JEE (ADVANCED) EXAM-2025

MATHEMATICS (PAPER-1)

SECTION – 1 : (Maximum Marks : 12)

- This section contains **FOUR (04)** questions.
- Each question has FOUR options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated **according to the following marking scheme**:

  Full Marks : +3 If **ONLY** the correct option is chosen;

  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

  Negative Marks : −1 In all other cases.

1. Let $\mathbb{R}$ denote the set of all real numbers. Let $a_i, b_i \in \mathbb{R}$ for $i \in \{1,2,3\}$.

Define the functions $f:\mathbb{R}\to\mathbb{R}, g:\mathbb{R}\to\mathbb{R}$, and $h:\mathbb{R}\to\mathbb{R}$ by

$$f(x) = a_1 + 10x + a_2x^2 + a_3x^3 + x^4$$

$$g(x) = b_1 + 3x + b_2x^2 + b_3x^3 + x^4$$

$$h(x) = f(x+1) - g(x+2)$$

If $f(x) \neq g(x)$ for every $x \in \mathbb{R}$, then the coefficient of x^3 in $h(x)$ is

(A) 8 (B) 2

(C) –4 (D) –6

2. Three students S_1, S_2, and S_3 are given a problem to solve. Consider the following events:

U : At least one of S_1, S_2, and S_3 can solve the problem,

V : S_1 can solve the problem, given that neither S_2 nor S_3 can solve the problem,

$W : S_2$ can solve the problem and S_3 cannot solve the problem,

$T : S_3$ can solve the problem.

For any event E, let $P(E)$ denote the probability of E. If

$P(U) = \frac{1}{2}, \quad P(V) = \frac{1}{10}, \quad$ and $\quad P(W) = \frac{1}{12}$ then P(T) is equal to

(A) $\frac{13}{36}$ (B) $\frac{1}{3}$

(C) $\frac{19}{60}$ (D) $\frac{1}{4}$

3. Let $\mathbb{R}$ denote the set of all real numbers. Define the function $f:\mathbb{R}\to\mathbb{R}$ by

$$f(x)=\begin{cases}2-2x^2-x^2\sin\frac{1}{x} & \text{if } x\neq 0\\ 2 & \text{if } x=0\end{cases}$$

Then which one of the following statements is TRUE?

(A) The function f is NOT differentiable at x = 0

(B) There is a positive real number δ, such that f is a decreasing function on the interval $(0,\delta)$

(C) For any positive real number δ, the function f is NOT an increasing function on the interval $(-\delta,0)$

(D) $x=0$ is a point of local minima of f

4. Consider the matrix

$$P=\begin{pmatrix}2&0&0\\0&2&0\\0&0&3\end{pmatrix}$$

Let the transpose of a matrix X be denoted by X^T. Then the number of 3×3 invertible matrices Q with integer entries, such that $Q^{-1}=Q^T$ and $PQ=QP$ is

(A) 32 (B) 8 (C) 16 (D) 24

SECTION – 2 : (Maximum Marks : 12)

- This section contains **THREE (3)** questions
- Each question has **FOUR** options (A), (B), (C) and (D). ONE OR **MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated **according to the following marking scheme**:

  Full Marks : +4 ONLY if (all) the correct option(s) is(are) chosen;

  Partial Marks : +3 If all the four options are correct but ONLY three options are chosen;

  Partial Marks : +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;

  Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;

  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

  Negative Marks : −2 In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then

  choosing ONLY (A), (B) and (D) will get +4 marks;

choosing ONLY (A) and (B) will get +2 marks;
choosing ONLY (A) and (D) will get +2 marks;
choosing ONLY (B) and (D) will get +2 marks;
choosing ONLY (A) will get +1 mark;
choosing ONLY (B) will get +1 mark;
choosing ONLY (D) will get +1 mark;
choosing no option (i.e. the question is unanswered) will get 0 marks;

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5. Let L_1 be the line of intersection of the planes given by the equations

$$2x+3y+z=4 \text{ and } x+2y+z=5$$

Let L_2 be the line passing through the point $P(2,-1,3)$ and parallel to L_1. Let M denote the plane given by the equation

$$2x+y-2z=6$$

Suppose that the line L_2 meets the plane M at the point Q. Let R be the foot of the perpendicular drawn from P to the plane M.

Then which of the following statements is (are) TRUE?

(A) The length of the line segment PQ is $9\sqrt{3}$

(B) The length of the line segment QR is 15

(C) The area of ΔPQR is $\frac{3}{2}\sqrt{234}$

(D) The acute angle between the line segments PQ and PR is $\cos^{-1}\left(\frac{1}{2\sqrt{3}}\right)$

6. Let $\mathbb{N}$ denote the set of all natural numbers, and $\mathbb{Z}$ denote the set of all integers. Consider the functions $f:\mathbb{N}\to\mathbb{Z}$ and $g:\mathbb{Z}\to\mathbb{N}$ defined by

$$f(n)=\begin{cases}(n+1)/2 & \text{if } n \text{ is odd}\\(4-n)/2 & \text{if } n \text{ is even}\end{cases}$$

and $g(n)=\begin{cases}3+2n & \text{if } n\ge 0\\-2n & \text{if } n<0\end{cases}$

Define $(g\circ f)(n)=g(f(n))$ for all $n\in\mathbb{N}$, and $(f\circ g)(n)=f(g(n))$ for all $n\in\mathbb{Z}$.

