# MATHS

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# MATRICES

## Example

**1.** If $e^{A}$ is defined as $e^{A}=I+A+\frac{A^2}{2!}+\frac{A^3}{3!}+\ldots=\frac{1}{2}\begin{bmatrix} f(x) & g(x) \\ g(x) & f(x) \end{bmatrix}$, where $A=\begin{bmatrix} x & x \\ x & x \end{bmatrix}$, $0<x<1$ and I is identity matrix, then find the functions f(x) and g(x).

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**2.** Prove that matrix $\begin{bmatrix} \frac{b^2-a^2}{a^2+b^2} & \frac{-2ab}{a^2+b^2} \\ \frac{-2ab}{a^2+b^2} & \frac{a^2-b^2}{a^2+b^2} \end{bmatrix}$ is orthogonal.

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**3.** If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, where a, b, c and d are real numbers, then prove that $A^2 - (a+d)A + (ad - bc)I = O$. Hence or therwise, prove that if $A^3 = O$ then $A^2 = O$

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**4.** If $A = ([a_{ij}])_{n \times n}$ is such that $(a)_{ij} = \overline{a_{ji}}, \forall i, j$ and $A^2 = O,$ then

Statement 1: Matrix $A$ null matrix.

Statement 2: $|A| = 0.$

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**5.** Find the possible square roots of the two rowed unit matrix I.

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**6.** Prove the orthogonal matrices of order two are of the form $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ or $\begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{bmatrix}$

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**7.** Let $A = \begin{bmatrix} \tan\frac{\pi}{3} & \sec\frac{2\pi}{3} \\ \cot\left(2013\frac{\pi}{3}\right) & \cos(2012\pi) \end{bmatrix}$ and P be a $2 \times 2$ matrix such that $PP^T = I$, where $I$ is an identity matrix of order 2. If $Q = PAP^T$ and $R = [r_{\text{ij}}]_{2 \times 2} = P^T Q^8 P$, then find $r_{11}$.

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**8.** Consider, $A = \begin{bmatrix} a & 2 & 1 \\ 0 & b & 0 \\ 0 & -3 & c \end{bmatrix}$, where a, b and c are the roots of the equation $x^3 - 3x^2 + 2x - 1 = 0$. If matric B is such that $AB = BA$, $A + B - 2I \neq O$ and $A^2 - B^2 = 4I - 4B$, then find the value of det. (B)

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**9.** If A and B are square matrices of order 3 such that $|A| = 3$ and $|B| = 2$, then find the value of $\left|A^{-1} adj\left(B^{-1}\right) adj\left(2A^{-1}\right)\right|$

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## ILLUSTRATION

**1.** If a matrix has 28 elements, what are the possible orders it can have ?

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**2.** Construct a $2 \times 2$ matrix, where

(i) $a_{\text{ij}} = \dfrac{(i - 2j)^2}{2}$ (ii) $a_{\text{ij}} = |-2i + 3j|$

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**3.** What is the maximum number of different elements required to form a symmetric matrix of order 12 ?

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**4.** If a square matix a of order three is defined $A = [a_{ij}]$ where $a_{ij} = sgn(i - j)$, then prove that A is skew-symmetric matrix.

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**5.** For what values of x and y are the following matrices equal ?

$$A = \begin{bmatrix} 2x+1 & 3y \\ 0 & y^2 - 5y \end{bmatrix}, B = \begin{bmatrix} x+3 & y^2+2 \\ 0 & -6 \end{bmatrix}$$

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**6.** For $\alpha, \beta, \gamma \in R$, let

$$A = \begin{bmatrix} \alpha^2 & 6 & 8 \\ 3 & \beta^2 & 9 \\ 4 & 5 & \gamma^2 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2\alpha & 3 & 5 \\ 2 & 2\beta & 6 \\ 1 & 4 & 2\gamma - 3 \end{bmatrix}$$ If tr(A)=tr(B), then find the value of $\left(\frac{1}{\alpha}\right) + \left(\frac{1}{\beta}\right) + \left(\frac{1}{\gamma}\right)$

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**7.** Find the values of x for which matrix $\begin{bmatrix} 3 & -1+x & 2 \\ 3 & -1 & x+2 \\ x+3 & -1 & 2 \end{bmatrix}$ is singular.

