$
4. $(-\infty, 0) \cup (1, \infty)$

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

Q.10 If corner points of the bounded feasible region are $(0, 0)$, $(3, 0)$ and $(0, 3)$ and objective function is $Z = 4x + 7y$, then the

maximum value of Z is

1. 12
2. 21
3. 27
4. 17

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

Q.11 The area (in sq. units) of the region bounded by the curve $y = 2x^3$, x-axis and ordinates $x = -1$ and $x = 1$ is.

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

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

Q.12 $\int \frac{x^3 - 1}{x^2} dx$ is equal to

1. $\frac{x^2}{2} + x + c$, where c is constant of integration
2. $\frac{x^2}{2} - \frac{1}{x} + c$, where c is constant of integration
3. $\frac{x^2}{2} - x + c$, where c is constant of integration
4. $\frac{x^2}{2} + \frac{1}{x} + c$, where c is constant of integration

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

Q.13 If A and B are square matrices of the same order, then $(A + B)(A - B)$ is equal to

1. $A^2 - B^2$
2. $A^2 - B^2 + BA - AB$
3. $A^2 - BA - AB - B^2$
4. $B^2 + A^2 + AB - BA$

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

Q.14

The general solution of the differential equation $\log_e\left(\frac{dy}{dx}\right) = ax + by$ is

1. $\frac{e^{-ax}}{a} + \frac{e^{by}}{b} + C = 0$, Where C is constant of integration
2. $\frac{e^{-ax}}{a} - \frac{e^{by}}{b} + C = 0$, Where C is constant of integration
3. $\frac{e^{ax}}{a} + \frac{e^{-by}}{b} + C = 0$, Where C is constant of integration
4. $\frac{e^{ax}}{a} - \frac{e^{-by}}{b} + C = 0$, Where C is constant of integration

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

Q.15

The function, $f(x) = x + \frac{a^2}{x}, a > 0, x \neq 0$ has a local maxima at

1. $x = -a$
2. $x = a$
3. $x = \frac{1}{a}$
4. $x = -\frac{1}{a}$

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

Section : **Applied Mathematics**

Q.16

If X is normal distribution random variable with mean $\mu = 10$ and standard deviation $\sigma = 2$, Z is standard normal variable and $F(Z)$ is cumulative distribution function, then which of the following are true?

[Given that $F(1.5) = 0.9332, F(3) = 0.9986, F(2.25) = 0.9878$ and $F(1) = 0.8413$]

(A) $P(X < 13) = 0.9332$

(B) $P(X > 16) = 0.9986$

(C) $P(12 < X < 14.5) = 0.1465$

(D) $P(X > 8) = 0.8413$

Choose the correct answer from the options given below:

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

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

Q.17

If $M = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}$ and $N = [7 \quad 1 \quad -4]$, then $(MN)^T$ will be equal to:

1. $\begin{bmatrix} 7 & 1 & -4 \\ 2 & -1 & 3 \\ 9 & 0 & -1 \end{bmatrix}$
2. $\begin{bmatrix} 14 & 2 & -8 \\ -7 & -1 & 4 \\ 21 & 3 & -12 \end{bmatrix}$

3. $\begin{bmatrix} 14 & -7 & 21 \\ 2 & -1 & 3 \\ 1 & 3 & -12 \end{bmatrix}$

4. $\begin{bmatrix} 14 & -7 & 21 \\ 2 & -1 & 3 \\ -8 & 4 & -12 \end{bmatrix}$

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

Q.18 If the money is worth 8% per annum compounded semi-annually, then the present value of a sequence of payments of

₹1,000 made at the end of every 6 months and continuing forever, is:

1. ₹ 20,000
2. ₹ 25,000
3. ₹ 15,000
4. ₹ 18,000

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

Q.19 A measurable characteristic of a population is called
1. Statistic
2. Sample
3. Parameter
4. Statistical Inference

