Roll No. ☐☐☐☐☐☐☐☐

Q.P. Code 65/1/1

MATHEMATICS

CBSE Class XII Board Examination 2025

Time allowed: 3 hours **Maximum Marks: 80**

General Instructions:

1. The paper has 38 questions in five sections (A to E); every question must be attempted.
2. Section A: Q1–18 are MCQs and Q19–20 are Assertion-Reason questions, 1 mark each.
3. Section B: Q21–25 are very short answer questions of 2 marks each.
4. Section C: Q26–31 are short answer questions of 3 marks each.
5. Section D: Q32–35 are long answer questions of 5 marks each.
6. Section E: Q36–38 are case-study questions of 4 marks each.
7. There is no overall choice; internal choices are given in 2 questions of Section B, 3 of Section C, 2 of Section D and 2 of Section E.
8. Calculators are not allowed.

SECTION A

20 multiple choice questions of 1 mark each (Q19–20 are Assertion-Reason).

1. For the diagonal matrix $A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, which matrix is A^{-1}? **1**

(A) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

(C) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(D) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

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2. Given $\vec{a} = 3\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, which statement is true? **1**

(A) $\vec{a} \parallel \vec{b}$ **(B)** $\vec{a} \perp \vec{b}$

(C) $|\vec{b}| > |\vec{a}|$ **(D)** $|\vec{a}| = |\vec{b}|$

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3. Evaluate $\int_{-1}^{1} \frac{|x|}{x}\, dx$ (with $x \neq 0$). **1**

(A) −1 **(B)** 0

(C) 1 **(D)** 2

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4. Which one of these functions of x and y is NOT homogeneous? **1**

(A) $y^2 - xy$ **(B)** $x - 3y$

(C) $\sin^2 \frac{y}{x} + \frac{y}{x}$ **(D)** $\tan x - \sec y$

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5. Let $f(x) = |x| + |x - 1|$. What can be said about f at x = 0 and at x = 1? **1**

(A) Continuous and differentiable at both points

(B) Differentiable but not continuous at both points

(C) Continuous but not differentiable at both points

(D) Neither continuous nor differentiable at both points

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6. A is a 2 × 2 matrix with det A = 4. Find det(4 adj A). **1**

(A) 16 **(B)** 64

(C) 256 **(D)** 512

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7. E and F are independent events with $P(E) = \frac{2}{3}$ and $P(F) = \frac{3}{7}$. Find $P(E \mid \bar{F})$. **1**

(A) $\frac{1}{6}$ **(B)** $\frac{1}{2}$

(C) $\frac{2}{3}$ **(D)** $\frac{7}{9}$

8. Find the absolute maximum value of $f(x) = x^3 - 3x + 2$ on the interval [0, 2]. **1**

(A) 0 **(B)** 2

(C) 4 **(D)** 5

9. A is a 3 × 3 matrix $\begin{bmatrix} 1 & -2 & -1 \\ 0 & 4 & -1 \\ -3 & 2 & 1 \end{bmatrix}$, B is the 3 × 1 column $\begin{bmatrix} -2 \\ -5 \\ -7 \end{bmatrix}$ and C = [9 8 7] is a 1 × 3 row. Which products are defined? **1**

(A) AB only **(B)** AC only

(C) BA only **(D)** AB, AC and BA all

10. If $\int \frac{2^{1/x}}{x^2}\,dx = k \cdot 2^{1/x} + C$, find k. **1**

(A) $\frac{-1}{\log 2}$ **(B)** $-\log 2$

(C) -1 **(D)** $\frac{1}{2}$

11. Vectors satisfy $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ with $|\vec{a}| = \sqrt{37}$, $|\vec{b}| = 3$, $|\vec{c}| = 4$. Find the angle between $\vec{b}$ and $\vec{c}$. **1**

(A) $\frac{\pi}{6}$ **(B)** $\frac{\pi}{4}$

(C) $\frac{\pi}{3}$ **(D)** $\frac{\pi}{2}$

12. Find the integrating factor of the differential equation $(x + 2y^3)\frac{dy}{dx} = 2y$. **1**

(A) $e^{y^2/2}$ **(B)** $\frac{1}{\sqrt{y}}$

(C) $\frac{1}{y^2}$ **(D)** e^{-1/y^2}

13. The matrix $A = \begin{bmatrix} 7 & 0 & x \\ 0 & 7 & 0 \\ 0 & 0 & y \end{bmatrix}$ is a scalar matrix. Find y^x. **1**