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**8.** If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} -3 & -2 \\ 1 & -5 \\ 4 & 3 \end{bmatrix}$, then find $D = \begin{bmatrix} p & q \\ r & s \\ t & u \end{bmatrix}$ such that $A + B - D = O$.

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**9.** $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ and $A + A^T = I$, find the value of $\alpha$.

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**10.** Let $A$ be a square matrix. Then prove that $(i) A + A^T$ is a symmetric matrix and,$(ii) A - A^T$ is a skew-symmetric matrix

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**11.** If $A = \begin{bmatrix} 2 & -1 \\ 3 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 4 \\ 7 & 2 \end{bmatrix}$, find $3A - 2B$.

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**12.** Find non-zero values of $x$ satisfying the matrix equation:

$$x\begin{bmatrix} 2x & 2 \\ 3 & x \end{bmatrix} + 2\begin{bmatrix} 8 & 5x \\ 4 & 4x \end{bmatrix} = 2\begin{bmatrix} x^2+8 & 24 \\ 10 & 6x \end{bmatrix}$$

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**13.** Let $A+2B=\begin{bmatrix}1&2&0\\6&-3&3\\-5&3&1\end{bmatrix}$ and $2A-B=\begin{bmatrix}2&-1&5\\2&-1&6\\0&1&2\end{bmatrix}$, then find $tr(A)-tr(B)$.

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**14.** If $\begin{bmatrix}\lambda^2-2\lambda+1&\lambda-2\\1-\lambda^2+3\lambda&1-\lambda^2\end{bmatrix}=A\lambda^2+B\lambda+C$, where A, B and C are matrices then find matrices B and C.

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**15.** Prove that every square matrix can be uniquely expressed as the sum of a symmetric matrix and a skew-symmetric matrix.

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**16.** Matrix A ha s m rows and n+ 5 columns; matrix B has m rows and $11-n$ columns. If both AB and BA exist, then (A) AB and BA are square matrix (B) AB and BA are of order $8 \times 8$ and $3 \times 13$, respectively (C) $AB = BA$ (D) None of these

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17. If $A = \begin{bmatrix} 2 & 3 & -1 \\ 1 & 4 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \\ 2 & 1 \end{bmatrix}$ then prove that AB and BA are not equal.

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18. Find the value of x and y that satisfy the equations $\begin{bmatrix} 3 & -2 \\ 3 & 0 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} y & y \\ x & x \end{bmatrix} = \begin{bmatrix} 3 & 3 \\ 3y & 3y \\ 10 & 10 \end{bmatrix}$

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**19.** Find the values of $x,\ y,\ z$ if the matrix

$A = \begin{bmatrix} 0 & 2y & z \\ x & y & -z \\ x & -y & z \end{bmatrix}$ satisfy the equation $A^T A = I_3$.

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**20.** If A $= \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ then prove that $A^n = \begin{bmatrix} \cos n\theta & \sin n\theta \\ -\sin n\theta & \cos n\theta \end{bmatrix}, n \in N.$

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**21.** If $A = \begin{pmatrix} p & q \\ 0 & 1 \end{pmatrix}$, then show that $A^8 = \begin{pmatrix} p^8 & q\left(\frac{p^8 - 1}{p - 1}\right) \\ 0 & 1 \end{pmatrix}$

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**22.** Let $A = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix}$ be a matrix. If $A^{10} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ then prove that $a + d$ is divisible by 13.

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**23.** Show that the solutions of the equation $\begin{bmatrix} x & y \\ z & t \end{bmatrix}^2 = 0 are \begin{bmatrix} x & y \\ z & t \end{bmatrix} = \begin{bmatrix} \pm\sqrt{\alpha\beta} & -\beta \\ \alpha & \pm\sqrt{\alpha\beta} \end{bmatrix}$, where $\alpha, \beta$ are arbitrary.

