

Name \_\_\_\_\_

Section \_\_\_\_\_

Roll No. \_\_\_\_\_

## CRPF PUBLIC SCHOOL, ROHINI, DELHI

## MID-TERM EXAMINATION (2025-26)

## MATHEMATICS (SET- A)

## CLASS - XII

Time Allowed: 3 hrs

Maximum Marks: 80

**General Instructions:**

1. This Question paper contains - **five sections** A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. **Section A** has **18 MCQ's and 02 Assertion Reasoning based questions** of 1 mark each.
3. **Section B** has **5 Very Short Answer (VSA)-type questions** of 2 marks each.
4. **Section C** has **6 Short Answer (SA)-type questions** of 3 marks each.
5. **Section D** has **4 Long Answer (LA)-type questions** of 5 marks each.
6. **Section E** has **3 source based/case based/passage based/integrated units of assessment** (4 marks each) with sub parts.

**SECTION – A (MCQ) 1 Mark Questions**

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| <b>Q1</b> | A function $f : \mathbb{R}_+ \rightarrow \mathbb{R}$ (where $\mathbb{R}_+$ is the set of all non-negative real numbers) defined by $f(x) = 4x + 3$ is :<br>(A) one-one but not onto<br>(B) onto but not one-one<br>(C) both one-one and onto<br>(D) neither one-one nor onto |
| <b>Q2</b> | A relation R defined on set $A = \{x : x \in \mathbb{Z} \text{ and } 0 \leq x \leq 10\}$ as $R = \{(x, y) : x = y\}$ is given to be an equivalence relation. The number of equivalence classes is :<br>(A) 1<br>(B) 2<br>(C) 10<br>(D) 11                                    |
| <b>Q3</b> | If A is an identity matrix of order n, then $A(\text{Adj } A)$ is a/an :<br>(A) identity matrix<br>(B) row matrix<br>(C) zero matrix<br>(D) skew symmetric matrix                                                                                                            |

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| Q4  | <p>If A and B are square matrices both of order 3, such that <math> A  = -3</math> and <math> B  = 2</math>, then <math> 2AB </math> is equal to :</p> <p>(A) 48 (B) -48<br/>(C) -24 (D) -12</p>                                                                                     |
| Q5  | <p>The domain of <math>f(x) = \cos^{-1}(2x)</math> is :</p> <p>(A) <math>[-1, 1]</math> (B) <math>\left[0, \frac{1}{2}\right]</math><br/>(C) <math>[-2, 2]</math> (D) <math>\left[-\frac{1}{2}, \frac{1}{2}\right]</math></p>                                                        |
| Q6  | <p>The principal value of <math>\sin^{-1}\left(\sin\left(-\frac{10\pi}{3}\right)\right)</math> is :</p> <p>(A) <math>-\frac{2\pi}{3}</math> (B) <math>-\frac{\pi}{3}</math><br/>(C) <math>\frac{\pi}{3}</math> (D) <math>\frac{2\pi}{3}</math></p>                                   |
| Q7  | <p>What is the total number of possible matrices of order <math>3 \times 3</math> with each entry as <math>\sqrt{2}</math> or <math>\sqrt{3}</math> ?</p> <p>(A) 9 (B) 512<br/>(C) 615 (D) 64</p>                                                                                    |
| Q8  | <p>Let both <math>AB'</math> and <math>B'A</math> be defined for matrices A and B. If order of A is <math>n \times m</math>, then the order of B is :</p> <p>(A) <math>n \times n</math> (B) <math>n \times m</math><br/>(C) <math>m \times m</math> (D) <math>m \times n</math></p> |
| Q9  | <p>If A and B are square matrices of same order, then <math>(AB^T - BA^T)</math> is a</p> <p>(A) symmetric matrix (B) skew-symmetric matrix<br/>(C) null matrix (D) unit matrix</p>                                                                                                  |
| Q10 | <p>The derivative of <math>\sin^{-1}(2x^2 - 1)</math> with respect to <math>\sin^{-1}x</math> is :</p> <p>(A) <math>\frac{2}{x}</math> (B) 2<br/>(C) <math>\frac{\sqrt{1-x^2}}{\sqrt{1-4x^2}}</math> (D) <math>1-x^2</math></p>                                                      |

