DOON PUBLIC SCHOOL, PASCHIM VIHAR, NEW DELHI

Examination: Pre Boards-1 [2025-26]

Subject: Mathematics (Set-2)

Class: 12th

Duration: 3 Hours **Date: 26 /11/2025** **Max Marks: 80**

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) This question paper contains 38 questions. All questions are compulsory.

(ii) This question paper is divided into five Sections A, B, C, D and E.

(iii) In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each.

(iv) In Section B, Questions no. 21 to 25 are very short answer (VSA) type questions, carrying 2 marks each.

(v) In Section C, Questions no. 26 to 31 are short answer (SA) type questions, carrying 3 marks each.

(vi) In Section D, Questions no. 32 to 35 are long answer (LA) type questions carrying 5 marks each.

(vii) In Section E, Questions no. 36 to 38 are Case Study based questions carrying 4 marks each.

(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and 2 questions in Section E.

(ix) Use of calculators is not allowed.

SECTION-A

This section comprises multiple choice questions (MCQs) of 1 mark each.

Q1: If $\begin{bmatrix} 3 & 2 \\ 1 & x \end{bmatrix}\begin{bmatrix} x \\ 1 \end{bmatrix} = \begin{bmatrix} 14 \\ 8 \end{bmatrix}$, then x is

(a) 4 (b) -4 (d) -3 (d) 16/3

Q2: If A is a square matrix of order 3 and |A| = 6, then the value of |adj A| is :

(a) 36 (b) 6 (c) 27 (d) 216

Q3: The value of $\int_0^{\frac{\pi}{6}} sin3xdx$ is

(a) $\sqrt{3}/2$ (b) $1/3$ (c) $-\sqrt{3}/2$ (d) -1/3

Q4: If $\vec{a}$, $\vec{b}$ and $\vec{a}+\vec{b}$ are all unit vectors and θ is the angle between $\vec{a}$ and $\vec{b}$, then the value of θ is :

(a) π/3 (b) π/6 (c) 2π/3 (d) 5π/6

Q5: $\int \frac{cos2x}{sin^2xcos^2x}dx$ is equal to

(a) $-tanx - cotx + c$ (b) $tanx - cotx + c$ (c) $-tanx + cotx + c$ (d) $tanx + cotx + c$

Q6: The point which lies in the half plane $2x + y \leq 4$ is

(a) (0,8) (b) (1,1) (c) (5,5) (d) (2,2)

Q7: Let P and Q be two points with position vectors $\vec{a} - 2\vec{b}$ and $2\vec{a} + \vec{b}$ respectively. The position vector of a point which divides the join of P and Q externally in the ratio 3 : 2 is:

(a) $4\vec{a} - 7\vec{b}$ (b) $4\vec{a} + 7\vec{b}$ (c) $\vec{a} + 4\vec{b}$ (d) $\frac{8\vec{a}+7\vec{b}}{5}$

Q8: The difference of the order and the degree of the differential equation: $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^3 + x^4 = 0$ is :

(a) 1 (b) 2 (c) -1 (d) 0

Q9: Derivative of $\tan^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)$ respect to $\sin^{-1}\left(2x\sqrt{1-x^2}\right)$ is

(a) -1/2 (b) 2 (c) 1/2 (d) -1/4

Q10: It Is given that X$\begin{bmatrix} 3 & 2 \\ 1 & -1 \end{bmatrix} = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$, then matrix X is

(a) $\begin{bmatrix} 0 & -1 \\ 1 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

Q11: The value of the cofactor of the element of second row and third column of the matrix $\begin{bmatrix} 4 & 3 & 2 \\ 2 & -1 & 0 \\ 1 & 2 & 3 \end{bmatrix}$ is

