

**JEE Main April 2024**  
**Question Paper With Text Solution**  
**08 April | Shift-2**

**MATHEMATICS**



**JEE Main & Advanced | XI-XII Foundation | VI-X Pre-Foundation**

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**JEE MAIN APRIL 2024 | 08<sup>TH</sup> APRIL SHIFT-2****SECTION - A**

Question ID : 87827056058

1. Let  $A = \{2,3,6,8,9,11\}$  and  $B = \{1,4,5,10,15\}$ . Let  $R$  be a relation on  $A \times B$  defined by  $(a, b)R(c, d)$  if and only if  $3ad - 7bc$  is an even integer. Then the relation  $R$  is :

- (1) an equivalence relation (2) reflexive but not symmetric  
 (3) reflexive and symmetric but not transitive (4) transitive but not symmetric

**Ans.** Official answer NTA(3)**Sol.**

Question ID : 87827056061

2. If  $\alpha \neq a, \beta \neq b, \gamma \neq c$  and  $\begin{vmatrix} \alpha & b & c \\ a & \beta & c \\ a & b & \gamma \end{vmatrix} = 0$ , then  $\frac{a}{\alpha-a} + \frac{b}{\beta-b} + \frac{\gamma}{\gamma-c}$  is equal to :

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

**Ans.** Official answer NTA(2)**Sol.**

Question ID : 87827056066

3. For  $a, b > 0$ , let  $f(x) = \begin{cases} \frac{\tan((a+1)x) + b \tan x}{x}, & x < 0 \\ 3, & x = 0 \\ \frac{\sqrt{ax + b^2x^2} - \sqrt{ax}}{b\sqrt{ax}\sqrt{x}}, & x > 0 \end{cases}$  be a continuous function at  $x = 0$ . Then  $\frac{b}{a}$  is equal

to :

- (1) 5 (2) 6 (3) 4 (4) 8

**Ans.** Official answer NTA(2)**Sol.****MATRIX JEE ACADEMY****Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911****Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in**



Question ID : 87827056067

4. If the function  $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1$ ,  $a > 0$  has a local maximum at  $x = \alpha$  and a local minimum at  $x = \alpha^2$ , then  $\alpha$  and  $\alpha^2$  are the roots of the equation :
- (1)  $8x^2 + 6x - 1 = 0$     (2)  $x^2 + 6x + 8 = 0$     (3)  $x^2 - 6x + 8 = 0$     (4)  $8x^2 - 6x + 1 = 0$

**Ans.** Official answer NTA(3)**Sol.**

Question ID : 87827056074

5. Let  $\vec{a} = 4\hat{i} - \hat{j} + \hat{k}$ ,  $\vec{b} = 11\hat{i} - \hat{j} + \hat{k}$  and  $\vec{c}$  be a vector such that  $(\vec{a} + \vec{b}) \times \vec{c} = \vec{c} \times (-2\vec{a} + 3\vec{b})$ . If  $(2\vec{a} + 3\vec{b}) \cdot \vec{c} = 1670$  then  $|\vec{c}|^2$  is equal to :
- (1) 1618                      (2) 1609                      (3) 1600                      (4) 1627

**Ans.** Official answer NTA(1)**Sol.**

Question ID : 87827056069

6. The area of the region in the first quadrant inside the circle  $x^2 + y^2 = 8$  and outside the parabola  $y^2 = 2x$  is equal to :
- (1)  $\pi - \frac{2}{3}$                       (2)  $\pi - \frac{1}{3}$                       (3)  $\frac{\pi}{2} - \frac{1}{3}$                       (4)  $\frac{\pi}{2} - \frac{2}{3}$

**Ans.** Official answer NTA(1)**Sol.**

Question ID : 87827056076

7. There are three bags X, Y and Z. Bag X contains 5 one-rupee coins and 4 five-rupee coins; Bag Y contains 4 one-rupee coins and 5 five-rupee coins and Bag Z contains 3 one-rupee coins and 6 five-rupee coins. A bag is selected at random and a coin drawn from it at random is found to be a one-rupee coin. Then the probability, that it came from bag Y, is :
- (1)  $\frac{1}{2}$                       (2)  $\frac{1}{4}$                       (3)  $\frac{1}{3}$                       (4)  $\frac{5}{12}$

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**Ans.** Official answer NTA (3)

**Sol.**

Question ID : 87827056064

8. The sum of all possible values of  $\theta \in [-\pi, 2\pi]$ , for which  $\frac{1+i\cos\theta}{1-2i\cos\theta}$  is purely imaginary, is equal to :

- (1)  $2\pi$                       (2)  $5\pi$                       (3)  $3\pi$                       (4)  $4\pi$