(A) 0 **(B)** 1

(C) 7 **(D)** ±7

14. A bounded feasible region of an LPP has corner points (2, 72), (15, 20) and (40, 15). For Z = 18x + 9y, which statement is correct? **1**

(A) Maximum at (2, 72), minimum at (15, 20)

(B) Maximum at (15, 20), minimum at (40, 15)

(C) Maximum at (40, 15), minimum at (15, 20)

(D) Maximum at (40, 15), minimum at (2, 72)

15. A and B are invertible matrices. Which of these statements is FALSE? **1**

(A) $(A+B)^{-1} = B^{-1} + A^{-1}$ **(B)** $(AB)^{-1} = B^{-1}A^{-1}$

(C) $\text{adj}(A) = |A|\,A^{-1}$ **(D)** $|A|^{-1} = |A^{-1}|$

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16. An LPP with objective Z = ax + by has a bounded feasible region. Which is correct? **1**

(A) Z has only a maximum value

(B) Z has only a minimum value

(C) Z has both a maximum and a minimum value

(D) Z has neither a maximum nor a minimum value

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17. The figure shows the parabola $y^2 = x$ with the region above the x-axis, below the upper half of the parabola and to the left of the line x = 4 shaded (from x = 0 to x = 4, y from 0 up to 2). Which integral gives the shaded area? **1**

(A) $\int_0^4 x\,dx$ **(B)** $\int_0^2 y^2\,dy$

(C) $2\int_0^4 \sqrt{x}\,dx$ **(D)** $\int_0^4 \sqrt{x}\,dx$

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18. The figure shows the graph of y = cos x for x from $-\pi/2$ to π (it rises to 1 at x = 0, crosses the x-axis at $\pm\pi/2$ and reaches -1 at π). Which graph represents its inverse? **1**

(A) an increasing curve on $(-\pi/2, \pi/2)$ with y from -1 to 1, through the origin;

(B) another increasing curve through the origin with y from -1 to 1;

(C) a decreasing curve with x from -1 to 1 and y from π (at $x = -1$) down to 0 (at x = 1), passing through $(0, \pi/2)$;

(D) a decreasing curve over all real x lying between the horizontal lines y = 0 and $y = \pi$, through $(0, \pi/2)$.

(A) Graph (A) **(B)** Graph (B)

(C) Graph (C) **(D)** Graph (D)

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19. Assertion (A): The function $f : \mathbb{Z} \to \mathbb{Z}$, f(x) = 3x − 5 (Z = integers), is a bijection. **1**

Reason (R): A function is bijective when it is both one-one (injective) and onto (surjective).

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

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20. Assertion (A): The function f(x) = 3x − 8 for x ≤ 5 and f(x) = 2k for x > 5 is continuous at x = 5 when k = 5/2. **1**

Reason (R): f is continuous at x = a when the left-hand limit, the right-hand limit and f(a) are all equal.

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

SECTION B

5 very short answer (VSA) questions of 2 marks each.

21. Find the derivative of $2^{\cos^2 x}$ with respect to $\cos^2 x$. **2**

OR

Given $\tan^{-1}(x^2 + y^2) = a^2$ (a constant), find $\frac{dy}{dx}$.

22. Find the value of $\tan^{-1}\left[2\sin\left(2\cos^{-1}\frac{\sqrt{3}}{2}\right)\right]$. **2**

23. The diagonals of a parallelogram are $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} - \hat{k}$. Find its area. **2**

24. For $f(x) = 5x^{3/2} - 3x^{5/2}$ (x ≥ 0), find the intervals where f is (i) increasing (ii) decreasing. **2**

25. Two kite strings cross each other. They lie along $\vec{a} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + 4\hat{k}$ (strings are taut). Find the angle between the strings. **2**

OR

For the points A(2, 1, 3) and B(8, −1, 0), find a vector of magnitude 21 units pointing opposite to $\overrightarrow{AB}$.

SECTION C

6 short answer (SA) questions of 3 marks each.

26. Each side of an equilateral triangle grows at 3 cm/s. How fast is the area growing when a side is 15 cm? **3**

27. Solve graphically: maximise Z = x + 2y subject to $x - y \geq 0$, $x - 2y \geq -2$, $x \geq 0$, $y \geq 0$. **3**

28. Find $\int \frac{x + \sin x}{1 + \cos x}\, dx$. **3**

OR

Evaluate $\int_0^{\pi/4} \frac{dx}{\cos^3 x \sqrt{2 \sin 2x}}$.