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| Q11 | <p>If <math>x = \sin t</math> and <math>y = \cos t</math>, then <math>\frac{d^2y}{dx^2}</math> at <math>t = \frac{\pi}{4}</math> is :</p> <p>(A) <math>-1</math> (B) <math>2</math></p> <p>(C) <math>2\sqrt{2}</math> (D) <math>-2\sqrt{2}</math></p>                                                                                                                                                                                                                                                                                                        |
| Q12 | <p>If <math>f(x) =  x  +  x-1 </math>, then which of the following is correct ?</p> <p>(A) <math>f(x)</math> is both continuous and differentiable, at <math>x = 0</math> and <math>x = 1</math>.</p> <p>(B) <math>f(x)</math> is differentiable but not continuous, at <math>x = 0</math> and <math>x = 1</math>.</p> <p>(C) <math>f(x)</math> is continuous but not differentiable, at <math>x = 0</math> and <math>x = 1</math>.</p> <p>(D) <math>f(x)</math> is neither continuous nor differentiable, at <math>x = 0</math> and <math>x = 1</math>.</p> |
| Q13 | <p>The derivative of <math>\sin(x^2)</math> w.r.t. <math>x</math>, at <math>x = \sqrt{\pi}</math> is :</p> <p>(A) <math>1</math> (B) <math>-1</math></p> <p>(C) <math>-2\sqrt{\pi}</math> (D) <math>2\sqrt{\pi}</math></p>                                                                                                                                                                                                                                                                                                                                   |
| Q14 | <p><math>\int_0^{\pi/2} \frac{\sin x - \cos x}{1 + \sin x \cos x} dx</math> is equal to :</p> <p>(A) <math>\pi</math> (B) Zero (0)</p> <p>(C) <math>\int_0^{\pi/2} \frac{2 \sin x}{1 + \sin x \cos x} dx</math> (D) <math>\frac{\pi^2}{4}</math></p>                                                                                                                                                                                                                                                                                                         |
| Q15 | <p><math>\int \frac{x+5}{(x+6)^2} e^x dx</math> is equal to :</p> <p>(A) <math>\log(x+6) + C</math> (B) <math>e^x + C</math></p> <p>(C) <math>\frac{e^x}{x+6} + C</math> (D) <math>\frac{-1}{(x+6)^2} + C</math></p>                                                                                                                                                                                                                                                                                                                                         |
| Q16 | <p>If <math>\int_0^a \frac{1}{1+4x^2} dx = \frac{\pi}{8}</math>, then the value of 'a' is :</p> <p>(A) <math>\frac{1}{4}</math> (B) <math>\frac{1}{2}</math></p> <p>(C) <math>\frac{1}{8}</math> (D) <math>4</math></p>                                                                                                                                                                                                                                                                                                                                      |

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| Q17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>The maximum value of <math>Z = 3x + 4y</math> subject to the constraints <math>x + y \leq 1</math>, <math>x, y \geq 0</math> is :</p> <p>(A) 3 (B) 4</p> <p>(C) 7 (D) 0</p>                                                                                                                                                                             |
| Q18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Of all the points of the feasible region of an LPP, for maximum or minimum values of objective function, the points lie :</p> <p>(A) inside the feasible region</p> <p>(B) at the boundary line of the feasible region</p> <p>(C) at the corners of the feasible region</p> <p>(D) at the points of intersection of the feasible region with x-axis</p> |
| <p style="text-align: center;"><b>Assertion Reasoning Based Questions</b></p> <p>Given below are two statements: one is labelled as <b>Assertion A</b> and other is labelled as <b>Reason R</b>. In the light of the above statements, choose the <b>most appropriate</b> answer from the options given below</p> <p>(A) Both <b>A</b> and <b>R</b> are correct and <b>R</b> is the correct explanation of <b>A</b></p> <p>(B) Both <b>A</b> and <b>R</b> are correct but <b>R</b> is <b>NOT</b> the correct explanation of <b>A</b></p> <p>(C) <b>A</b> is correct but <b>R</b> is not correct</p> <p>(D) <b>A</b> is not correct but <b>R</b> is correct</p> |                                                                                                                                                                                                                                                                                                                                                            |
| Q19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Consider the function <math>f: \mathbb{R} \rightarrow \mathbb{R}</math>, defined as <math>f(x) = x^3</math>.</p> <p><i>Assertion (A) :</i> <math>f(x)</math> is a one-one function.</p> <p><i>Reason (R) :</i> <math>f(x)</math> is a one-one function, if co-domain = range.</p>                                                                       |
| Q20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p><i>Assertion (A) :</i> <math>f(x) = [x]</math>, <math>x \in \mathbb{R}</math>, the greatest integer function is not differentiable at <math>x = 2</math>.</p> <p><i>Reason (R) :</i> The greatest integer function is not continuous at any integral value.</p>                                                                                         |
| <p style="text-align: center;"><b>SECTION – B (Very Short Answer (VSA)-type questions) 2 Marks Each</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                            |
| Q21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Find value of k if</p> $\sin^{-1} \left[ k \tan \left( 2 \cos^{-1} \frac{\sqrt{3}}{2} \right) \right] = \frac{\pi}{3}.$                                                                                                                                                                                                                                 |
| Q22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>If <math>A = \begin{bmatrix} 2 &amp; -1 \\ -1 &amp; 2 \end{bmatrix}</math> and <math>I</math> is the identity matrix of order 2, then show that <math>A^2 = 4A - 3I</math>.</p>                                                                                                                                                                         |