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

Q.20 The probability distribution of a random variable x is :

$$P(X=x)=\begin{cases} kx^2, & \text{for } x=1,2,3 \\ 2kx, & \text{for } x=4,5,6 \text{ where } k \text{ is a constant.} \\ 0, & \text{otherwise} \end{cases}$$

Match List-I with List-II

List I	List II
(A) k	(I) 7/22
(B) $P(X \geq 4)$	(II) 1/44
(C) $P(X<4)$	(III) 95/22
(D) E[X]	(IV) 15/22

Choose the correct answer from the options given below:

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

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

Q.21 The value of $3^{18} \pmod 4$ is equal to

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

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

Q.22

Match **List-I** with **List-II**

List-I	**List-II**
(Function)	**(Derivative with respect to 'x')**
(A) $f(x) = x^x$	(I) $a\,x^{a-1}$
(B) $f(x) = a^x$	(II) 0
(C) $f(x) = a^a$	(III) $a^x \log_e a$
(D) $f(x) = x^a$	(IV) $x^x(1 + \log_e x)$

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

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

Match List-I with List-II

List-I **List-II**

(Function) **(Derivative with respect to 'x')**

(A) $f(x) = x^x$ \[\text{(I) } a x^{a-1}

(B) $f(x) = a^x$ (II) 0

(C) $f(x) = a^a$ (III) $a^x \log_e a$

(D) $f(x) = x^a$ (IV) $x^x(1 + \log_e x)$

Choose the correct answer from the options given below:

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

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

Q.23 **Mr. 'X' wishes to purchase a house for ₹ 49,65,000 with a down payment of ₹ 15,00,000 and balance amount in EMI for 25 years. If bank charges 6\% per annum compounded monthly. Then the EMI is: [Given that $(1.005)^{300} = 4.4650$]**

1. ₹ 24375
2. ₹ 20275
3. ₹ 25750
4. ₹ 22325

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

Q.24

If three balls are drawn one by one without replacement from a bag containing 5 white and 4 red balls, then the probability distribution of the number of white balls drawn is

1.

X	0	1	2	3
P(X)	30/91	45/91	15/91	1/91

2.

X	0	1	2	3
P(X)	1/21	5/14	10/21	5/42

3.

X	0	1	2	3
P(X)	1/8	3/8	3/8	1/8

4.

X	0	1	2	3
P(X)	12/19	16/35	16/35	3/95

\[\text{If three balls are drawn one by one without replacement from a bag containing 5 white and 4 red balls, then the probability distribution of the number of white balls drawn is}\]

1

X 0 1 2 3

P(X) 30/91 45/91 15/91 1/91

2

X 0 1 2 3

P(X) 1/21 5/14 10/21 5/42

3

X 0 1 2 3

P(X) 1/8 3/8 3/8 1/8

4

X 0 1 2 3

P(X) 12/19 16/35 16/35 3/95

Options 1. 1

2. 2

3. 3

4. 4

Q.25 Consider the following hypothesis test:

$H_0 : \mu \leq 12$

$H_a : \mu > 12$

A sample of 25 provided a sample mean $\bar{x} = 14$ and a sample standard deviation $S = 4.32$. If $t_{0.05} = 1.711$, then which of the following is correct?

(A) The test statistic is defined as $t = \frac{\bar{x} - \mu}{S/\sqrt{n}}$.

(B) The value of the test statistic is 1.31.

(C) At $\alpha = 0.05$, the null hypothesis is rejected.

(D) If the value of the t-statistic is less than t_α, then null hypothesis is accepted.

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. (A) and (D) only

Options 1. 1

2. 2

3. 3

4. 4

Q.26 The value of the integral $I = \int_0^1 \frac{1}{\sqrt{1+3\sqrt{x}}}\, dx$ is:

1. 16/27
2. 8/3
3. 2/9

4. 8/9

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

Q.27 In what ratio, water must be added to dilute honey costing ₹ 320 per liter so that the resulted syrup would be worth ₹ 280 per liter?