(a) -5 (b) 5 (c) -11 (d) 11

Q12: Solution of differential equation $(1 + y^2)(1 + logx)dx + xdy = 0$ is

(a) $\tan^{-1} y + log|x| + \frac{(log|x|)^2}{2} = c$

(b) $\tan^{-1} y - log|x| + \frac{(log|x|)^2}{2} = c$

(c) $\tan^{-1} y - log|x| - \frac{(log|x|)^2}{2} = c$

(d) $\tan^{-1} y + log|x| \frac{(log|x|)^2}{2} = c$

Q13: Sum of magnitude of a unit vector and a zero vector is

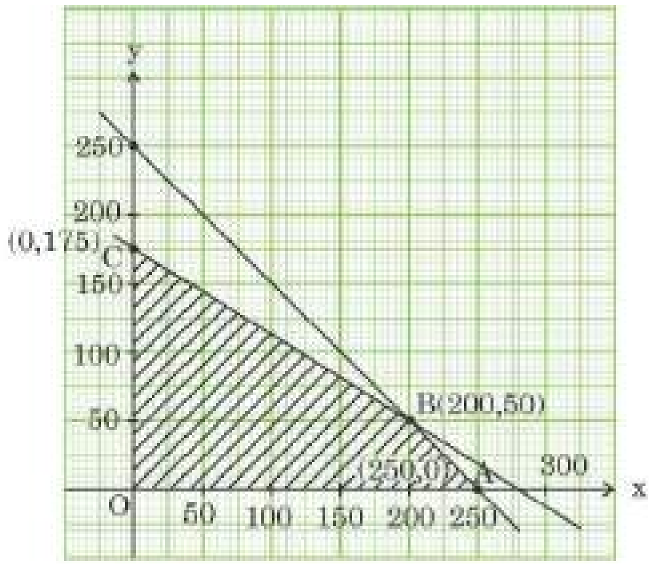
(a) -1 (b) 0 (c) 1 (d) none of these

Q14: If $x = acos\theta + bsin\theta$ and $y = asin\theta - bcos\theta$, then which of the following is correct?

(a) $ydy + xdx = 0$

(b) $xdy + ydx = 0$
(c) $ydy - xdx = 0$
(d) $xdy - ydx = 0$

Q15: The corner points of the bounded feasible region of an LPP are O(0, 0), A(250, 0), B(200, 50) and C(0, 175). If the maximum value of the objective function Z = 2ax + by occurs at the points A(250, 0) and B(200, 50), then the relation between a and b is :



(a) 2a = b (b) 2a = 3b (c) a = b (d) a = 2b

Q16: A family has 2 children and the elder child is a girl. The probability that both children are girls is :

(a) 1/8 (b) 1/4 (c) 3/4 (d) 1/2

Q17: If matrix A = $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ and $A^2 = kA$, then value of k is

(a) -1 (b) 2 (c) -2 (d) 1

Q18: The vector equation of a line which passes through the point (1, -2, 3) and is parallel to the vector $3\hat{i} - 2\hat{j} + 4\hat{k}$ is:

(a) $\vec{r} = (-\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(3\hat{i} - 2\hat{j} + 4\hat{k})$
(b) $\vec{r} = (-3\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(\hat{i} - 2\hat{j} + 3\hat{k})$
(c) $\vec{r} = (\hat{i} - 2\hat{j} + 3\hat{k}) + \lambda(3\hat{i} - 2\hat{j} + 4\hat{k})$
(d) $\vec{r} = (3\hat{i} - 2\hat{j} + 4\hat{k}) + \lambda(\hat{i} - 2\hat{j} + 3\hat{k})$

Questions number **19** and **20** are **Assertion and Reason** based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of the Assertion(A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

Q19: Assertion (A) : Given two independent events A and B such that P(A) = 0·3 and P(B) = 0·6, then P(Not A and B) = 0·42
Reason (R) : For two independent events A and B, P(A and B) = P(A).P(B)

Q20: Assertion (A): The Principal value of $\cot^{-1}(\sqrt{3})$ is 5π/6.
Reason (R): Domain of $\cot^{-1} x$ is $\mathbb{R} - \{-1,1\}$.

