# JEE Main 2025 April 2 Shift 1 Mathematics
# Question Paper with Solutions

| Time Allowed :3 Hours | Maximum Marks :300 | Total Questions :75 |
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**General Instructions**

**Read the following instructions very carefully and strictly follow them:**

1. Multiple choice questions (MCQs)
2. Questions with numerical values as answers.
3. There are three sections: **Mathematics, Physics, Chemistry**.
4. **Mathematics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
5. **Physics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory..
6. **Chemistry:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
7. Total: 75 Questions (25 questions each).
8. 300 Marks (100 marks for each section).
9. **MCQs:** Four marks will be awarded for each correct answer and there will be a negative marking of one mark on each wrong answer.
10. **Questions with numerical value answers:** Candidates will be given four marks for each correct answer and there will be a negative marking of 1 mark for each wrong answer.

## Mathematics

## Section - A

**1.** The largest $n \in N$ such that $3^n$ divides 50! is:

(1) 21 (2) 22 (3) 23 (4) 25

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**2.** Let one focus of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ be at $(\sqrt{10}, 0)$, and the corresponding directrix be $x = \frac{\sqrt{10}}{2}$. If $e$ and $l$ are the eccentricity and the latus rectum respectively, then $9(e^2 + l)$ is equal to:

(1) 14 (2) 16 (3) 18 (4) 12

**3.** The number of sequences of ten terms, whose terms are either 0 or 1 or 2, that contain exactly five 1's and exactly three 2's, is equal to:

(1) 360 (2) 45 (3) 2520 (4) 1820

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**4.** Let $f : R \to R$ be a twice differentiable function such that

$$f''(x)\sin\left(\frac{x}{2}\right) + f'(2x-2y) = (\cos x)\sin(y+2x) + f(2x-2y)$$

for all $x, y \in R$. If $f(0) = 1$, then the value of $24f^{(4)}\left(\frac{5\pi}{3}\right)$ is:

(1) 2 (2) –3 (3) 1 (4) 3

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**5.** Let $A = \begin{bmatrix} \alpha & -1 \\ 6 & \beta \end{bmatrix}$, $\alpha > 0$, such that $\det(A) = 0$ and $\alpha + \beta = 1$. If $I$ denotes the $2 \times 2$ identity matrix, then the matrix $(1 + A)^5$ is:

(1) $\begin{bmatrix} 4 & -1 \\ 6 & -1 \end{bmatrix}$ (2) $\begin{bmatrix} 257 & -64 \\ 514 & -127 \end{bmatrix}$ (3) $\begin{bmatrix} 1025 & -511 \\ 2024 & -1024 \end{bmatrix}$ (4) $\begin{bmatrix} 766 & -255 \\ 1530 & -509 \end{bmatrix}$

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**6.** The term independent of $x$ in the expansion of

$$\left(\frac{x+1}{x^{3/2}+1-\sqrt{x}} \cdot \frac{x+1}{x-\sqrt{x}}\right)^{10}$$

for $x > 1$ is:

(1) 210 (2) 150 (3) 240 (4) 120

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**7.** If $\theta \in [-2\pi,\ 2\pi]$, then the number of solutions of

$$2\sqrt{2}\cos^2\theta + (2-\sqrt{6})\cos\theta - \sqrt{3} = 0$$

is:

(1) 12 (2) 6 (3) 8 (4) 10

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**8.** Let $a_1, a_2, a_3, \ldots$ be in an A.P. such that

$$\sum_{k=1}^{12} 2a_{2k-1} = \frac{72}{5}, \quad \text{and} \quad \sum_{k=1}^{n} a_k = 0,$$

then $n$ is:

(1) 11 (2) 10 (3) 18 (4) 17

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**9.** If the function $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1$, where $a > 0$, attains its local maximum and minimum at $p$ and $q$, respectively, such that $p^2 = q$, then $f(3)$ is equal to:

(1) 55 (2) 10 (3) 23 (4) 37

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**10.** Let $z$ be a complex number such that $|z| = 1$. If

$$\frac{2 + kz}{k + z} = kz, \ k \in R,$$

then the maximum distance of $k + ik^2$ from the circle $|z - (1 + 2i)| = 1$ is:

(1) $\sqrt{5} + 1$ (2) 2 (3) 3 (4) $\sqrt{5} + \sqrt{1}$

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**11.** If $\vec{a}$ is a non-zero vector such that its projections on the vectors $2\hat{\imath} - \hat{\jmath} + 2\hat{k}$, $\hat{\imath} + 2\hat{\jmath} - 2\hat{k}$, and $\hat{k}$ are equal, then a unit vector along $\vec{a}$ is:

(1) $\frac{1}{\sqrt{155}}(7\hat{\imath}+9\hat{\jmath}+5\hat{k})$ (2) $\frac{1}{\sqrt{155}}(7\hat{\imath}+9\hat{\jmath}-5\hat{k})$ (3) $\frac{1}{\sqrt{155}}(7\hat{\imath}+9\hat{\jmath}+5\hat{k})$ (4) $\frac{1}{\sqrt{155}}(7\hat{\imath}+9\hat{\jmath}-5\hat{k})$