Then which of the following statements is (are) TRUE?

(A) $g\circ f$ is NOT one-one and $g\circ f$ is NOT onto

(B) $f\circ g$ is NOT one-one but $f\circ g$ is onto

(C) g is one-one and g is onto

(D) f is NOT one-one but f is onto

7. Let $\mathbb{R}$ denote the set of all real numbers. Let $z_1 = 1+2i$ and $z_2 = 3i$ be two complex numbers, where $i=\sqrt{-1}$. Let $S = \{(x,y)\in \mathbb{R}\times\mathbb{R} : |x+iy-z_1| = 2|x+iy-z_2|\}$

Then which of the following statements is (are) TRUE?

(A) S is a circle with centre $\left(-\frac{1}{3}, \frac{10}{3}\right)$

(B) S is a circle with centre $\left(\frac{1}{3}, \frac{8}{3}\right)$

(C) S is a circle with radius $\frac{\sqrt{2}}{3}$

(D) S is a circle with radius $\frac{2\sqrt{2}}{3}$

SECTION – 3 : (Maximum Marks : 30)

- This section contains **SIX (06)** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated **according to the following marking scheme:**

  Full Marks : +4 If ONLY the correct numerical value is entered in the designated place;

  Zero Marks : 0 In all other cases.

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8. Let the set of all relations R on the set $\{a,b,c,d,e,f\}$, such that R is reflexive and symmetric, and R contains exactly 10 elements, be denoted by S.

Then the number of elements in S is ____.

9. For any two points M and N in the X Y-plane, let $\overrightarrow{MN}$ denote the vector from M to N, and $\vec{0}$ denote the zero vector. Let P, Q and R be three distinct points in the XY-plane. Let S be a point inside the triangle ΔPQR such that

$$\overrightarrow{SP} + 5\overrightarrow{SQ} + 6\overrightarrow{SR} = \vec{0}$$

Let E and F be the mid-points of the sides PR and QR, respectively. Then the value of

$\frac{\text{length of the line segment } EF}{\text{length of the line segment } ES}$ is _______.

10. Let S be the set of all seven-digit numbers that can be formed using the digits 0,1 and 2 . For example, 2210222 is in S , but 0210222 is **NOT** in S .

Then the number of elements x in S such that at least one of the digits 0 and 1 appears exactly twice in x, is equal to ___________ .

11. Let α and β be the real numbers such that $\lim_{x\to 0}\frac{1}{x^3}\left(\frac{\alpha}{2}\int_0^x \frac{1}{1-t^2}dt+\beta x\cos x\right)=2$

Then the value of $\alpha+\beta$ is ______ .

12. Let $\mathbb{R}$ denote the set of all real numbers. Let $f:\mathbb{R}\to\mathbb{R}$ be a function such that $f(x)>0$ for all $x\in\mathbb{R}$, and $f(x+y)=f(x)f(y)$ for all $x,y\in\mathbb{R}$.

Let the real numbers $a_1,a_2,\ldots,a_{50}$ be in an arithmetic progression. If $f(a_{31})=64f(a_{25})$, and $\sum_{i=1}^{50} f(a_i)=3\left(2^{25}+1\right)$ then the value of $\sum_{i=6}^{30} f(a_i)$ is ______ .

13. For all $x>0$, let $y_1(x), y_2(x)$, and $y_3(x)$ be the functions satisfying

$$\frac{dy_1}{dx}-(\sin x)^2 y_1=0, \quad y_1(1)=5$$

$$\frac{dy_2}{dx}-(\cos x)^2 y_2=0, \quad y_2(1)=\frac{1}{3}$$

$$\frac{dy_3}{dx}-\left(\frac{2-x^3}{x^3}\right)y_3=0, \quad y_3(1)=\frac{3}{5e}$$

respectively. Then

$$\lim_{x\to 0^+}\frac{y_1(x)y_2(x)y_3(x)+2x}{e^{3x}\sin x}$$

is equal to _____ .

SECTION-4 (Maximum Marks: 12)

- This section contains **THREE (03)** Matching List Sets.
- Each set has **ONE** Multiple Choice Question.
- Each set has TWO lists: List-I and List-II.
- **List-I** has Four entries (P), (Q), (R) and (S) and List-**II** has Five entries (1), (2), (3), (4) and (5).
- FOUR options are given in each Multiple Choice Question based on List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 ONLY if the option corresponding to the correct combination is chosen;

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

Negative Marks : −1 In all other cases.