**Ans.** Official answer NTA (3)

**Sol.**

Question ID : 87827056062

9. The number of ways five alphabets can be chosen from the alphabets of the word MATHEMATICS, where the chosen alphabets are not necessarily distinct, is equal to :

- (1) 181                      (2) 177                      (3) 179                      (4) 175

**Ans.** Official answer NTA (3)

**Sol.**

Question ID : 87827056065

10. In an increasing geometric progression of positive terms, the sum of the second and sixth terms is  $\frac{70}{3}$  and the product of the third and fifth terms is 49. Then the sum of the 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> terms is equal to :

- (1) 91                      (2) 96                      (3) 78                      (4) 84

**Ans.**

**Ans.** Official answer NTA (1)

Question ID : 87827056075

11. Let  $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ ,  $\vec{b} = 2\hat{i} + 3\hat{j} - 5\hat{k}$  and  $\vec{c} = 3\hat{i} - \hat{j} + \lambda\hat{k}$  be three vectors. Let  $\vec{r}$  be a unit vector along  $\vec{b} + \vec{c}$ . If  $\vec{r} \cdot \vec{a} = 3$ , then  $3\lambda$  is equal to :

- (1) 30                      (2) 21                      (3) 25                      (4) 27

**Ans.** Official answer NTA (3)

**Sol.**

Question ID : 87827056060

12. If the system of equations  $x + 4y - z = \lambda$ ,  $7x + 9y + \mu z = -3$ ,  $5x + y + 2z = -1$  has infinitely many solutions, then  $(2\mu + 3\lambda)$  is equal to :

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

**Ans.** Official answer NTA (3)**Sol.**

Question ID : 87827056068

13. Let  $\int_{\alpha}^{\log_e 4} \frac{dx}{\sqrt{e^x - 1}} = \frac{\pi}{6}$ . Then  $e^{\alpha}$  and  $e^{-\alpha}$  are the roots of the equation :

- (1)  $2x^2 - 5x - 2 = 0$     (2)  $x^2 - 2x - 8 = 0$     (3)  $2x^2 - 5x + 2 = 0$     (4)  $x^2 + 2x - 8 = 0$

**Ans.** Official answer NTA (3)**Sol.**

Question ID : 87827056077

14. If the value of  $\frac{3 \cos 36^\circ + 5 \sin 18^\circ}{5 \cos 36^\circ - 3 \sin 18^\circ}$  is  $\frac{a\sqrt{5} - b}{c}$ , where a, b, c are natural numbers and  $\gcd(a, c) = 1$ , then  $a + b + c$  is equal to :

- (1) 52                      (2) 50                      (3) 40                      (4) 54

**Ans.** Official answer NTA (1)**Sol.**

Question ID : 87827056063

15. If the term independent of x in the expansion of  $\left(\sqrt{ax^2} + \frac{1}{2x^3}\right)^{10}$  is 105, then  $a^2$  is equal to :

- (1) 4                      (2) 2                      (3) 9                      (4) 6

**Ans.** Official answer NTA (1)**MATRIX JEE ACADEMY****Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911****Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in**

**Sol.**

Question ID : 87827056072

16. If the image of the point  $(-4,5)$  in the line  $x + 2y = 2$  lies on the circle  $(x + 4)^2 + (y - 3)^2 = r^2$ , then  $r$  is equal to:
- (1) 4                      (2) 1                      (3) 3                      (4) 2

**Ans.** Official answer NTA (4)**Sol.**

Question ID : 87827056059

17. Let  $f(x) = \begin{cases} -a & \text{if } -a \leq x \leq 0 \\ x+a & \text{if } 0 < x \leq a \end{cases}$  where  $a > 0$  and  $g(x) = \frac{(f(|x|) - |f(x)|)}{2}$ . Then the function  $g : [-a, a] \rightarrow [-a, a]$  is :
- (1) one-one                      (2) neither one-one nor onto  
(3) onto                      (4) both one-one and onto

**Ans.** Official answer NTA (2)**Sol.**

Question ID : 87827056070

18. Let  $y=y(x)$  be the solution curve of the differential equation  $\sec y \frac{dy}{dx} + 2x \sin y = x^3 \cos y$ ,  $y(1) = 0$ . Then  $y(\sqrt{3})$  is equal to :
- (1)  $\frac{\pi}{6}$                       (2)  $\frac{\pi}{12}$                       (3)  $\frac{\pi}{4}$                       (4)  $\frac{\pi}{3}$

