Tarun Classes of Mathematics

IIT-JEE Mains | CBSE | PU-CET | NDA

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Matrices And Determinants

Subjects : Maths | **Previous Year Questions of JEE Mains**

Maths - Section A (MCQ)

1. Let $\alpha, \beta \in \mathbb{R}$ be such that the system of linear equations

$x + 2y + z = 5$

$2x + y + \alpha z = 5$

$8x + 4y + \beta z = 18$

has no solution. Then $\frac{\beta}{\alpha}$ is equal to :

A) -4 **B)** 4 **C)** 8 **D)** -8

2. If the system of equations

$x + 5y + 6z = 4$,

$2x + 3y + 4z = 7$,

$x + 6y + az = b$

has infinitely many solutions, then the point (a, b) lies on the line

A) $y - x = 3$ **B)** $x - y = 3$ **C)** $x + y = 11$ **D)** $x + y = 12$

3. Consider the system of linear equations in x, y, z:

$x + 2y + tz = 0$,

$6x + y + 5tz = 0$,

$3x + t^2y + f(t)z = 0$,

where $f : \mathbb{R} \to \mathbb{R}$ is a differentiable function. If this system has infinitely many solutions for all $t \in \mathbb{R}$, then f

A) is a constant function **B)** is strictly increasing on $\mathbb{R}$

C) is strictly decreasing on $\mathbb{R}$ **D)** has two critical points

4. Let $A = \begin{bmatrix} 1 & 3 & -1 \\ 2 & 1 & \alpha \\ 0 & 1 & -1 \end{bmatrix}$ be a singular matrix. Let $f(x) = \int_0^x (t^2 + 2t + 3)\, dt$, $x \in [1, \alpha]$. If M and m are respectively the maximum and the minimum values of f in $[1, \alpha]$, then $3(M - m)$ is equal to :

A) 64 **B)** 68 **C)** 72 **D)** 76

5. If $f : \mathbf{N} \to \mathbf{Z}$ is defined by

$$f(n) = \begin{vmatrix} n & -1 & -5 \\ -2n^2 & 3(2k+1) & 2k+1 \\ -3n^3 & 3k(2k+1) & 3k(k+2)+1 \end{vmatrix}, k \in \mathbf{N},$$

and $\sum_{n=1}^{k} f(n) = 98$, then k is equal to :

A) 3 **B)** 4 **C)** 5 **D)** 6

6. The sum of all possible values of $\theta \in [0, 2\pi]$, for which the system of equations :

$x\cos 3\theta - 8y - 12z = 0$

$x\cos 2\theta + 3y + 3z = 0$

$x + y + 3z = 0$

has a non-trivial solution, is equal to :

A) π **B)** 2π **C)** 3π **D)** 4π

7. If the system of linear equations:

$x + y + z = 6$,

$x + 2y + 5z = 10$,

$2x + 3y + \lambda z = \mu$

has infinitely many solutions, then the value of $\lambda + \mu$ equals:

A) 12 **B)** 16 **C)** 22 **D)** 28

8. Consider the matrices $A = \begin{bmatrix} 2 & -2 \\ 4 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 9 \\ 1 & 3 \end{bmatrix}$. If matrices P and Q are such that $PA = B$ and $AQ = B$, then the absolute value of the sum of the diagonal elements of $2(P + Q)$ is _____.

A) 35 **B)** 33 **C)** 34 **D)** 36

9. Let $S = \left\{ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} : a, b, c, d \in \{0, 1, 2, 3, 4\} \text{ and } A^2 - 4A + 3I = 0 \right\}$ be a set of 2×2 matrixes. Then the number of matrixes in S, for which the sum of the diagonal elements is equal to 4, is:

A) 20 **B)** 17 **C)** 21 **D)** 19

10. Let $A = \begin{bmatrix} 1 & 1 & 2 \\ -2 & 0 & 1 \\ 1 & 3 & 5 \end{bmatrix}$. Then the sum of all elements of the matrix $\text{adj}(\text{adj}(2(\text{adj}A)^{-1}))$ is equal to:

A) 3 **B)** 4 **C)** -4 **D)** -3

11. Let $A = \begin{bmatrix} 1 & 2 & 7 \\ 4 & -2 & 8 \\ 3 & 8 & -7 \end{bmatrix}$ and $\det(A - \alpha I) = 0$, where α is a real number. If the largest possible value of α is p, then the circle $(x - p)^2 + (y - 2p)^2 = 320$, intersects the co-ordinate axes at

A) 1 point **B)** 2 points **C)** 3 points **D)** 4 points

12. Let M be a 3×3 matrix such that $M \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$, $M \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 2 \end{pmatrix}$ and $M \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$. If $M \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 7 \\ 11 \end{pmatrix}$, then $x + y + z$ equals :

A) 4 **B)** 5 **C)** 7 **D)** 11

13. Let A be a 3×3 matrix such that $A^T \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 2 \\ 2 \end{bmatrix}$, $A^T \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}$, $A \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \\ 4 \end{bmatrix}$ and $A \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix}$. If $\det(A) = 1$, then $\det(\text{adj}(A^2 + A))$ is equal to:

A) 16 **B)** 25 **C)** 49 **D)** 64

14. Let $A = \begin{bmatrix} -1 & 1 & -1 \\ 1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ satisfy $A^2 + \alpha(adj(adj(A))) + \beta(adj(A)(adj(adj(A)))) = \begin{bmatrix} 2 & -2 & 2 \\ -2 & 0 & -1 \\ 0 & 0 & -1 \end{bmatrix}$ for some $\alpha, \beta \in \mathbb{R}$. Then $(\alpha - \beta)^2$ is equal to _____

A) 1 **B)** 2 **C)** 3 **D)** 4

15. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$ and $B = [b_{ij}]$, $1 \le i, j \le 3$. If $B = A^{99} - I$, then the value of $\frac{b_{31} - b_{21}}{b_{32}}$ is :

A) 99 B) 199 C) 149 D) 159

16. Let $A=\begin{bmatrix}\alpha & 1 & 2\\ 2 & 3 & 0\\ 0 & 4 & 5\end{bmatrix}$ and $B=\begin{bmatrix}1 & 0 & 0\\ 0 & -5\alpha & 0\\ 0 & 4\alpha & -2\alpha\end{bmatrix}+\text{adj}(A)$. If $\det(B)=66$, then $\det(\text{adj}(A))$ equals:

A) 289 B) 361 C) 441 D) 529

17. Let $A=\begin{bmatrix}3 & -4\\ 1 & -1\end{bmatrix}$ and B be two matrices such that $A^{100}=100B+I$. Then the sum of all the elements of B^{100} is ___ .

A) 0 B) 100 C) 1 D) -1

18. The number of 3×2 matrices A, which can be formed using the elements of the set $\{-2,-1,0,1,2\}$ such that the sum of all the diagonal elements of A^TA is 5, is ___ .

A) 300 B) 312 C) 324 D) 340

19. If the system of equations $3x+y+4z=3$, $2x+ay-z=-3$, $x+2y+z=4$ has no solution, then the value of a is equal to :

A) 19 B) 4 C) 13 D) 23

20. The system of linear equations
$x+y+z=6$,
$2x+5y+az=36$,
$x+2y+3z=b$ has:

A) unique solution for $a=8$ and $b=16$

B) infinitely many solutions for $a=8$ and $b=14$

C) infinitely many solutions for $a=8$ and $b=16$

D) unique solution for $a=8$ and $b=14$

21. If $A=\begin{bmatrix}2 & 3\\ 3 & 5\end{bmatrix}$, then the determinant of the matrix $(A^{2025}-3A^{2024}+A^{2023})$ is

A) 28 B) 12 C) 24 D) 16

22. Let n be the number obtained on rolling a fair die. If the probability that the system
$x-ny+z=6$
$x+(n-2)y+(n+1)z=8$
$(n-1)y+z=1$
Has a unique solution is $\frac{k}{6}$, then the sum of k and all possible values of n is:

A) 21 B) 24 C) 20 D) 22

23. Let $A=\begin{bmatrix}2 & 2+p & 2+p+q\\ 4 & 6+2p & 8+3p+2q\\ 6 & 12+3p & 20+6p+3q\end{bmatrix}$.
If $\det(\text{adj}(\text{adj}(3\ \text{A})))=2^{\text{m}}\cdot 3^{\text{n}},\text{m},\text{n}\in\text{N}$, then $\text{m}+\text{n}$ is equal to

A) 22 B) 24 C) 26 D) 20

24. Let I be the identity matrix of order 3×3 and for the matrix $\text{A}=\begin{bmatrix}\lambda & 2 & 3\\ 4 & 5 & 6\\ 7 & -1 & 2\end{bmatrix}$, $|\text{A}|=-1$. Let B be the inverse of the matrix $\text{adj}\,(\text{A}\,\text{adj}\,(\text{A}^2))$. Then $|(\lambda B+1)|$ is equal to ____

A) 30 B) 32 C) 36 D) 38

25. Let A be a matrix of order 3×3 and $|A|=5$. If $|2\,\text{adj}(3\ \text{A}\,\text{adj}(2\ \text{A}))|=2^{\alpha}\cdot 3^{\beta}\cdot 5^{\gamma}\alpha,\beta,\gamma\in\text{N}$ then $\alpha+\beta+\gamma$ is equal to

A) 25 **B)** 26 **C)** 27 **D)** 28

26. For a 3×3 matrix M, let trace (M) denote the sum of all the diagonal elements of M. Let A be a 3×3 matrix such that $|A| = \frac{1}{2}$ and trace $(A) = 3$. If $B = \text{adj}(\text{adj}(2A))$, then the value of $|B|+$ trace (B) equals :

A) 56 **B)** 132 **C)** 174 **D)** 280

27. Let the system of equations
$x + 5y - z = 1$
$4x + 3y - 3z = 7$
$24x + y + \lambda z = \mu$
$\lambda, \mu \in \mathrm{R}$, have infinitely many solutions. Then the number of the solutions of this system, If x, y, z are integers and satisfy $7 \leq x + y + z \leq 77$, is

A) 3 **B)** 6 **C)** 5 **D)** 4

28. If the system of linear equations
$3x + y + \beta z = 3$
$2x + \alpha y - z = -3$
$x + 2y + z = 4$
has infinitely many solutions, then the value of $22\beta - 9\alpha$ is :

A) 49 **B)** 31 **C)** 43 **D)** 37

29. Let $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & -2 \\ 0 & 1 \end{bmatrix}$ and $P = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}, \theta > 0$. If $\mathrm{B} = \mathrm{PAP}^{\mathrm{T}}, \mathrm{C} = \mathrm{P}^{\mathrm{T}}\mathrm{B}^{10}\mathrm{P}$ and the sum of the diagonal elements of C is $\frac{\mathrm{m}}{\mathrm{n}}$, where $\gcd(\mathrm{m}, \mathrm{n}) = 1$, then $\mathrm{m} + \mathrm{n}$ is :

A) 127 **B)** 258 **C)** 65 **D)** 2049

30. For some a, b, let $f(x) = \begin{vmatrix} \mathrm{a} + \frac{\sin x}{x} & 1 & \mathrm{b} \\ \mathrm{a} & 1 + \frac{\sin x}{x} & \mathrm{b} \\ \mathrm{a} & 1 & \mathrm{b} + \frac{\sin x}{x} \end{vmatrix}, x \neq 0, \lim_{x \to 0} f(x) = \lambda + \mu\mathrm{a} + \nu\mathrm{b}$. Then $(\lambda + \mu + v)^2$ is equal to :

A) 16 **B)** 25 **C)** 9 **D)** 36

31. The system of equations
$x + y + z = 6$
$x + 2y + 5z = 9,$ has no solution if
$x + 5y + \lambda z = \mu,$

A) $\lambda = 15, \mu \neq 17$ **B)** $\lambda \neq 17, \mu \neq 18$ **C)** $\lambda = 17, \mu \neq 18$ **D)** $\lambda = 17, \mu = 18$