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| Q23                                                                | <p>(a) Find the value of <math>k</math>, so that <math>f(x) = \begin{cases} \frac{k \cos x}{\pi - 2x}, &amp; \text{if } x \neq \frac{\pi}{2} \\ 3, &amp; \text{if } x = \frac{\pi}{2} \end{cases}</math> is continuous at <math>x = \frac{\pi}{2}</math>.</p> <p style="text-align: center;"><b>OR</b></p> <p>(b) Find <math>\frac{dy}{dx}</math>, if <math>y = \tan^{-1} \left( \frac{1 + \sin x}{\cos x} \right)</math>.</p> |
| Q24                                                                | <p>The radius of a cylinder is increasing at the rate of 3 cm/s, and its height is decreasing at the rate of 5 cm/s. Find the rate of change of its volume, when radius is 4 cm and height is 7 cm.</p> <p style="text-align: center;"><b>OR</b></p> <p>Find the maximum slope of the curve <math>y = -x^3 + 3x^2 + 9x - 30</math>.</p>                                                                                        |
| Q25                                                                | Evaluate: $\int \frac{\sqrt{\cot x}}{\sin x \cos x} dx$                                                                                                                                                                                                                                                                                                                                                                        |
| <b>SECTION – C (Short Answer (SA)-type questions) 3 Marks Each</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Q26                                                                | <p>Evaluate :</p> $\sec^2(\tan^{-1} 3) + \operatorname{cosec}^2(\cot^{-1} 2)$ <p style="text-align: center;"><b>OR</b></p> <p>Show that: <math>\cot^{-1} \left( \frac{\sqrt{1+\sin x} + \sqrt{1-\sin x}}{\sqrt{1+\sin x} - \sqrt{1-\sin x}} \right) = \frac{x}{2}, x \in \left( 0, \frac{\pi}{4} \right)</math></p>                                                                                                            |
| Q27                                                                | Find $\frac{dy}{dx}$ , if $y = x^{\tan x} + \frac{\sqrt{x^2 + 1}}{2}$ .                                                                                                                                                                                                                                                                                                                                                        |
| Q28                                                                | <p>Find the intervals in which the function <math>f</math> given by <math>f(x) = -2x^3 - 9x^2 - 12x + 1</math> is :</p> <p>(i) strictly increasing.</p> <p>(ii) strictly decreasing.</p>                                                                                                                                                                                                                                       |
| Q29                                                                | Find $\int \frac{x^2}{(x^2 + 4)(x^2 + 9)} dx$ .                                                                                                                                                                                                                                                                                                                                                                                |
| Q30                                                                | <p>Evaluate :</p> $\int_{-2}^1  x^3 - x  dx$ <p style="text-align: center;"><b>OR</b></p>                                                                                                                                                                                                                                                                                                                                      |