14. Consider the following frequency distribution:

Value	4	5	8	9	6	12	11
Frequency	5	f_1	f_2	2	1	1	3

Suppose that the sum of the frequencies is 19 and the median of this frequency distribution is 6.

For the given frequency distribution, let α denote the mean deviation about the mean, β denote the mean deviation about the median, and σ^2 denote the variance.

Match each entry in List-I to the correct entry in List-II and choose the correct option.

List-I	**List-II**
(P) $7f_1+9f_2$ is equal to	(1) 146
(Q) 19α is equal to	(2) 47
(R) 19β is equal to	(3) 48
(S) $19\sigma^2$ is equal to	(4) 145
	(5) 55

(A) (P) ⟶ (5) (Q) ⟶ (3) (R) ⟶ (2) (S) ⟶ (4)
(B) (P) ⟶ (5) (Q) ⟶ (2) (R) ⟶ (3) (S) ⟶ (1)
(C) (P) ⟶ (5) (Q) ⟶ (3) (R) ⟶ (2) (S) ⟶ (1)
(D) (P) ⟶ (3) (Q) ⟶ (2) (R) ⟶ (5) (S) ⟶ (4)

15. Let $\mathbb{R}$ denote the set of all real numbers. For a real number x, let $[x]$ denote the greatest integer less than or equal to x. Let n denote a natural number.

Match each entry in List-I to the correct entry in List-II and choose the correct option.

List-I | **List-II**

(P) The minimum value of n for which the function $f(x)=\left[\dfrac{10x^3-45x^2+60x+35}{n}\right]$ is continuous on the interval [1,2], is — (1) 8

(Q) The minimum value of n for which $g(x)=(2n^2-13n-15)(x^3+3x)$, $x\in\mathbb{R}$, is an increasing function on $\mathbb{R}$, is — (2) 9

(R) The smallest natural number n which is greater than 5, such that $x=3$ is a point of local minima of $h(x)=(x^2-9)^n(x^2+2x+3)$, is — (3) 5

(S) Number of $x_0\in\mathbb{R}$ such that — (4) 6

$$l(x)=\sum_{k=0}^{4}\left(\sin|x-k|+\cos\left|x-k+\frac{1}{2}\right|\right),$$

$x\in\mathbb{R}$, is **NOT** differentiable at x_0, is — (5) 10

(A) (P) ⟶ (1) (Q) ⟶ (3) (R) ⟶ (2) (S) ⟶ (5)
(B) (P) ⟶ (2) (Q) ⟶ (1) (R) ⟶ (4) (S) ⟶ (3)
(C) (P) ⟶ (5) (Q) ⟶ (1) (R) ⟶ (4) (S) ⟶ (3)
(D) (P) ⟶ (2) (Q) ⟶ (3) (R) ⟶ (1) (S) ⟶ (5)

16. Let $\vec{w} = \hat{i} + \hat{j} - 2\hat{k}$, and $\vec{u}$ and $\vec{v}$ be two vectors, such that $\vec{u} \times \vec{v} = \vec{w}$ and $\vec{v} \times \vec{w} = \vec{u}$. Let α, β, γ, and t be real numbers such that

$$\vec{u} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}, \quad -t\alpha + \beta + \gamma = 0, \quad \alpha - t\beta + \gamma = 0, \quad \text{and } \alpha + \beta - t\gamma = 0$$

Match each entry in List-I to the correct entry in List-II and choose the correct option.

List-I	**List-II**
(P) $\lvert\vec{v}\rvert^2$ is equal to	(1) 0
(Q) If $\alpha = \sqrt{3}$, then γ^2 is equal to	(2) 1
(R) If $\alpha = \sqrt{3}$, then $(\beta + \gamma)^2$ is equal to	(3) 2
(S) If $\alpha = \sqrt{2}$, then $t + 3$ is equal to	(4) 3
	(5) 5

(A) (P) ⟶ (2) (Q) ⟶ (1) (R) ⟶ (4) (S) ⟶ (5)

(B) (P) ⟶ (2) (Q) ⟶ (4) (R) ⟶ (3) (S) ⟶ (5)

(C) (P) ⟶ (2) (Q) ⟶ (1) (R) ⟶ (4) (S) ⟶ (3)

(D) (P) ⟶ (5) (Q) ⟶ (4) (R) ⟶ (1) (S) ⟶ (3)

NTA FINAL ANSWERS

1.	**(C)**	**2.**	**(A)**	**3.**	**(C)**	**4.**	**(C)**	**5.**	**(A,C)**
6.	**(A,D)**	**7.**	**(A,D)**	**8.**	**105**	**9.**	**1.15 to 1.25**	**10.**	**762**
11.	**2.35 to 2.45**	**12.**	**96**	**13.**	**2**	**14.**	**(C)**	**15.**	**(B)**
16.	**(A)**								