

JEE MAIN Sample Paper Mathematics

Duration: 1 Hour

Maximum Marks: 100

Instructions

1. This paper contains TWO sections: Section A and Section B.
2. Section A contains 20 Multiple Choice Questions (MCQs).
3. Section B contains 5 Numerical Value Questions.
4. All questions are compulsory.
5. Each correct answer carries **+4 marks**.
6. Each incorrect answer carries **-1 mark**.
7. No negative marking for unattempted questions.
8. Use $g = 9.8 \text{ m/s}^2$ unless otherwise stated.

Section A — Multiple Choice Questions

- Q1.** Let A be a 3×3 matrix such that $A^2 = A$ and $(I - A)^4 = I - kA$. The value of k is: [2024]
- (A) 1
(B) 2
(C) 0
(D) 4
- Q2.** Constant term in $(\sqrt{x} - k/x^2)^{10}$ is 405. Find $|k|$: [2023]
- (A) 2
(B) 3
(C) 9
(D) $\sqrt{3}$
- Q3.** Let $f(x) = |x - 1| + |x - 2| + |x - 3|$. Minimum value of $f(x)$ is: [2022]
- (A) 1
(B) 2
(C) 3
(D) 0
- Q4.** Eccentricity of hyperbola $\frac{x^2}{\cos^2 \theta} - \frac{y^2}{\sin^2 \theta} = 1 > 2$ for $\theta \in (0, \pi/2)$, length of latus rectum interval: [2025]
- (A) $(3, \infty)$
(B) $(1, 3)$
(C) $(2, \infty)$
(D) $(0, 2)$
- Q5.** Area bounded by $y = \log_e(x + e)$, $x = \log_e(1/y)$ and x-axis is: [2021]
- (A) 1
(B) 2
(C) $e - 1$
(D) $1 + e$

- Q6.** Mean = 9, variance = 18, 7 observations are 6,7,10,12,12,13,8. Find 8th: [2024]
 (A) 2
 (B) 4
 (C) 5
 (D) 3
- Q7.** Number of points of intersection of $r = 2 \sin \theta$ and $r = 2 \cos \theta$: [2023]
 (A) 1
 (B) 2
 (C) 3
 (D) 4
- Q8.** If $\int \frac{x^2-1}{x^4+x^2+1} dx = \frac{1}{2} \log |f(x)| + C$, then $f(x)$ is: [2022]
 (A) $\frac{x^2-x+1}{x^2+x+1}$
 (B) $\frac{x^2+x+1}{x^2-x+1}$
 (C) $x^2 + \frac{1}{x^2}$
 (D) $x + \frac{1}{x}$
- Q9.** $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = \hat{i} + \hat{j}$. \vec{c} satisfies $\vec{a} \cdot \vec{c} = |\vec{c}|$, $|\vec{c} - \vec{a}| = 2\sqrt{2}$, angle between $(\vec{a} \times \vec{b})$ and \vec{c} is $\pi/6$. Then $|(\vec{a} \times \vec{b}) \times \vec{c}|$ is: [2025]
 (A) 2/3
 (B) 3/2
 (C) 1/2
 (D) 5/2
- Q10.** If $x^2 + y^2 + \sin y = 4$, $\frac{d^2y}{dx^2}$ at (2,0) is: [2021]
 (A) -4
 (B) -8
 (C) -2
 (D) 0
- Q11.** Number of solutions of $\sin x \cos x = 1/4$ in $[0, \pi]$ is: [2024]
 (A) 1
 (B) 2
 (C) 3
 (D) 4
- Q12.** Plane passing through (1, 2, 3) perpendicular to $x+y+z = 1$ and $x-y+z = 0$. Distance of (0, 0, 0) from plane: [2023]
 (A) $1/\sqrt{2}$
 (B) $\sqrt{2}$
 (C) $2\sqrt{2}$
 (D) 3
- Q13.** Sum of coefficients of even powers in $(1 + x + x^2 + \dots + x^{2n})^n = 61$. Find n : [2022]
 (A) 2
 (B) 3
 (C) 4
 (D) 5
- Q14.** Shortest distance between lines $\vec{r} = (1-t)\hat{i} + (t-2)\hat{j} + (3-2t)\hat{k}$ and $\vec{r} = (s+1)\hat{i} + (2s-1)\hat{j} - (2s+1)\hat{k}$ is: [2025]
 (A) 0
 (B) $1/\sqrt{2}$
 (C) $2\sqrt{2}$
 (D) 9
- Q15.** If α, β are roots of $x^2 - x + 1 = 0$, then $\alpha^{2021} + \beta^{2021}$ is: [2021]
 (A) 1
 (B) 2
 (C) -1
 (D) 0

Q16. Line $y = 3x + k$ touches circle $x^2 + y^2 = 10$. Value of k : [2024]

- (A) ± 10
- (B) ± 5
- (C) $\pm\sqrt{10}$
- (D) ± 2

Q17. $f(x) = \min\{x, x^2, x^3\}$. Number of non-differentiable points: [2023]

- (A) 1
- (B) 2
- (C) 3
- (D) 0

Q18. Binomial distribution: mean = 4, variance = 3. Probability of exactly 1 success: [2022]

- (A) $4(3/4)^{15}$

- (B) $16(3/4)^{15}$
- (C) $(3/4)^{16}$
- (D) $16(1/4)^{16}$

Q19. $y = y(x)$ solves $(x + 1)dy - ydx = (x + 1)^2 e^x dx$, $y(0) = 0$. $y(1)$ is: [2025]

- (A) $2e$
- (B) e
- (C) $2(e - 1)$
- (D) $e - 1$

Q20. Number of 5-digit numbers such that sum of digits is even: [2024]

- (A) 45000
- (B) 50000
- (C) 44999
- (D) 90000

Section B — Numerical Value Questions

Q21. Solve $2x + 3y - z = 0$, $x + ky - 2z = 0$, $2x - y + z = 0$ for non-trivial solution. Find k . [2024]

Q22. Area bounded by $y = \sqrt{x}$ and $y = x - 2$. [2023]

Q23. If $\vec{a} \cdot \vec{b} = 3$ and $|\vec{a} \times \vec{b}| = 4$, find $|\vec{a}|^2 |\vec{b}|^2$. [2025]

Q24. Find number of local maxima of $f(x) = \int_0^{x^2} \frac{t^2 - 5t + 4}{2 + e^t} dt$. [2022]

Q25. Probability of hitting target $1/4$, fired n times, probability ≥ 0.9 . Find minimum n . [2024]

Answer Key

Section A

1.(A)	2.(B)	3.(B)	4.(A)	5.(A)
6.(A)	7.(B)	8.(A)	9.(B)	10.(B)
11.(B)	12.(B)	13.(B)	14.(D)	15.(A)
16.(A)	17.(B)	18.(B)	19.(C)	20.(A)

Section B

21. $9/2$	22. 4.5	23. 25	24. 2	25. 8
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