1. 1:5
2. 3:5
3. 1:7
4. 2:9

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

Q.28 Which of the following is correct about the compound annual growth rate?

1. It is an average annualized return of an investment.
2. It is calculated by taking the arithmetic mean of series of returns.
3. It is a linear measure that does not account for the effects of compounding.
4. It smoothens out the volatile nature of year by year growth/decay rates and provides more accurate results.

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

Q.29

In the month of January, the number of cases diagnosed of influenza epidemic are given in the following table

Date	1	2	3	4	5	6	7
Number of cases	2	0	5	12	20	27	46

The 3-day moving averages are :

1. 2.3, 5.6, 19.6, 12.6, 31.3
2. 2, 5.6, 12.3, 19.6, 21.6
3. 2.3, 5.3, 12.3, 19.6, 31.6
4. 2.3, 5.6, 12.3, 19.6, 31

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

Q.30 For the linear programming problem (LPP),

Maximize $Z = 4x + y$

Subject to:

$x + y \leq 5$

$3x + y \leq 9$

$x, y \geq 0$

Which of the following are \textbf{NOT} true?

(A) The given LPP has unbounded feasible region.
(B) The corner points of the feasible region are (0, 0), (0, 5), (3, 2) and (3, 0).
(C) The optimal value of the objective function is 12.
(D) The given LPP has a unique optimal solution.

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

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

Options 1. 1
2. 2

3. 3
4. 4

Q.31

If a, b and c are positive real numbers, then

Match **List-I** with **List-II**

List-I	List-II
(Expression)	**(The Least value of the expression)**
(A) $(a+b)(b+c)(c+a)$	(I) $8abc$
(B) $(a+b+c)(ab+bc+ca)$	(II) $9a^2b^2c^2$
(C) $(a^2b+b^2c+c^2a)(ab^2+bc^2+ca^2)$	(III) $9abc$
(D) $(a+b)^2(b+c)^2(c+a)^2$	(IV) $64a^2b^2c^2$

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

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

If a, b and c are positive real numbers, then
Match List-I with List-II

List I
(Expression)
(A) $(a+b)(b+c)(c+a)$
[\text{(B) } (a+b+c)(ab+bc+ca)\]
(C) $(a^2+b^2+c^2)(ab^2+bc^2+ca^2)$
(D) $(a+b)^2(b+c)^2(c+a)^2$

List II
(The Least value of the expression)
(I) 8abc
(II) $9a^2b^2c^2$
(III) 9abc
(IV) $64a^2b^2c^2$

Choose the correct answer from the options given below:
1. (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
2. (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
3. (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
4. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

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

Q.32

The matrix $\begin{bmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{bmatrix}$ is a

(A) Null matrix
(B) Unit matrix
(C) Symmetric matrix
(D) Skew-symmetric matrix

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

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

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

Q.33

If $y = 38.85 + 7.64(x - 2020)$ is the equation of the straight line trend for the following data:

Year (x)	2017	2018	2019	2020	2021	2022	2023
Profit (Rs. '000) (y)	14	30	26	44	38	56	64

The trend value for the year 2021 by least square method is :

1. 45.6
2. 46.49
3. 38.9
4. 42.6

If $y = 38.85 + 7.64(x - 2020)$ is the equation of the straight line trend for the following data:

Year(x)	2017	2018	2019	2020	2021	2022	2023
Profit(Rs. '000) (y)	14	30	26	44	38	56	64

The trend value for the year 2021 by least square method is :

1. 45.
2. 46.49
3. 38.9
4. 42.6

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

Q.34

If $A = [a_{ij}]_{2\times 2}$ where $a_{ij} = \begin{cases} 1, & i \neq j \\ 0, & i = j \end{cases}$ and I is the identity matrix of order 2, then $(A^2 - 3A + 4I)$ is:

(A) Symmetric Matrix
(B) Skew-symmetric Matrix
(C) Non-singular Matrix
(D) Square Matrix

Choose the correct answer from the options given below:

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

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

Q.35

If $y = \sqrt{2024x + 2025}$, then which of the following is correct?