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**24.** Let $A$ be square matrix. Then prove that $AA^T$ and $A^TA$ are symmetric matrices.

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**25.** If A, B are square materices of same order and B is a skewsymmetric matrix, show that $A^TBA$ is skew-symmetric.

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**26.** If A and B are square matrices of same order such that $AB + BA = O$, then prove that $A^3 - B^3 = (A + B)(A^2 - AB - B^2)$.

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**27.** Let $A = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$ .If $A^6 = kA - 205I$ then find the numerical quantity of $k - 40$

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**28.** Let A, B, C, D be (not necessarily square) real matrices such that $A^T = BCD : B^T = CDA; C^T = DAB$ and $D^T = ABC$. For the matrix $S = ABCD$, consider the two statements. I. $S^3 = S$ II. $S^2 = S^4$ (A) II is true but not I (B) I is true but not II (C) both I and II are true (D) both I and II are false

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**29.** If A and B are square matrices of the same order such that $AB = BA$, then prove by induction that $AB^n = B^n A$.

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**30.** If $A = [-110-2]$ , then prove that $A^2 + 3A + 2I = O$. Hence, find $BandC$ matrices of order 2 with integer elements, if $A = B^3 + C^3$.

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**31.** If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ then find tr. $\left(A^{2012}\right)$.

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**32.** If A is a nonsingular matrix satisfying $AB - BA = A$, then prove that det. $(B + I) =$ det, $(B - I)$.

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**33.** If det, $(A - B) \neq 0$, $A^4 = B^4$, $C^3A = C^3B$ and $B^3A = A^3B$, then find the value of det. $\left(A^3 + B^3 + C^3\right)$.

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**34.** Given a matrix $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}, where a, b, c$ are real positive numbers $abc = 1 and A^T A = I$, then find the value of $a^3 + b^3 + c^3$.

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**35.** If $M$ is a $3 \times 3$ matrix, where det $M = 1 and MM^T = 1, where I$ is an identity matrix, prove theat det $(M - I) = 0$.

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**36.** Consider point P(x, y) in first quadrant. Its reflection about x-axis is $Q(x_1, y_1)$. So, $x_1 = x$ and $y_1 = -y$.

This may be written as : $\begin{cases} x_1 = 1.\, x + 0.\, y \\ y_1 = 0.\, x + (-1)y \end{cases}$

This system of equations can be put in the matrix as :

$$\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

Here, matrix $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ is the matrix of reflection about x-axis. Then find the matrix of reflection about the line $y = x$.

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**37.** If $A = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ then A is `1) an idempotent matrix 2) nilpotent matrix 3) involutary 4) orthogonal matrix

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**38.** If $A = \begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix}$ then find $A^{14} + 3A - 2I$

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**39.** The matrix $A = [-5 - 8035012 -]$ is a. idempotent matrix b. involutory matrix c. nilpotent matrix d. none of these

A. idempotent matrix

B. involutory matrix

C. nilpotent matrix

D. none of these

**Answer: involutory matrix**

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**40.** If $abc = p$ and $A = \begin{bmatrix} a & b & c \\ c & a & b \\ b & c & a \end{bmatrix}$, prove that A is orthogonal if and only if a, b, c are the roots of the equation $x^3 \pm x^2 - p = 0$.

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**41.** Let A be an orthogonal matrix, and B is a matrix such that $AB = BA$, then show that $AB^T = B^T A$.

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**42.** Find the adjoint of the matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & -3 \\ -1 & 2 & 3 \end{bmatrix}$.

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**43.** If $S = \begin{bmatrix} \frac{\sqrt{3}-1}{2\sqrt{2}} & \frac{\sqrt{3}+1}{2\sqrt{2}} \\ -\left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right) & \frac{\sqrt{3}-1}{2\sqrt{2}} \end{bmatrix}$, $A = \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}$ and $P = S(\text{adj.A})S^T$, then find matrix $S^T P^{10} S$.