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|                                                            | <p>Evaluate :</p> $\int_0^{\pi} \frac{x \sin x}{1 + \cos^2 x} dx$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Q31                                                        | <p>Solve the following LPP graphically :</p> <p>Maximize <math>Z = 2x + 3y</math></p> <p>subject to the constraints <math>x + 4y \leq 8</math></p> $2x + 3y \leq 12$ $3x + y \leq 9$ $x \geq 0, y \geq 0.$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| SECTION – D (Long Answer (LA)-type questions) 5 Marks Each |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Q32                                                        | <p>If <math>A = \begin{bmatrix} 3 &amp; 2 &amp; 1 \\ 4 &amp; -1 &amp; 2 \\ 7 &amp; 3 &amp; -3 \end{bmatrix}</math>, find <math>A^{-1}</math>. Using <math>A^{-1}</math>, solve the given system of equations <math>3x + 4y + 7z = 14</math>; <math>2x - y + 3z = 4</math>; <math>x + 2y - 3z = 0</math>.</p> <p style="text-align: center;"><b>OR</b></p> <p>If <math>A = \begin{bmatrix} 2 &amp; 2 &amp; -4 \\ -4 &amp; 2 &amp; -4 \\ 2 &amp; -1 &amp; 5 \end{bmatrix}</math> and <math>B = \begin{bmatrix} 1 &amp; -1 &amp; 0 \\ 2 &amp; 3 &amp; 4 \\ 0 &amp; 1 &amp; 2 \end{bmatrix}</math>, find <math>BA</math> and use this to solve the system of equations :</p> $y + 2z = 8,$ $x - y = -1,$ $2x + 3y + 4z = 20$ |
| Q33                                                        | <p>(a) If <math>x\sqrt{1+y} + y\sqrt{1+x} = 0</math>, <math>-1 &lt; x &lt; 1</math>, <math>x \neq y</math>, then prove that <math>\frac{dy}{dx} = -\frac{1}{(1+x)^2}</math></p> <p>(b) If <math>y = (\tan^{-1} x)^2</math>, show that <math>(x^2 + 1)^2 \frac{d^2 y}{dx^2} + 2x(x^2 + 1) \frac{dy}{dx} = 2</math></p>                                                                                                                                                                                                                                                                                                                                                                                                    |
| Q34                                                        | <p>Find all the points of local maxima and local minima of the function :</p> $f(x) = -\frac{3}{4}x^4 - 8x^3 - \frac{45}{2}x^2 + 105.$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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| Q35                                                    | <p>Find :</p> $\int \frac{(3 \cos x - 2) \sin x}{5 - \sin^2 x - 4 \cos x} dx$ <p style="text-align: center;">OR</p> <p>Evaluate : <math>\int (\sqrt{\tan x} + \sqrt{\cot x}) dx</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>SECTION – E (Case Study questions) 4 Marks Each</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Q36                                                    | <p>A class-room teacher is keen to assess the learning of her students the concept of “relations” taught to them. She writes the following five relations each defined on the set <math>A = \{1, 2, 3\}</math> :</p> <p><math>R_1 = \{(2, 3), (3, 2)\}</math></p> <p><math>R_2 = \{(1, 2), (1, 3), (3, 2)\}</math></p> <p><math>R_3 = \{(1, 2), (2, 1), (1, 1)\}</math></p> <p><math>R_4 = \{(1, 1), (1, 2), (3, 3), (2, 2)\}</math></p> <p><math>R_5 = \{(1, 1), (1, 2), (3, 3), (2, 2), (2, 1), (2, 3), (3, 2)\}</math></p> <p>The students are asked to answer the following questions about the above relations :</p> <p>(i) Identify the relation which is reflexive, transitive but not symmetric.</p> <p>(ii) Identify the relation which is reflexive and symmetric but not transitive.</p> <p>(iii) (a) Identify the relations which are symmetric but neither reflexive nor transitive.</p> <p style="text-align: center;">OR</p> <p>(iii) (b) What pairs should be added to the relation <math>R_2</math> to make it an equivalence relation ?</p> |
| Q37                                                    | <p>A scholarship is a sum of money provided to a student to help him or her pay for education. Some students are granted scholarships based on their academic achievements, while others are rewarded based on their financial needs.</p> <div style="text-align: center;">   </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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|     | <p>Every year a school offers scholarships to girl children and meritorious achievers based on certain criteria. In the session 2022 – 23, the school offered monthly scholarship of ₹ 3,000 each to some girl students and ₹ 4,000 each to meritorious achievers in academics as well as sports.</p> <p>In all, 50 students were given the scholarships and monthly expenditure incurred by the school on scholarships was ₹ 1,80,000.</p> <p>Based on the above information, answer the following questions :</p> <p>(i) Express the given information algebraically using matrices. 1</p> <p>(ii) Check whether the system of matrix equations so obtained is consistent or not. 1</p> <p>(iii) (a) Find the number of scholarships of each kind given by the school, using matrices. 2</p> <p style="text-align: center;"><b>OR</b></p> <p>(iii) (b) Had the amount of scholarship given to each girl child and meritorious student been interchanged, what would be the monthly expenditure incurred by the school ? 2</p> |
| Q38 | <p>A window is in the form of a rectangle surmounted by an equilateral triangle on its length. Let the rectangular part have length and breadth <math>x</math> and <math>y</math> metres respectively.</p> <p>Based on the given information, answer the following questions :</p> <p>(i) If the perimeter of the window is 12 m, find the relation between <math>x</math> and <math>y</math>. 1</p> <p>(ii) Using the expression obtained in (i), write an expression for the area of the window as a function of <math>x</math> only. 1</p> <p>(iii) (a) Find the dimensions of the rectangle that will allow maximum light through the window. (use expression obtained in (ii)) 2</p> <p style="text-align: center;"><b>OR</b></p> <p>(iii) (b) If it is given that the area of the window is <math>50 \text{ m}^2</math>, find an expression for its perimeter in terms of <math>x</math>. 2</p>                                                                                                                           |