

# JEE Main 2025 April 4 Shift 2 Mathematics Question Paper

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. Let  $a > 0$ . If the function  $f(x) = 6x^3 - 45ax^2 + 108a^2x + 1$  attains its local maximum and minimum values at the points  $x_1$  and  $x_2$  respectively such that  $x_1x_2 = 54$ , then  $a + x_1 + x_2$  is equal to:

- (1) 15
- (2) 18
- (3) 24
- (4) 13

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2. Let  $f$  be a differentiable function on  $R$  such that  $f(2) = 4$ . Let

$\lim_{x \rightarrow 0} (f(2+x))^{3/x} = e^\alpha$ . Then the number of times the curve  $y = 4x^3 - 4x^2 - 4(\alpha - 7)x - \alpha$  meets the x-axis is:

- (1) 2
  - (2) 1
  - (3) 0
  - (4) 3
- 

**3. The sum of the infinite series  $\cot^{-1} \left(\frac{7}{4}\right) + \cot^{-1} \left(\frac{19}{4}\right) + \cot^{-1} \left(\frac{39}{4}\right) + \cot^{-1} \left(\frac{67}{4}\right) + \dots$  is:**

- (1)  $\frac{\pi}{2} + \tan^{-1} \left(\frac{1}{2}\right)$
  - (2)  $\frac{\pi}{2} - \cot^{-1} \left(\frac{1}{2}\right)$
  - (3)  $\frac{\pi}{2} + \cot^{-1} \left(\frac{1}{2}\right)$
  - (4)  $\frac{\pi}{2} - \tan^{-1} \left(\frac{1}{2}\right)$
- 

**4. Let  $A = \{-3, -2, -1, 0, 1, 2, 3\}$  and  $R$  be a relation on  $A$  defined by  $xRy$  if and only if  $2x - y \in \{0, 1\}$ . Let  $l$  be the number of elements in  $R$ . Let  $m$  and  $n$  be the minimum number of elements required to be added in  $R$  to make it reflexive and symmetric relations, respectively. Then  $l + m + n$  is equal to:**

- (1) 18
  - (2) 17
  - (3) 15
  - (4) 16
- 

**5. Let the product of  $\omega_1 = (8 + i) \sin \theta + (7 + 4i) \cos \theta$  and  $\omega_2 = (1 + 8i) \sin \theta + (4 + 7i) \cos \theta$  be  $\alpha + i\beta$ , where  $i = \sqrt{-1}$ . Let  $p$  and  $q$  be the maximum and the minimum values of  $\alpha + \beta$  respectively.**

- (1) 140
  - (2) 130
  - (3) 160
  - (4) 150
- 

**6. Let the values of  $p$ , for which the shortest distance between the lines  $\frac{x+1}{3} = \frac{y}{4} = \frac{z}{5}$  and  $\vec{r} = (p\hat{i} + 2\hat{j} + \hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 4\hat{k})$  is  $\frac{1}{\sqrt{6}}$ , be  $a, b$ , where  $a < b$ . Then the length of the latus rectum of the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  is:**

- (1) 9
  - (2)  $\frac{3}{2}$
  - (3)  $\frac{2}{3}$
  - (4) 18
- 

**7. The axis of a parabola is the line  $y = x$  and its vertex and focus are in the first quadrant at distances  $\sqrt{2}$  and  $2\sqrt{2}$  units from the origin, respectively. If the point  $(1, k)$  lies on the parabola, then a possible value of  $k$  is:**

- (1) 4

- (2) 9
  - (3) 3
  - (4) 8
- 

8. Let the domains of the functions  $f(x) = \log_4 \log_3 \log_7(8 - \log_2(x^2 + 4x + 5))$  and  $g(x) = \sin^{-1} \left( \frac{7x+10}{x-2} \right)$  be  $(\alpha, \beta)$  and  $[\gamma, \delta]$ , respectively. Then  $\alpha^2 + \beta^2 + \gamma^2 + \delta^2$  is equal to:

- (1) 15
  - (2) 13
  - (3) 16
  - (4) 14
- 

9. A line passing through the point  $A(-2, 0)$ , touches the parabola  $P : y^2 = x - 2$  at the point  $B$  in the first quadrant. The area of the region bounded by the line  $AB$ , parabola  $P$ , and the x-axis is:

- (1)  $\frac{7}{3}$
  - (2) 2
  - (3)  $\frac{8}{3}$
  - (4) 3
- 

10. Let the sum of the focal distances of the point  $P(4, 3)$  on the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  be  $8\sqrt{\frac{5}{3}}$ . If for  $H$ , the length of the latus rectum is  $\ell$  and the product of the focal distances of the point  $P$  is  $m$ , then  $9\ell^2 + 6m$  is equal to:

- (1) 184
  - (2) 186
  - (3) 185
  - (4) 187
- 

11. Let the matrix  $A = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$  satisfy  $A^n = A^{n-2} + A^2 - I$  for  $n \geq 3$ . Then the sum of all the elements of  $A^{50}$  is:

- (1) 53
  - (2) 52
  - (3) 39
  - (4) 44
- 

12. If the sum of the first 20 terms of the series

$$\frac{4.1}{4 + 3.1^2 + 1^4} + \frac{4.2}{4 + 3.2^2 + 2^4} + \frac{4.3}{4 + 3.3^2 + 3^4} + \frac{4.4}{4 + 3.4^2 + 4^4} + \dots$$

is  $\frac{m}{n}$ , where  $m$  and  $n$  are coprime, then  $m + n$  is equal to:

- (1) 423

- (2) 420
  - (3) 421
  - (4) 422
- 

**13. If**

$2^m 3^n 5^k$ , where  $m, n, k \in N$ , then  $m + n + k$  is equal to: (1)