1. $y\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = 0$
2. $y\frac{d^2y}{dx^2} - 2\left(\frac{dy}{dx}\right)^2 = 0$
3. $y\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 = 0$
4. $y\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = 0$

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

Q.36

If a person rides his motorbike x km at 30 km per hour, he has to spend ₹ 3 per kilometer on petrol; if he rides y km at a faster speed of 40 km per hour, the petrol cost increases to ₹ 4 per kilometer. If he has ₹ 100 to spend on petrol and wishes to find the maximum distance he can travel within one hour, then linear programming problem (LPP) formulation is:

1. Maximize Distance(D) $= x + y$ subject to the constraints $3x + 4y \leq 120,\ 4x + 3y \geq 100,\ x \geq 0, y \geq 0.$

2. Maximize Distance(D) $= x + y$ subject to the constraints $3x + 4y \leq 70,\ 4x + 3y \leq 1,\ x \geq 0, y \geq 0$.
3. Maximize Distance(D) $= x + y$ subject to the constraints $3x + 4y \leq 100,\ 4x + 3y \leq 120,\ x \geq 0, y \geq 0$.
4. Maximize Distance(D) $= x + y$ subject to the constraints $3x + 4y \leq 100,\ 4x + 3y \leq 120,\ x \leq 0, y \leq 0$.

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

Q.37 If the price of a machinery costing ₹ 25000 is expected to have a useful life of 4 years and a scrap value of ₹ 5000.

Then the annual depreciation by linear method is:

1. ₹ 10000
2. ₹ 6500
3. ₹ 5000
4. ₹ 4000

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

Q.38 Three pipes A, B and C are installed to fill a tank. Pipes A and B opened together can fill the tank in the same time in

which C can alone fill the tank. If pipe B can fill the tank 15 minutes faster than pipe A and 5 minutes slower than pipe

C, then the time required by pipe A to fill the tank alone is

1. 20 minutes
2. 30 minutes
3. 24 minutes
4. 36 minutes

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

Q.39 A person invested ₹ 20000 in a mutual fund in year 2018. The value of the mutual fund increased to ₹ 32000 in year

2023. The compound annual growth rate of his investment is:

[Given that $(1.6)^{\frac{1}{5}} = 1.098$]

1. 9.8\%
2. 8.7\%
3. 10 \%
4. 7.8 \%

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

Q.40 Which of the following is correct about the Sinking Fund?

1. It is a long-term account which can be closed any time.
2. It is set-up for a particular upcoming expense.
3. Any amount can be deposited in the sinking fund at any point of time.
4. It can be used in any emergency.

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

Q.41 If the total cost and total revenue of a company that produces and sells x units of a particular product are

$C(x) = 5x + 350$ and $R(x) = 50x - x^2$ respectively, then which of the following is/are the breakeven values:

(A) $x = 10$

(B) $x = 25$

(C) $x = 45$

(D) $x = 30$

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

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

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

Q.42 In which of the following, the time series may show the gradual shifts to relatively higher or lower values over a long period of time?

1. Cyclical component
2. Irregular component
3. Seasonal component
4. Trend component

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

Q.43 Which of the following is NOT correct?

1. If matrix B is the inverse of matrix A, then A is the inverse of B.
2. A rectangular matrix of order $m \times n, m \neq n$ does not possess an inverse.
3. If A and B are symmetric matrices of the same order, then (AB-BA) is a skew-symmetric matrix.
4. If a square matrix is invertible, then it may have more than one inverse.