29. Show that the lines $\vec{r} = (1 - \lambda)\hat{i} + (\lambda - 2)\hat{j} + (3 - 2\lambda)\hat{k}$ and $\vec{r} = (\mu + 1)\hat{i} + (2\mu - 1)\hat{j} - (2\mu + 1)\hat{k}$ are skew, and find the shortest distance between them. **3**

OR

In a cricket match the bowler, wicket-keeper and leg-slip fielder stand in a straight line at position vectors $\vec{B} = 2\hat{i} + 8\hat{j}$, $\vec{W} = 6\hat{i} + 12\hat{j}$ and $\vec{F} = 12\hat{i} + 18\hat{j}$. In what ratio does the wicket-keeper divide the segment from the bowler to the fielder?

30. X = number of students absent in a class on a Saturday has the distribution: P(X = 0) = p, P(X = 2) = 2p, P(X = 4) = 3p, P(X = 5) = p. **3**

(i) Find p. (1 mark)

(ii) Find the mean number of absent students on a Saturday. (2 marks)

OR

3000 people applied for a job; two-thirds were women and the rest men. Selection was by written test. A man scores a distinction with probability 0.4 and a woman with probability 0.35. Find the probability that a randomly picked candidate has a distinction.

31. Draw the graph of y = |x + 3| and, by integration, find the area bounded by this curve and the x-axis between x = −6 and x = 0. **3**

SECTION D

4 long answer (LA) questions of 5 marks each.

32. If $\sqrt{1-x^2}+\sqrt{1-y^2}=a(x-y)$, prove that $\frac{dy}{dx}=\sqrt{\frac{1-y^2}{1-x^2}}$. **5**

OR

Given $x=a\left(\cos\theta+\log\tan\frac{\theta}{2}\right)$ and y = sin θ, find $\frac{d^2y}{dx^2}$ at θ = π/4.

33. Find the absolute maximum and absolute minimum values of $f(x)=2x^3-15x^2+36x+1$ on [1, 5]. **5**

34. Find the image A′ of the point A(1, 6, 3) in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$. Also write the equation of the line through A and A′. **5**

OR

On the line $\frac{x+5}{1}=\frac{y+3}{4}=\frac{z-6}{-9}$ find a point P which is 7 units from Q(2, 4, −1). Then write the equation of line PQ.

35. A school puts 180 students into three clubs – Sports, Music and Drama – such that: the Sports club strength equals Music + Drama together; the Music club has 20 more than half of the Sports club; and all three together have 180 students. Using the matrix method, find how many students go to each club. **5**

SECTION E

3 case-study based questions of 4 marks each.

36. A company is laying a rectangular solar-panel area on a roof using 300 m of boundary material in total. A partition parallel to one pair of sides splits it into two parts. Let x m be the length of each side perpendicular to the partition and y m the length of each side parallel to it. **4**

(i) Write the equation for the total material used (boundary + partition) in terms of x and y. (1)

(ii) Express the area as a function of x. (1)

(iii) Find the critical point of the area function, confirm with the second-derivative test that it gives the maximum, and find the maximum area. (2)

OR

(iii) Using the first-derivative test, find the maximum area the company can enclose with the (b) 300 m of boundary material, keeping the parallel partition.

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37. A teacher writes five relations on A = {1, 2, 3}: **4**

$R_1 = \{(2, 3), (3, 2)\}$

$R_2 = \{(1, 2), (1, 3), (3, 2)\}$

$R_3 = \{(1, 2), (2, 1), (1, 1)\}$

$R_4 = \{(1, 1), (1, 2), (3, 3), (2, 2)\}$

$R_5 = \{(1, 1), (1, 2), (3, 3), (2, 2), (2, 1), (2, 3), (3, 2)\}$

(i) Which relation is reflexive and transitive but not symmetric? (1)

(ii) Which relation is reflexive and symmetric but not transitive? (1)

(iii) Which relations are symmetric but neither reflexive nor transitive? (2)

OR

(iii) Which ordered pairs must be added to R_2 to make it an equivalence relation? (b)

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38. A bank gives loans at fixed, floating or variable interest rates; 10%, 20% and 70% of borrowers choose these respectively. The chance of defaulting is 5% for fixed-rate, 3% for floating-rate and 1% for variable-rate borrowers. **4**

(i) Find the probability that a borrower defaults. (2)

(ii) A borrower has defaulted. Find the probability that the loan was at a variable rate. (2)

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Questions restated from the CBSE Class XII Board Examination 2025 (set 65/1/1) for practice. Reading passages and map items are described, not reproduced.