- (1) 19
  - (2) 21
  - (3) 18
  - (4) 20
- 

**14. Let for two distinct values of  $p$ , the lines  $y = x + p$  touch the ellipse  $E : \frac{x^2}{4} + \frac{y^2}{9} = 1$  at the points  $A$  and  $B$ . Let the line  $y = x$  intersect  $E$  at the points  $C$  and  $D$ . Then the area of the quadrilateral  $ABCD$  is equal to:**

- (1) 36
  - (2) 24
  - (3) 48
  - (4) 20
- 

**15. Consider two sets  $A$  and  $B$ , each containing three numbers in A.P. Let the sum and the product of the elements of  $A$  be 36 and  $p$ , respectively, and the sum and the product of the elements of  $B$  be 36 and  $q$ , respectively. Let  $d$  and  $D$  be the common differences of A.P's in  $A$  and  $B$ , respectively, such that  $D = d + 3$ ,  $d > 0$ . If  $\frac{p+q}{p-q} = \frac{19}{5}$ , then  $p - q$  is equal to:**

- (1) 600
  - (2) 450
  - (3) 630
  - (4) 540
- 

**16. If a curve  $y = y(x)$  passes through the point  $(1, \frac{\pi}{2})$  and satisfies the differential equation**

$$(7x^4 \cot y - e^x \csc y) \frac{dx}{dy} = x^5, \quad x \geq 1, \text{ then at } x = 2, \text{ the value of } \cos y \text{ is:}$$

- (1)  $\frac{e^2}{64}$
  - (2)  $\frac{e^2}{128}$
  - (3)  $\frac{e^2}{128} - 1$
  - (4)  $\frac{e^2}{64} + 1$
- 

**17. The center of a circle  $C$  is at the center of the ellipse  $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ , where  $a > b$ . Let  $C$  pass through the foci  $F_1$  and  $F_2$  of  $E$  such that the circle  $C$  and the ellipse  $E$  intersect at four points. Let  $P$  be one of these four points. If the area of**

the triangle  $PF_1F_2$  is 30 and the length of the major axis of  $E$  is 17, then the distance between the foci of  $E$  is:

- (1) 8
  - (2) 10
  - (3) 12
  - (4) 14
- 

18. Let  $f(x) + 2f\left(\frac{1}{x}\right) = x^2 + 5$  and

$2g(x) - 3g\left(\frac{1}{2}\right) = x, x > 0$ . If  $\alpha = \int_1^2 f(x) dx, \beta = \int_1^2 g(x) dx$ , then the value of  $9\alpha + \beta$  is:

- (1) 1
  - (2) 0
  - (3) 10
  - (4) 11
- 

19. Let  $A$  be the point of intersection of the lines

$$L_1 : \frac{x-7}{1} = \frac{y-5}{0} = \frac{z-3}{-1} \quad \text{and} \quad L_2 : \frac{x-1}{3} = \frac{y+3}{4} = \frac{z+7}{5}$$

Let  $B$  and  $C$  be the points on the lines  $L_1$  and  $L_2$ , respectively, such that  $AB - AC = \sqrt{15}$ . Then the square of the area of the triangle  $ABC$  is:

- (1) 54
  - (2) 63
  - (3) 57
  - (4) 60
- 

20. Let the mean and the standard deviation of the observations 2, 3, 4, 5, 7,  $a, b$  be 4 and  $\sqrt{2}$  respectively. Then the mean deviation about the mode of these observations is:

- (1) 1
  - (2)  $\frac{3}{4}$
  - (3) 2
  - (4)  $\frac{1}{2}$
- 

## SECTION-B

21. If  $\alpha$  is a root of the equation  $x^2 + x + 1 = 0$  and

$$\sum_{k=1}^n \left( \alpha^k + \frac{1}{\alpha^k} \right)^2 = 20, \quad \text{then } n \text{ is equal to } \dots\dots\dots$$

- (1) 11
- (2) 10

(3) 9

(4) 8

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**22. If**

$$\int \frac{(\sqrt{1+x^2} + x)^{10}}{(\sqrt{1+x^2} - x)^9} dx = \frac{1}{m} \left( (\sqrt{1+x^2} + x)^n (n\sqrt{1+x^2} - x) \right) + C,$$

where  $m, n \in N$  and  $C$  is the constant of integration, then  $m + n$  is equal to:

(1) 379

(2) 380

(3) 381

(4) 378

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**23. A card from a pack of 52 cards is lost. From the remaining 51 cards,  $n$  cards are drawn and are found to be spades. If the probability of the lost card to be a spade is**

$$\frac{11}{50}, \text{ then } n \text{ is equal to } \text{-----}$$

(1) 1

(2) 2

(3) 3

(4) 4

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**24. Let  $m$  and  $n$ ,  $m < n$  be two 2-digit numbers. Then the total number of pairs  $(m, n)$  such that  $\gcd(m, n) = 6$ , is -----**

(1) 64

(2) 60

(3) 50

(4) 55

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**25. Let the three sides of a triangle ABC be given by the vectors**

$$2\hat{i} - \hat{j} + \hat{k}, \quad \hat{i} - 3\hat{j} - 5\hat{k}, \quad \text{and} \quad 3\hat{i} - 4\hat{j} - 4\hat{k}.$$

**Let  $G$  be the centroid of the triangle ABC. Then**

$$6 \left( |\vec{AG}|^2 + |\vec{BG}|^2 + |\vec{CG}|^2 \right) \text{ is equal to } \text{-----}$$

(1) 164

(2) 166

(3) 162

(4) 160

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