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

Q.44 The particular solution of the differential equation $e^x\sqrt{1-y^2}dx + \frac{y}{x}dy = 0,$ given that $y = 1,$ when $x = 0,$ is:

1. $\sqrt{1-y^2} = (x-1)e^x + 1$
2. $\sqrt{1-y^2} = (x+1)e^x - 1$
3. $\sqrt{y-y^2} = (x+1)e^x - 1$
4. $\sqrt{y} = (x-1)e^x - 1$

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

Q.45 Which of the following statements are correct?

(A) The method of least squares determines the position of the trend line of the given time series.

(B) The trend line is called the line of best fit.

(C) The line of best fit is a line in which the sum of deviations of the actual values of the variable from their corresponding trend value is always positive.

(D) The normal equations of the trend line $y = a + bx$ are $\sum y = na + b\sum x$ and $\sum xy = a\sum x + b\sum x^2$, where n is the numbers of observations.

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

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

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

Q.46 In a game of 100 points, A can give 20 points to B and 28 points to C. How many points can B give C?

1. 10 points
2. 20 points
3. 28 points
4. 8 points

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

Q.47 A swimmer whose speed in still water is 6 km/hr, swims between two points in a river and returns to the starting point.

He took 20 minutes more to cover the distance upstream than downstream. If the speed of the stream is 3 km/hr, then

the distance between the two points is:

1. 1 km
2. 2.5 km
3. 6.5 km
4. 1.5 km

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

Q.48 In which of the following interval the function $f(x) = x^x, x > 0$ is strictly increasing?

1. $[e, \infty)$
2. $(\frac{1}{e}, \infty)$
3. $[1, \infty)$
4. $[0, \infty)$

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

Q.49 If $A = [a_{ij}]_{3\times3}$, where $a_{ij} = \begin{matrix}(-1)^{i+j} - 1, & i = j \\ (-1)^{i+j}, & i \neq j\end{matrix}$ then the value of $A + A^T$ is:

1. $A + I$, where I is the identity matrix of order 3.
2. $A - I$, where I is the identity matrix of order 3.
3. $2A$
4. $3A$

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

Q.50 If the probability of two successes is 9 times the probability of 3 successes in 3 trials of a binomial distribution, then the probability of success in each trial is:

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

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

Section : Core Mathematics

Q.51 If θ is an acute angle and the vector $\vec{a} = (\sin\theta)\hat{i} + (\cos\theta)\hat{j}$ is perpendicular to the vector $\vec{b} = \hat{i} - \sqrt{3}\hat{j}$ then θ is equal to

1. $\frac{\pi}{6}$
2. $\frac{\pi}{3}$
3. $\frac{\pi}{4}$
4. $\frac{\pi}{2}$

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

Q.52 If A and B are matrices of same order, then $(AB^T - BA^T)$ is always

1. a symmetric matrix
2. a skew symmetric matrix
3. neither a symmetric matrix nor a skew-symmetric matrix
4. a null matrix

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

Q.53 Let $A = \begin{bmatrix} 1 & \sin\theta & 1 \\ -\sin\theta & 1 & \sin\theta \\ -1 & -\sin\theta & 1 \end{bmatrix}$, where $0 \le \theta \le 2\pi$, then which of the following are true?

(A) $|A| = 2 + 2\sin^2\theta$
(B) $|A| = 2 + \sin^2\theta$
(C) minimum value of $|A|$ is 1
(D) maximum value of $|A|$ is 4

Choose the correct answer from the options given below:

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

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

Q.54 The vector equation of the line passing through points $A(3, 4, -7)$ and $B(1, -1, 6)$ is

1. $\vec{x} = 3\hat{i} + 4\hat{j} - 7\hat{k} + \lambda(\hat{i} - \hat{j} + 6\hat{k})$
2. $\vec{x} = (3 - 2\lambda)\hat{i} + (4 - 5\lambda)\hat{j} + (-7 + 13\lambda)\hat{k}$
3. $\vec{x} = \hat{i} - \hat{j} + 6\hat{k} + \lambda(3\hat{i} + 4\hat{j} - 7\hat{k})$
4. $\vec{x} = (-2 + 3\lambda)\hat{i} + (-5 + 4\lambda)\hat{j} + (13 - 7\lambda)\hat{k}$

