JEE Main 2025 April 7 Shift 1 Mathematics Question Paper

Time Allowed :3 Hours	Maximum Marks :300	Total Questions :75

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. Evaluate the following limit:

$$\lim_{x \to 0^+} \frac{\tan\left(5x^{\frac{1}{3}}\right)\log\left(1+3x^2\right)}{\left(\tan^{-1}\left(3\sqrt{x}\right)\right)^2\left(e^{5x^{\frac{4}{3}}}-1\right)}$$

(1) $\frac{1}{15}$
(2) 1
(3) $\frac{1}{3}$
(4) $\frac{5}{3}$

2. If the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x}{1} = \frac{y}{\alpha} = \frac{z-5}{1}$ is $\frac{5}{\sqrt{6}}$, then the sum of all possible values of α is:

(1) $\frac{3}{2}$

(2) $\frac{-3}{2}$

(3) 3

(4) -3

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3. Let $x = -1$ and $x = 2$ be the critical points of the function $f(x) = x^3 + ax^2 + b\log|x| + 1$, where $x \neq 0$. Let m and M be the absolute minimum and maximum values of f in the interval $\left[-2, -\frac{1}{2}\right]$. Then, $|M + m|$ is equal to:

(1) 21.1

(2) 19.8

(3) 22.1

(4) 20.9

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4. The remainder when $\left((64)^{64}\right)^{64}$ is divided by 7 is equal to:

(1) 4

(2) 1

(3) 3

(4) 6

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5. Let P be the parabola, whose focus is $(-2, 1)$ and directrix is $2x + y + 2 = 0$. Then the sum of the ordinates of the points on P, whose abscissa is -2, is:

(1) $\frac{3}{2}$

(2) $\frac{5}{2}$

(3) $\frac{1}{4}$

(4) $\frac{3}{4}$

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6. Let $y = y(x)$ be the solution curve of the differential equation

$$x(x^2 + e^x)\,dy + \left(e^x(x-2)y - x^3\right)\,dx = 0, \quad x > 0,$$

passing through the point $(1, 0)$. Then $y(2)$ is equal to:
(1) $\frac{4}{4-e^2}$
(2) $\frac{2}{2+e^2}$
(3) $\frac{2}{2-e^2}$
(4) $\frac{4}{4+e^2}$

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7. From a group of 7 batsmen and 6 bowlers, 10 players are to be chosen for a team, which should include at least 4 batsmen and at least 4 bowlers. One batsman and one bowler who are captain and vice-captain respectively of the team should be included. Then the total number of ways such a selection can be made, is:
(1) 165

(2) 155

(3) 145

(4) 135

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8. If for $\theta \in \left[-\frac{\pi}{3}, 0\right]$, the points

$$(x, y) = \left(3\tan\left(\theta + \frac{\pi}{3}\right), 2\tan\left(\theta + \frac{\pi}{6}\right)\right)$$

lie on $xy + \alpha x + \beta y + \gamma = 0$, then $\alpha^2 + \beta^2 + \gamma^2$ is equal to:
(1) 80
(2) 72
(3) 96
(4) 75

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9. Let C_1 be the circle in the third quadrant of radius 3, that touches both coordinate axes. Let C_2 be the circle with center $(1, 3)$ that touches C_1 externally at the point (α, β). If $(\beta - \alpha)^2 = \frac{m}{n}$, and $\gcd(m, n) = 1$, then $m + n$ is equal to:
(1) 9

(2) 13

(3) 22

(4) 31

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10. The integral

$$\int_0^{\pi} \frac{(x+3)\sin x}{1 + 3\cos^2 x}\,dx$$

is equal to:
(1) $\frac{\pi}{\sqrt{3}}(\pi+1)$
(2) $\frac{\pi}{\sqrt{3}}(\pi+2)$
(3) $\frac{\pi}{3\sqrt{3}}(\pi+6)$
(4) $\frac{\pi}{2\sqrt{3}}(\pi+4)$

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11. Among the statements:
(S1): The set $\{z \in C - \{-i\} : |z| = 1 \text{ and } \frac{z-i}{z+i} \text{ is purely real}\}$ contains exactly two elements.
(S2): The set $\{z \in C - \{-1\} : |z| = 1 \text{ and } \frac{z-1}{z+1} \text{ is purely imaginary}\}$ contains infinitely many elements.
Then, which of the following is correct?
(1) both are incorrect
(2) only (S1) is correct
(3) only (S2) is correct
(4) both are correct