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

A) 6 **B)** 10 **C)** 20 **D)** 12

33. Let $P = [p_{ij}]$ and $Q = [q_{ij}]$ be two square matrices of order 3 such that $q_{ij} = 2^{(i+j-1)}p_{ij}$ and $det(Q) = 2^{10}$. Then the value of $det(adj(adj\ P))$ is:

A) 32 **B)** 16 **C)** 81 **D)** 124

34. If $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ is a solution of the system of equations $AX = B$ where $adjA = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$, then $|x + y + z|$ is equal to:

A) 3 **B)** $\frac{3}{2}$ **C)** 1 **D)** 2

35. Let $\alpha, \beta(\alpha \neq \beta)$ be the values of m , for which the equations $x+y+z=1; x+2y+4z=\mathrm{m}$ and $x+4y+10z=m^2$ have infinitely many solutions. Then the value of $\sum_{n=1}^{10}\left(n^{\alpha}+n^{\beta}\right)$ is equal to :

A) 3080 **B)** 560 **C)** 3410 **D)** 440

36. Let M and m respectively be the maximum and the minimum values of

$$f(x)=\begin{vmatrix} 1+\sin^2 x & \cos^2 x & 4\sin 4x \\ \sin^2 x & 1+\cos^2 x & 4\sin 4x \\ \sin^2 x & \cos^2 x & 1+4\sin 4x \end{vmatrix}, x \in \mathrm{R}$$

Then M^4-m^4 is equal to :

A) 1280 **B)** 1295 **C)** 1215 **D)** 1040

Maths - Section B (Numeric)

37. For some $\alpha, \beta \in R$ let $A=\begin{bmatrix}\alpha & 2\\ 1 & 2\end{bmatrix}$ and $B=\begin{bmatrix}1 & 1\\ 1 & \beta\end{bmatrix}$ be such that $A^2-4A+2I=B^2-3B+I=O$. Then $(\det(\mathrm{adj}(A^3-B^3)))^2$ is equal to ....

38. Let A be a 3×3 matrix such that $A+A^T=O$. If $A\begin{bmatrix}1\\-1\\0\end{bmatrix}=\begin{bmatrix}3\\3\\2\end{bmatrix}$, $A^2\begin{bmatrix}1\\-1\\0\end{bmatrix}=\begin{bmatrix}-3\\19\\-24\end{bmatrix}$ and $\det(adj(2adj(A+I)))$ = $(2)^{\alpha}\cdot(3)^{\beta}\cdot(11)^{\gamma}$, then $\alpha+\beta+\gamma$ is equal to ___ .

39. Let $|A|=6$ where A is a 3×3 matrix. If $|adj(3adj(A^2\cdot adj(2A)))|=2^m\cdot 3^n$, $m,n\in N$, then $m+n$ is equal to:

40. Let A be a square matrix of order 3 such that $\det(A)=-2$ and $\det(3\,\mathrm{adj}(-6\,\mathrm{adj}(3A)))=2^{\mathrm{m+n}}\cdot 3^{\mathrm{mn}}, \mathrm{m}>\mathrm{n}$. Then $4\,\mathrm{m}+2\mathrm{n}$ is equal to _____

Matrices And Determinants

Subjects : Maths

Previous Year Questions of JEE Mains

Maths - Section A (MCQ)

1 - B	2 - B	3 - B	4 - B	5 - A	6 - D	7 - C	8 - C	9 - D	10 - D
11 - C	12 - B	13 - D	14 - D	15 - C	16 - C	17 - A	18 - B	19 - A	20 - B
21 - D	22 - D	23 - B	24 - D	25 - C	26 - D	27 - A	28 - B	29 - C	30 - A
31 - C	32 - D	33 - B	34 - D	35 - D	36 - A				

Maths - Section B (Numeric)

37 - 225	38 - 18	39 - 62	40 - 34