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

Q.55

List-I	List-II
Differential equation	**Integrating factor**
(A) $x\frac{dy}{dx} - y = 2x^2$	(I) e^{-y}
(B) $\frac{dy}{dx} + \frac{y}{x} = 2x$	(II) $\frac{1}{x}$
(C) $x\frac{dy}{dx} + 2y = x^2\log x$	(III) x

$(D)\frac{dx}{dy}-x=y$ (IV) x^2

Choose the \textbf{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.56 A die is thrown three times. If the first throw is a five, the probability of getting 14 as the sum is

1. $\frac{1}{9}$
2. $\frac{1}{18}$
3. $\frac{1}{36}$
4. $\frac{1}{54}$

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

Q.57 In which of the following intervals, the function $f(x)=-x^2-2x+15$ is decreasing ?

1.$(-1,\infty)$
2.$(-\infty,-1)$
3.$(-\infty,2)$
4.$(0,-1)$

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

Q.58 $\int \sin x \sin 2x \sin 3x\,dx$ is equal to

1. $-\frac{1}{48}(6\cos 2x+3\cos 4x+2\cos 6x)+C$, Where C is constant of integration
2. $-\frac{1}{48}(2\cos 2x+3\cos 4x-6\cos 6x)+C$, Where C is constant of integration
3. $-\frac{1}{48}(6\cos 2x+3\cos 4x-2\cos 6x)+C$, Where C is constant of integration
4. $-\frac{1}{48}(2\cos 2x+3\cos 4x+6\cos 6x)+C$, Where C is constant of integration

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

Q.59 Match List-I with List-II

List-I Function	List-II Property
(A) $f(x)=\begin{cases}\frac{x}{\lvert x\rvert} & : x\neq 0\\ 0 & : x=0\end{cases}$	(I) continuous but not differentiable at $x=0$
(B) $f(x)=\lvert x\rvert$	(II) continuous but not differentiable at $x=1$
(C) $f(x)=\lvert x^2-1\rvert$	(III) discontinuous at $x=0$
(D) $f(x)=\lvert x-1\rvert$	(IV) continuous but not differentiable at $x=1,-1$

Choose the correct answer from the options given below:
1. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
2. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)
3. (A) - (III), (B) - (I), (C) - (II), (D) - (IV)
4. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

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

Q.60 Let E and F are events associated with an experiment. If $P(E) = 0.4, P(F) = 0.8$ and $P(F|E) = 0.6$ then $P(E|F)$ is

1. 0.4
2. 0.2
3. 0.3
4. 0.5

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

Q.61 Let A and B are square matrices of order 3 such that $A + B = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$. If A is a symmetric matrix, then the value of $|B|$ is

1. 0
2. 1
3. 3
4. 27

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

Q.62 One person speaks truth in 60% of the cases and another person in 80% of the cases. They are likely to agree in stating the same fact in

1. 48% of the cases
2. 56% of the cases
3. 58% of the cases
4. 70% of the cases

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

Q.63 If $\vec{a}, \vec{b}, \vec{c}$ are three mutually perpendicular unit vectors, then $|\vec{a} + \vec{b} + \vec{c}|$ is equal to

1. 3
2. 9
3. $\sqrt{3}$
4. 0

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

Q.64 The projection of the vector $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ on the vector $2\hat{i} + 6\hat{j} + 3\hat{k}$ is

1. $\frac{5}{\sqrt{14}}$
2. $\frac{5}{7}$
3. 0
4. $\frac{5}{14}$

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

Q.65 If matrices $A = [1 \quad 2 \quad 3]$ and $B = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$, then BA is equal to

1. [14]
2. [1 4 9]
3. $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{bmatrix}$