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SECTION-B

This section comprises very short answer (VSA) type questions of 2 marks each.

Q21: Simplify: $\tan^{-1}\left(\frac{sinx}{1-cosx}\right) - \tan^{-1}\left(\frac{cosx}{1+sinx}\right)$

OR

Prove that the modulus function is neither one-one nor onto.

Q22: For the vectors $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} + 3\hat{j} - 5\hat{k}$, verify that angle between $\vec{a}$ and $\vec{a} \times \vec{b}$ is π/2

Q23: Find the interval in which the function $x^4 - 4x^3 + 4x^2 + 15$ is strictly decreasing.

Q24: Function f is defined as $f(x) = \begin{cases} 2x+2 & if\ x < 2 \\ k & if\ x = 2 \\ 3x & if\ x > 2 \end{cases}$. Find the value of k for which the function is continuous at x = 2.

Q25: If $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$ and magnitudes of $\vec{a}, \vec{b}$ and $\vec{c}$ are 3, 7 and 5 respectively, then find angle between $\vec{b}$ and $\vec{c}$.

OR

Express the vector $\vec{a} = 2\hat{i} - 5\hat{j} + 2\hat{k}$ as the sum of two vectors such that one is parallel to the vector $\vec{b} = \hat{i} + 3\hat{k}$ and the other is perpendicular to $\vec{b}$.

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SECTION-C

This section comprises short answer (SA) type questions of 3 marks each.

Q26: Find the particular solution of the differential equation: $\frac{dy}{dx} = \frac{x^2+y^2}{2xy}$: given that y = 1 when x = 2.

OR

Find the particular solution of the differential equation: $xlogx\frac{dy}{dx} + y = \frac{2}{x}logx$: given that y = 1, when x = 2.

Q27: Evaluate: $\int_0^{\frac{\pi}{2}} \frac{xsinxcosx}{sin^4x+cos^4x}dx$

OR

Evaluate: $\int_0^4 |x-2| + |x-3|\,dx$

Q28: Solve the following Linear Programming Problem graphically:

Minimise z = 3x + 8y

subject to the constraints: $3x + 4y \geq 8, 5x + 2y \geq 11, x \geq 0, y \geq 0.$

Q29: If A and B are two independent events, then the probability of occurrence of at least one of A and B is given by 1– P(A')P(B').

OR

Given three identical boxes I, II and III, each containing two coins. In box I, both coins are gold coins, in box II, both are silver coins and in the box III, there is one gold and one silver coin. A person chooses a box at random and takes out a coin. If the coin is of gold, what is the probability that the other coin in the box is also of gold?

Q30: Find: $\int \frac{1}{(1+tan^2x)\sqrt{5-4tanx-tan^2x}}dx$

Q31: Find: $\int \frac{3dx}{x(4x^4-5)} - \int \frac{x^2}{x^2-1}dx$

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SECTION-D

This section comprises long answer type questions (LA) of 5 marks each.

Q32: Let A = $\begin{bmatrix} 3 & 2 & 1 \\ 4 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix}$, find A^{-1} and hence solve the following system of linear equations:

3x + 2y + z = 2000 , 4x + y + 3z = 2500, x + y + z = 900

Q33: Using integration, find area enclosed by the curve $3(x^2+2) + 2(y^2+3) = 24.$

Q34: Find the vector and cartesian equation of lines AC and BD where A(1, 2, 3), B(3, 1, 2), C(-1 ,4 ,2) and D(2, 4, 2). Also, find angle between them.

OR

Find the Shortest distance between the lines $\frac{x+1}{2} = \frac{y-1}{3} = \frac{z}{4}$ and $\frac{x-1}{1} = \frac{y+2}{5}; z + 2.$

Q35: Show that the relation S in set ℝ of real numbers defined by S = {(a, b) : a ≤ b^3, a∈ ℝ , b∈ ℝ } is neither reflexive, nor symmetric, nor transitive.