**Ans.** Official answer NTA (3)**Sol.**

Question ID : 87827056071

19. If the line segment joining the points  $(5,2)$  and  $(2,a)$  subtends an angle  $\frac{\pi}{4}$  at the origin, then the absolute value of the product of all possible values of  $a$  is :

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(1) 2

(2) 8

(3) 4

(4) 6

**Ans.** Official answer NTA (3)**Sol.**

Question ID : 87827056073

20. If the shortest distance between the lines  $\frac{x-\lambda}{2} = \frac{y-4}{3} = \frac{z-3}{4}$  and  $\frac{x-2}{4} = \frac{y-4}{6} = \frac{z-7}{8}$  is  $\frac{13}{\sqrt{29}}$ , then a value of  $\lambda$  is :

(1)  $\frac{13}{25}$ 

(2) 1

(3)  $-\frac{13}{25}$ 

(4) -1

**Ans.** Official answer NTA (2)**Sol.****SECTION - B**

Question ID : 87827056081

21. Let A be the region enclosed by the parabola  $y^2 = 2x$  and the line  $x = 24$ . Then the maximum area of the rectangle inscribed in the region A is \_\_\_\_\_.

**Ans.** Official answer NTA (128)**Sol.**

Question ID : 87827056085

22. Let S be the focus of the hyperbola  $\frac{x^2}{3} - \frac{y^2}{5} = 1$ , on the positive x-axis. Let C be the circle with its centre at  $A(\sqrt{6}, \sqrt{5})$  and passing through the point S. If O is the origin and SAB is a diameter of C, then the square of the area of the triangle OSB is equal to \_\_\_\_\_.

**Ans.** Official answer NTA (40)**Sol.**



Question ID : 87827056083

23. If  $\int \frac{1}{\sqrt[5]{(x-1)^4 (x+3)^6}} dx = A \left( \frac{\alpha x - 1}{\beta x + 3} \right)^B + C$ , where C is the constant of integration, then the value of  $\alpha + \beta + 20AB$  is \_\_\_\_\_.

**Ans.** Official answer NTA (7)**Sol.**

Question ID : 87827056078

24. The number of distinct real roots of the equation  $|x + 1| |x + 3| - 4|x + 2| + 5 = 0$ , is \_\_\_\_\_.

**Ans.** Official answer NTA (2)**Sol.**

Question ID : 87827056080

25. An arithmetic progression is written in the following way

		2		
	5		8	
11		14		17
20	23		26	29
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The sum of all the terms of the 10<sup>th</sup> row is \_\_\_\_\_.

**Ans.** Official answer NTA (1505)**Sol.**

Question ID : 87827056082

26. If  $\alpha = \lim_{x \rightarrow 0^+} \left( \frac{e^{\sqrt{\tan x}} - e^{\sqrt{x}}}{\sqrt{\tan x} - \sqrt{x}} \right)$  and  $\beta = \lim_{x \rightarrow 0} (1 + \sin x)^{\frac{1}{2} \cot x}$  are the roots of the quadratic equation  $ax^2 + bx - \sqrt{e} = 0$ , then  $12 \log_e (a + b)$  is equal to \_\_\_\_\_.

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**Ans.** Official answer NTA (6)

**Sol.**

Question ID : 87827056079

27. Let a ray of light passing through the point (3,10) reflects on the line  $2x + y = 6$  and the reflected ray passes through the point (7,2). If the equation of the incident ray is  $ax + by + 1 = 0$ , then  $a^2 + b^2 + 3ab$  is equal to \_\_\_\_\_.

**Ans.** Official answer NTA (1)

**Sol.**

Question ID : 87827056086

28. Let  $P(\alpha, \beta, \gamma)$  be the image of the point  $Q(1,6,4)$  in the line  $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ . Then  $2\alpha + \beta + \gamma$  is equal to \_\_\_\_\_.

**Ans.** Official answer NTA (11)

**Sol.**

Question ID : 87827056087

29. Let  $a, b, c \in \mathbb{N}$  and  $a < b < c$ . Let the mean, the mean deviation about the mean and the variance of the 5 observations 9, 25,  $a, b, c$  be 18, 4 and  $\frac{136}{5}$ , respectively. Then  $2a + b - c$  is equal to \_\_\_\_\_.

**Ans.** Official answer NTA (33)

**Sol.**

Question ID : 87827056084

30. Let  $\alpha|x| = |y|e^{xy-\beta}$ ,  $\alpha, \beta \in \mathbb{N}$  be the solution of the differential equation  $x dy - y dx + xy(x dy + y dx) = 0$ ,  $y(1) = 2$ . Then  $\alpha + \beta$  is equal to \_\_\_\_\_.

**Ans.** Official answer NTA (4)

**Sol.**