4. $\begin{bmatrix}1\\4\\9\end{bmatrix}$

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

Q.66 Consider the function $f(x) = x^3 - 3x$. Then
Match List-I with List-II

List-I	List-II
(A) Point of local Maxima	(I) 1
(B) Point of local Minima	(II) -1
(C) Local maximum value	(III) 2
\[(D) Local minimum value	(IV) -2

Choose the correct answer from the options given below:
1. (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
2. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
3. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
4. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

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

Q.67 If $y = 3^x + e^x + x^x + x^3$, then the value of $\frac{dy}{dx}$ at $x = 3$ is
1. $e^3 + 27\log_e 3 + 27$
2. $e^3 + 54\log_e 3 + 54$
3. $e^3 + 54\log_e 3 + 27$
4. $e^3 + 27\log_e 3 + 54$

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

Q.68 The feasible region associated with the inequality $2x + 3y > 4$ is
1. Open half plane containing the origin
2. Open half plane not containing the origin
3. Closed half plane containing the origin
4. Closed half plane not containing the origin

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

Q.69 The area (in sq. units) of the region enclosed by the ellipse $16x^2 + 25y^2 = 400$ is
1. 400π
2. 200π
3. 40π
4. 20π

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

Q.70 Consider two lines l_1 and l_2 with cartesian equations $\frac{x}{2} = \frac{1-y}{-2} = \frac{z}{1}$ and $\frac{2x-5}{16} = \frac{y-2}{-1} = \frac{z-5}{4}$ respectively. Which of the following is/are true?
(A) Direction ratio of l_1 are $2, 2, 1$
(B) Direction cosines of l_1 are $\frac{2}{3}, \frac{-2}{3}, \frac{1}{3}$
(C) Direction ratio of l_2 are $16, -1, 4$
(D) Angle between l_1 and l_2 is $\cos^{-1}\left(\frac{38}{3\sqrt{273}}\right)$
Choose the correct answer from the options given below:
1. (B), (C) and (D) only

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

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

Q.71 The function $f(x) = [x]$, where $[x]$ denotes the greatest integer function, is continuous at $x =$
(A) 2.9
(B) 5
(C) -3
(D) 6.5
Choose the correct answer from the options given below:
1. (A), (B) and (C) only
2. (B), (C) and (D) only
3. (A) and (D) only
4. (C) and (D) only

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

Q.72 Consider the LPP: Maximize $Z = x + y$ subject to the constraints $x + 2y \leq 70, 2x + y \leq 95, x, y \geq 0$. The optimal feasible solution is
1. $(20, 35)$
2. $(35, 20)$
3. $(30, 25)$
4. $(40, 15)$

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

Q.73 The value of $\tan^{-1}(1) + \cos^{-1}\left(-\frac{\sqrt{3}}{2}\right) + \sin^{-1}\left(\frac{1}{2}\right)$ is
1. $\frac{5\pi}{4}$
2. $\frac{\pi}{4}$
3. $\frac{5\pi}{12}$
4. $\frac{7\pi}{12}$

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

Q.74 The general solution of the differential equation $y\,dx - (x + 2y^2)\,dy = 0$ is
1. $\frac{x}{y} = 2x + C$, Where C is constant of integration
2. $y = 2x^2 + C$, Where C is constant of integration
3. $\frac{y}{x} = 2y + C$, Where C is constant of integration
4. $x = 2y^2 + Cy$, Where C is constant of integration

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

Q.75 Match List-I with List-II

List-I	List-II
(A) Angle between $\hat{i} - \hat{j}$ and $\hat{j} + \hat{k}$	(I) 0
(B) Angle between $2\hat{j} - \hat{k}$ and $\hat{j} + 2\hat{k}$	(II) $\frac{2\pi}{3}$
(C) Angle between $\hat{i} + 2\hat{j}$ and $5\hat{i} + 10\hat{j}$	(III) $\frac{\pi}{6}$