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12. The mean and standard deviation of 100 observations are 40 and 5.1, respectively. By mistake one observation is taken as 50 instead of 40. If the correct mean and the correct standard deviation are μ and σ respectively, then $10(\mu+\sigma)$ is equal to:
(1) 445

(2) 451

(3) 447

(4) 449

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13. Let x_1, x_2, x_3, x_4 be in a geometric progression. If 2, 7, 9, 5 are subtracted respectively from x_1, x_2, x_3, x_4, then the resulting numbers are in an arithmetic progression. Then the value of $\frac{1}{24}(x_1x_2x_3x_4)$ is:
(1) 72
(2) 18
(3) 36
(4) 216

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14. Let the set of all values of $p \in R$, for which both the roots of the equation $x^2 - (p+2)x + (2p+9) = 0$ are negative real numbers, be the interval (α, β). Then $\beta - 2\alpha$ is equal to:
(1) 0

(2) 9

(3) 5

(4) 20

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15. Let A be a 3×3 matrix such that

$$|\text{adj}(\text{adj}A)| = 81.$$

If

$$S = \left\{ n \in Z : |\text{adj}(\text{adj}A)|^{\frac{(n-1)^2}{2}} = |A|^{(3n^2-5n-4)} \right\},$$

then the value of

$$\sum_{n \in S} |A|(n^2 + n)$$

is:
(1) 866
(2) 750
(3) 820
(4) 732

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16. If the area of the region bounded by the curves $y = 4 - \frac{x^2}{4}$ and $y = \frac{x-4}{2}$ is equal to α, then 6α equals:
(1) 250

(2) 210

(3) 240

(4) 220

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17. Let the system of equations be:

$$2x + 3y + 5z = 9,$$

$$7x + 3y - 2z = 8,$$

$$12x + 3y - (4 + \lambda)z = 16 - \mu,$$

which has infinitely many solutions. Then the radius of the circle centered at (λ, μ) and touching the line $4x = 3y$ is:
(1) $\frac{17}{5}$
(2) $\frac{7}{5}$

(3) 7
(4) $\frac{21}{5}$

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18. Let the line L pass through $(1, 1, 1)$ and intersect the lines

$$\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$$

and

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

Then, which of the following points lies on the line L?
(1) $(4, 22, 7)$
(2) $(5, 4, 3)$
(3) $(10, -29, -50)$
(4) $(7, 15, 13)$

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19. Let the angle $\theta, 0 < \theta < \frac{\pi}{2}$ between two unit vectors $\hat{a}$ and $\hat{b}$ be $\sin^{-1}\left(\frac{\sqrt{65}}{9}\right)$. If the vector $\vec{c} = 3\hat{a} + 6\hat{b} + 9(\hat{a} \times \hat{b})$, then the value of $9(\vec{c} \cdot \hat{a}) - 3(\vec{c} \cdot \hat{b})$ is:
(1) 31

(2) 27

(3) 29

(4) 24

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20. Let ABC be the triangle such that the equations of lines AB and AC are:

$$3y - x = 2 \quad \text{and} \quad x + y = 2,$$

respectively, and the points B and C lie on the x-axis. If P is the orthocentre of the triangle ABC, then the area of the triangle PBC is equal to:
(1) 4
(2) 10
(3) 8
(4) 6

SECTION-B

21. The number of points of discontinuity of the function

$$f(x) = \left\lfloor \frac{x^2}{2} \right\rfloor - \left\lfloor \sqrt{x} \right\rfloor, \quad x \in [0, 4],$$

where $\lfloor \cdot \rfloor$ denotes the greatest integer function, is:

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22. The number of relations on the set $A = \{1, 2, 3\}$ containing at most 6 elements including $(1, 2)$, which are reflexive and transitive but not symmetric, is:

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23. Consider the hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1,$$

having one of its foci at $P(-3, 0)$. If the latus rectum through its other focus subtends a right angle at P, and

$$a^2b^2 = \alpha\sqrt{2} - \beta, \quad \alpha, \beta \in N,$$

then find α and β.

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24. The number of singular matrices of order 2, whose elements are from the set $\{2, 3, 6, 9\}$ is:

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25. For $n \geq 2$, let S_n denote the set of all subsets of $\{1, 2, 3, \ldots, n\}$ with no two consecutive numbers. For example, $\{1, 3, 5\} \in S_6$, but $\{1, 2, 4\} \notin S_6$. Then, find $n(S_5)$.
