

# JEE Main 2024 Mathematics Question Paper Jan 31 Shift 2

1. If  $a = \sin^{-1}(\sin 5)$ ,  $b = \cos^{-1}(\cos 5)$ , then  $a^2 + b^2$  is equal to:

- (1)  $8\pi^2 - 40\pi + 50$
  - (2)  $4\pi^2 + 25$
  - (3)  $8\pi^2 - 50$
  - (4)  $8\pi^2 + 40\pi + 50$
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2. A coin is biased such that head has two chances than tails, what is the probability of getting 2 heads and 1 tail?

- (1)  $\frac{1}{29}$
  - (2)  $\frac{2}{29}$
  - (3)  $\frac{1}{9}$
  - (4)  $\frac{4}{9}$
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3. Let mean and variance of 6 observations  $a, b, 68, 44, 40, 60$  be 55 and 194. If  $a > b$ , then find  $a + 3b$ .

- (1) 211.83
  - (2) 201.59
  - (3) 189.57
  - (4) 198.87
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4. If the 2nd, 8th, and 44th terms of an A.P. are the 1st, 2nd, and 3rd terms respectively of a G.P. and the first term of A.P. is 1, then the sum of the first 20 terms of the A.P. is:

- (1) 970
  - (2) 916
  - (3) 980
  - (4) 990
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5. The area of the region enclosed by the parabolas

$$y = 4 - x^2 \quad \text{and} \quad 3y = (x - 4)^2 \quad \text{is in (sq. units).}$$

- (1)  $\frac{14}{3}$
  - (2) 4
  - (3)  $\frac{32}{3}$
  - (4) 6
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6. If

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 1 & -1 \\ -1 & 4 & 0 \end{bmatrix}, \quad A^{-1} = \begin{bmatrix} 0 & 2 & 1 \\ 1 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix},$$

then the value of  $(A - 3I) \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \\ 3 \end{bmatrix}$  is:

- (1) (1, 2, 3)
- (2) (1, -2, 3)

- (3)  $(1, -2, -3)$   
(4)  $(-1, -2, -3)$
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7. Let  $f : \mathbb{R} \rightarrow \infty$  be an increasing function such that

$$\lim_{x \rightarrow \infty} \frac{f(7x)}{f(x)} = 1. \quad \text{Then} \quad \lim_{x \rightarrow \infty} \frac{f(5x)}{f(x) - 1} \quad \text{is equal to:}$$

- (1) 0  
(2) 4  
(3) 1  
(4)  $\frac{4}{5}$
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8. Let  $z_1$  and  $z_2$  be two complex numbers such that

$$z_1 + z_2 = 5 \quad \text{and} \quad z_1^3 + z_2^3 = 20 + 15i, \quad \text{then the value of} \quad |z_1^4 + z_2^4| \quad \text{is equal to:}$$

- (1) 75  
(2)  $25\sqrt{5}$   
(3)  $15\sqrt{15}$   
(4)  $30\sqrt{3}$
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9. The number of solutions to the equation

$$e^{\sin x} - 2e^{-\sin x} = 2$$

- (1) More than 2  
(2) 2  
(3) 1  
(4) 0
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10. The line passes through the center of the circle

$x^2 + y^2 - 16x - 4y = 0$ , it intersects with the positive coordinate axis at A & B. Then find the minimum value of OA + OB,

- (1) 20  
(2) 18  
(3) 12  
(4) 24
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11. If for some  $m, n$ :

$$6C_m + 2(6C_{m+1}) + 6C_{m+2} > 8C_3$$

and

$${}^{n-1}P_3 : {}^nP_4 = 1 : 8, \quad \text{then} \quad nP_{m+1} + n^{+1}C_m \quad \text{is equal to:}$$

- (1) 6756  
(2) 7250  
(3) 6223  
(4) 6550

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12. Let  $f : (-\infty, -1] \rightarrow (a, b)$  be defined as

$f(x) = e^{x^3-3x+1}$ , if  $f$  is both one and onto, then the distance from a point  $P(2a+4, b+2)$  to curve  $x+ye^{3-4} = 0$  is:

- (1)  $\sqrt{e^3 + 2}$
- (2)  $\frac{e^3+2}{\sqrt{e^3+1}}$
- (3)  $\frac{e^3+2}{\sqrt{e^6+1}}$
- (4)  $e$

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13. If  $(\alpha, \beta, \gamma)$  is the mirror image of the point  $(2, 3, 4)$  with respect to the line

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}, \quad \text{then } 2\alpha + 3\beta + 4\gamma \text{ is:}$$

- (1) 29
- (2) 30
- (3) 31
- (4) 32

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14. A parabola has vertex  $(2, 3)$ , equation of the directrix is  $2x - y = 1$ , and the equation of ellipse is

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ,  $e = \frac{1}{\sqrt{2}}$ , and ellipse passing through the focus of parabola. Then the square of the length of the latus rectum is

- (1)  $\frac{6564}{25}$
- (2)  $\frac{3288}{25}$
- (3)  $\frac{6272}{25}$
- (4)  $\frac{4352}{25}$

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21. The value of

$$\frac{120}{\pi^3} \int_0^\pi \frac{x^2 \sin x \cos x}{(\sin x)^4 + (\cos x)^4} dx \text{ is:}$$

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22. The number of ways to distribute the 21 identical apples to three children so that each child gets at least 2 apples is:

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23. If  $A = \{1, 2, 3, \dots, 100\}$ ,  $R = \{(x, y) \mid 2x = 3y, x, y \in A\}$  is a symmetric relation on  $A$ , and the number of elements in  $R$  is  $n$ , the smallest integer value of  $n$  is:

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24. Matrix  $A$  of order  $3 \times 3$  is such that  $|A| = 2$ , if

$$n = \text{adj}(\text{adj}(\text{adj}(\dots(A))\dots)) \quad 2024 \text{ times,}$$

then the remainder when  $n$  is divided by 9 is:

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