(D) Angle between $\sqrt{3}\hat{i}+\hat{j}$ and $\hat{i}$ (IV) $\frac{\pi}{2}$

Choose the correct answer from the options given below:

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

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

Q.76 Let $A=\{a,b,c\}$. Then number of relations containing (a,b) and (b,c) which are reflexive and transitive but not symmetric is

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

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

Q.77 If a line makes angles α,β,γ with the positive directions of x-axis, y-axis, z-axis respectively, then the value of $\cos 2\alpha+\cos 2\beta+\cos 2\gamma$ is equal to

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

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

Q.78 Which of the following statements are correct?

(A) If E and F are independent events then $P(E\cap F)=P(E)P(F)$

(B) If E and F are mutually exclusive events, then $P(E\cup F)=P(E)+P(F)-P(E)P(F)$

(C) The conditional probability of an event E, given the occurrence of the event F is given by $\frac{P(E\cap F)}{P(F)}, P(F)\neq 0$

(D) If E and F be the events associated with the sample space S of an experiment, then $P(\bar{E}|F)=2-P(E|F)$

Choose the correct answer from the options given below:

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

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

Q.79 For the function $f(x)=\sin x+\cos x, x\in[0,\pi]$, which one of the following is correct?

1. Point of absolute maxima is π
2. Absolute maximum value is $\sqrt{2}$
3. Absolute minimum value is 0
4. Point of absolute maxima is 0

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

Q.80 $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}}\frac{dx}{1+\sqrt{\tan x}}$ is equal to

1. $\frac{\pi}{4}$
2. $\frac{\pi}{2}$
3. $\frac{\pi}{6}$
4. $\frac{\pi}{12}$

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

Q.81 $\int \frac{dx}{9x^2-16}$ is equal to

1. $\frac{1}{24}\log_e\left|\frac{3x+4}{3x-4}\right|+C$, Where C is constant of integration
2. $\frac{3}{8}\log_e\left|\frac{3x+4}{3x-4}\right|+C$, Where C is constant of integration
3. $\frac{3}{8}\log_e\left|\frac{3x-4}{3x+4}\right|+C$, Where C is constant of integration
4. $\frac{1}{24}\log_e\left|\frac{3x-4}{3x+4}\right|+C$, Where C is constant of integration

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

Q.82 If the points $(2,-3),(\lambda,-1)$ and $(0,4)$ are collinear, then the value of λ is

1. $\frac{6}{7}$
2. $-\frac{6}{7}$
3. $-\frac{10}{7}$
4. $\frac{10}{7}$

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

Q.83 Match List-I with List-II

List-I	List-II
Type of matrix	Conditions
(A) Square matrix A	(I) $A=[a_{ij}]_{m\times m}$, where $\begin{cases}a_{ij}=0 & ,i\neq j\\ a_{ij}=k & ,i=j\end{cases}$ where $k\neq 0$ is constant.
(B) Scalar Matrix A	(II) $A=[a_{ij}]_{m\times m}$
(C) Diagonal matrix A	(III) $A=[a_{ij}]_{m\times m}$, where $\begin{cases}a_{ij}=0 & ,i\neq j\\ a_{ij}=1 & ,i=j\end{cases}$
\[(D) Identity matrix A	(IV) $A=[a_{ij}]_{m\times m}$, where $a_{ij}=0, i\neq j$

Choose the correct answer from the options given below:

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

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

Q.84 The area (in sq. units) of the region bounded by the line $y=x+2, x=0, x=1$ and $y=0$ is

1. 9
2. $\frac{5}{2}$
3. 18
4. $\frac{9}{2}$

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

Q.85 Let $f : \mathbb{R} \to \mathbb{R}$ be a function defined as $f(x) = x^4$. Which one of the following is true?

1. f is one-one and onto
2. f is one-one but not onto.
3. f is onto but not one-one.
4. f is neither one-one nor onto.

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