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**12.** Let $A$ be the set of all functions $f : Z \to Z$ and $R$ be a relation on $A$ such that

$$R = \{(f, g) : f(0) = g(1) \text{ and } f(1) = g(0)\}$$

Then $R$ is:

(1) Symmetric and transitive but not reflective (2) Symmetric but neither reflective nor transitive
(3) Reflexive but neither symmetric nor transitive (4) Transitive but neither reflexive nor symmetric

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**13.** For $\alpha, \beta, \gamma \in R$, if

$$\lim_{x \to 0} \frac{x^2 \sin \alpha x + (\gamma - 1)e^{x^2} - 3}{\sin 2x - \beta x} = 3,$$

then $\beta + \gamma - \alpha$ is equal to:

(1) 7 (2) 4 (3) 6 (4) –1

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**14.** If the system of equations:

$$3x + y + \beta z = 3$$
$$2x + \alpha y + z = 2$$
$$x + 2y + z = 4$$

has infinitely many solutions, then the value of $22\beta - 9\alpha$ is:

(1) 49 (2) 31 (3) 43 (4) 37

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**15.** Let $P_n = \alpha^n + \beta^n$, $n \in N$. If $P_{10} = 123,\ P_9 = 76,\ P_8 = 47$ and $P_1 = 1$, then the quadratic equation having roots $\alpha$ and $\frac{1}{\beta}$ is:

(1) $x^2 - x + 1 = 0$ (2) $x^2 + x - 1 = 0$ (3) $x^2 - x - 1 = 0$ (4) $x^2 + x + 1 = 0$

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**16.** If $S$ and $S'$ are the foci of the ellipse $\frac{x^2}{18} + \frac{y^2}{9} = 1$, and $P$ is a point on the ellipse, then $\min(\vec{SP} \cdot \vec{S'P}) + \max(\vec{SP} \cdot \vec{S'P})$ is equal to:

(1) $3(1 + \sqrt{2})$ (2) $3(6 + \sqrt{2})$ (3) 9 (4) 27

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**17.** Let the vertices Q and R of the triangle PQR lie on the line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$, $QR = 5$, and the coordinates of the point P be $(0, 2, 3)$. If the area of the triangle PQR is $\frac{m}{n}$, then:
(1) $m - 5\sqrt{21}n = 0$
(2) $2m - 5\sqrt{21}n = 0$
(3) $5m - 2\sqrt{21}n = 0$
(4) $5m - 21\sqrt{2}n = 0$

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**18.** Let ABCD be a tetrahedron such that the edges AB, AC and AD are mutually perpendicular. Let the areas of the triangles $ABC$, $ACD$, and $ADB$ be 5, 6 and 7 square units respectively. Then the area (in square units) of the tetrahedron ABCD is equal to:

(1) $\sqrt{30}$ (2) 12 (3) $\sqrt{10}$ (4) $7\sqrt{5}$

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**19.** Let $A \in R$ be a matrix of order 3x3 such that

$$\det(A) = -4 \quad \text{and} \quad A + I = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 0 & 1 \\ 4 & 1 & 2 \end{bmatrix}$$

where $I$ is the identity matrix of order 3. If $\det((A+I) \cdot \text{adj}(A+I))$ is $2^m$, then $m$ is equal to:

(1) 14 (2) 31 (3) 16 (4) 13

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**20.** Let the focal chord PQ of the parabola $y^2 = 4x$ make an angle of $60^\circ$ with the positive x-axis, where P lies in the first quadrant. If the circle, whose one diameter is PS, $S$ being the focus of the parabola, touches the y-axis at the point $(0, \alpha)$, then $5\alpha^2$ is equal to:

(1) 15 (2) 25 (3) 30 (4) 20

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## Mathematics

**SECTION-B**

**21.** Let [.] denote the greatest integer function. If

$$\int_1^e \frac{1}{xe^x} dx = \alpha - \log 2, \quad \text{then} \quad \alpha^2 \text{ is equal to:}$$

(1) 8 (2) 9 (3) 16 (4) 10

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**23.** If the area of the region

$$\{(x, y) : |4 - x^2| \leq y \leq x^2, y \geq 0\}$$

is $\frac{80\sqrt{2}}{\alpha - \beta}$, $\alpha, \beta \in N$, then $\alpha + \beta$ is equal to:

(1) 16 (2) 12 (3) 22 (4) 18

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**24.** Three distinct numbers are selected randomly from the set $\{1, 2, 3, \ldots, 40\}$. If the probability that the selected numbers are in an increasing G.P. is $\frac{m}{n}$, where $\gcd(m, n) = 1$, then $m + n$ is equal to:

(1) 14 (2) 31 (3) 16 (4) 13

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**25.** The absolute difference between the squares of the radii of the two circles passing through the point $(-9, 4)$ and touching the lines $x + y = 3$ and $x - y = 3$, is equal to:

(1) 768 (2) 550 (3) 860 (4) 999

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