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**44.** If $A$ is a square matrix such that $A(adjA) = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then $= \frac{|adj(adjA)|}{2|adjA|}$ is equal to

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**45.** Let $A$ be a square matrix of order 3 such that

adj. (adj. (adj. A)) $= \begin{bmatrix} 16 & 0 & -24 \\ 0 & 4 & 0 \\ 0 & 12 & 4 \end{bmatrix}$. Then find the value of $|A|$

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**46.** Let $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$ and $10B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$. If B is the inverse of A, then find the value of $\alpha$

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**47.** Matrices a and B satisfy $AB = B^{-1}$, where $B = \begin{bmatrix} 2 & -1 \\ 2 & 0 \end{bmatrix}$. Find

(i) without finding $B^{-1}$, the value of K for which

$KA - 2B^{-1} + I = O.$

(ii) without finding $A^{-1}$, find the matrix X satifying $A^{-1}XA = B.$

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**48.** Given the matrices A and B as $A = \begin{bmatrix} 1 & -1 \\ 4 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ 2 & -2 \end{bmatrix}$. The two matrices X and Y are such that $XA = B$ and $AY = B$, then find the matrix $3(X + Y)$

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**49.** If M is the matrix $\begin{bmatrix} 1 & -3 \\ -1 & 1 \end{bmatrix}$ then find matrix $\sum_{r=0}^{\infty} \left(\frac{-1}{3}\right)^r M^{r+1}$

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**50.** Let $p$ be a non singular matrix, and $I + P + p^2 + \ldots + p^n = 0$, then find $p^{-1}$.

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**51.** If A and B are square matrices of same order such that $AB = O$ and $B \neq O$, then prove that $|A| = 0$.

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**52.** If A is a symmetric matrix, B is a skew-symmetric matrix, $A + B$ is nonsingular and $C = (A + B)^{-1}(A - B)$, then prove that

(i) $C^T(A + B)C = A + B$ (ii) $C^T(A - B)C = A - B$

(iii) $C^T AC = A$

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**53.** If the matrices, $A, B, (A+B)$ are non-singular, then prove that $\left[A(A+B)^{-1}B\right]^{-1}=B^{-1}+A^{-1}$.

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**54.** If matrix a satisfies the equation $A^2=A^{-1}$, then prove that $A^{2^n}=A^{2^{(n-2)}}, n\in N$.

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**55.** If A and B are non-singular symmetric matrices such that $AB=BA$, then prove that $A^{-1}B^{-1}$ is symmetric matrix.

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**56.** If A is a matrix of order n such that $A^T A=I$ and X is any matrix such that $X=(A+I)^{-1}(A-I)$, then show that X is skew symmetric matrix.

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**57.** Show that two matrices

$A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 0 & 1 \\ 0 & 3 & 1 \end{bmatrix}$ are row equivalent.

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**58.** Using elementary transformations, find the inverse of the matrix :

$$\begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$$

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**59.** Let A be a $3 \times 3$ matric such that

A . $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 3 \\ 0 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$, then find $A^{-1}$.

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60. Solve the following system of equations, using matrix method. $x+2y+z=7, x+3z=11, 2x-3y=1$

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61. Using matrix method, show that following system of equation is inconsistent : $2x+3y-z+4=0$ $x-y+2z-7=0$ $x+4y-3z+5=0$

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62. If f(x) and g(x) are two functions with g(x)=x−1/x and fog(x) =x^3−1/ x^1, then f'(x) is equal to

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**63.** Find the characteristic roots of the two-rowed orthogonal matrix $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ and verify that they are of unit modulus.

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**64.** Show that if $\lambda_1, \lambda_2, \ldots., \lambda_n$ are $n$ eigenvalues of a square matrix a of order n, then the eigenvalues of the matric $A^2$ are $\lambda_1^2, \lambda_2^2, \ldots, \lambda_n^2$.