OR

Let R be the relation defined in the set A = {1, 2, 3, 4, 5, 6, 7} by
R = {(a, b): both a and b are either odd or even}. Show that R is an equivalence relation. Hence, find the elements of equivalence class [1].

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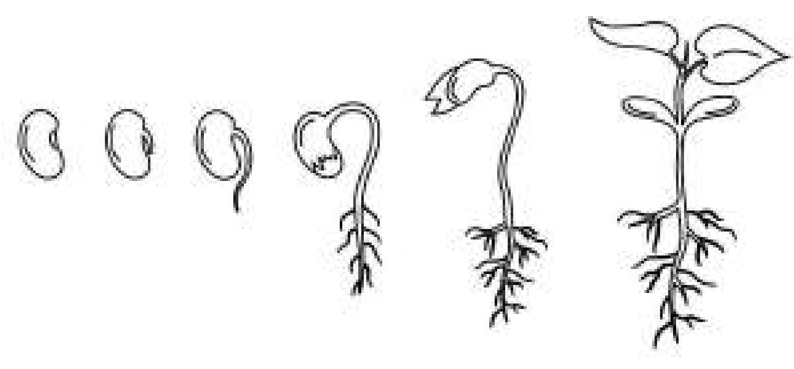
SECTION-E

This section comprises 3 Case Study Based Questions of 4 marks each.

CASE STUDY-1

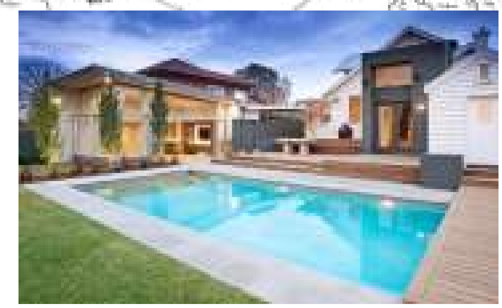
Q36: A shopkeeper sells three types of flower seeds A1, A2 and A3. They are sold as a mixture where the proportions are 4 : 4 : 2 respectively. The germination rates of the three types of seeds are 45%, 60% and 35%. Based on the above information, answer the following questions:



(i) What is the probability of a randomly chosen seed to germinate? (2)
(ii) What is the probability that the randomly selected seed is of type A1, given that it germinates? (2)

CASE STUDY-2

Q37: A housing society wants to commission a swimming pool for its residents. For this, they have to purchase a square piece of land and dig this to such a depth that its capacity is 250 cubic metres. Cost of land is Rs 500 per square metre. The cost of digging increases with the depth and cost for the whole pool is Rs 4000 $(\text{depth})^2$. Suppose the side of the square plot is x metres and depth is h metres.



On the basis of the above information, answer the following questions:

(i) Write cost C(h) as a function in terms of h. (1)

(ii) Find critical point. (1)

(iii) (a) Use second derivative test to find the value of h for which cost of constructing the pool is minimum. What is the minimum cost of construction of the pool? (2)

OR

(iii) (b) Use first derivative test to find the depth of the pool so that cost of construction is minimum. Also, find relation between x and h for minimum cost. (2)

CASE STUDY-3

Q38: As tank shown in the figure below is formed using a combination of cylinder and a cone, offers a better drainage as compared to flat bottomed tank.

A tap is connected to the tank whose conical part is full of water. Water is dripping out from a tap at the bottom at the uniform rate of $2cm^3$/sec. The semi vertical angle of the conical tank is 45^0.

On the basis of given information, answer the following questions:

(a) Find the volume of water in the tank in terms of its radius r. (1)

(b) Find the rate of change of radius at an instant when r is $2\sqrt{2}$cm. (1)

(c) (i) Find the rate at which the wet surface of the conical tank is decreasing at an instant when r is $2\sqrt{2}$cm. (2)

OR

(ii) Find the rate of change of height 'h' at any instant when slant height is 4cm. (2)