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**65.** If A is nonsingular, prove that the eigenvalues of $A^{-1}$ are the reciprocals of the eigenvalue of A.

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**66.** If one of the eigenvalues of a square matrix a order $3 \times 3$ is zero, then prove that det $A = 0$.

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## CAE 13.1

**1.** Construct a $3 \times 4$ matrix, whose elements are given by: $a_{ij} = \frac{1}{2}|-3i + j|$

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**2.** Find the value of $a$ if $[a - b2a + c2a - b3c + d] = [-15013]$

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**3.** Find the number of all possible matrices of order $3 \times 3$ with each entry 0 or 1. How many of these are symmetric ?

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**4.** Find the value of x for which the matrix $A = \begin{bmatrix} 2/x & -1 & 2 \\ 1 & x & 2x^2 \\ 1 & 1/x & 2 \end{bmatrix}$ is singular.

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**5.** If matric A is skew-symmetric matric of odd order, then show that tr. A = det. A.

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## CAE 13.2

**1.** Solve for x and y , $x\begin{bmatrix} 2 \\ 1 \end{bmatrix} + y\begin{bmatrix} 3 \\ 5 \end{bmatrix} + \begin{bmatrix} -8 \\ -11 \end{bmatrix} = 0.$

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**2.** If $A = \begin{bmatrix} 1 & 5 \\ 7 & 12 \end{bmatrix}$ and $B = \begin{bmatrix} 9 & 1 \\ 7 & 8 \end{bmatrix}$ then find a matrix C such that $3A + 5B + 2C$ is a null matrix.

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**3.** Solve the following equations for X and Y :

$2X - Y = \begin{bmatrix} 3 & -3 & 0 \\ 3 & 3 & 2 \end{bmatrix}, 2Y + X = \begin{bmatrix} 4 & 1 & 5 \\ -1 & 4 & -4 \end{bmatrix}$

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**4.** If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 2 \\ 2 & 2 & 3 \end{bmatrix} B = \begin{bmatrix} 1 & 2 & 2 \\ -2 & -1 & -2 \\ 2 & 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & 2 \\ 2 & 2 & 3 \end{bmatrix}$ then find the value of tr. $\left(A + B^T + 3C\right)$.

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**5.** If $A = \begin{bmatrix} 3 & -2 \\ 4 & -1 \end{bmatrix}$, then find all the possible values of $\lambda$ such that the matrix $(A - \lambda I)$ is singular.

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**6.** If matrix $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix} = B + C$, where B is symmetric matrix and C is skew-symmetric matrix, then find matrices B and C.

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## CAE 13.3

**1.** Consider the matrices

$$A = \begin{bmatrix} 4 & 6 & -1 \\ 3 & 0 & 2 \\ 1 & -2 & 5 \end{bmatrix}, B = \begin{bmatrix} 2 & 4 \\ 0 & 1 \\ -1 & 2 \end{bmatrix}, C = \begin{bmatrix} 3 \\ 1 \\ 2 \end{bmatrix}$$

Out of the given matrix products, which one is not defined ?

A. $(AB)^T C$

B. $C^T C (AB)^T$

C. $C^T AB$

D. $A^T ABB^T C$

**Answer: B**

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**2.** Let $A = BB^T + CC^T$, where $B = \begin{bmatrix} \cos\theta \\ \sin\theta \end{bmatrix}, C = \begin{bmatrix} \sin\theta \\ -\cos\theta \end{bmatrix}, \theta \in R.$

Then prove that $A$ is unit matrix.

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**3.** The matrix R(t) is defined by $R(t) = \begin{bmatrix} \cos t & \sin t \\ -\sin t & \cos t \end{bmatrix}$. Show that $R(s)R(t) = R(s+t)$.

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**4.** if $A = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$ where $i = \sqrt{-1}$ and $x \in N$ then $A^{4x}$ equals to:

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**5.** If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ prove that $A^k = \begin{bmatrix} 1+2k & -4k \\ k & 1-2k \end{bmatrix}$ where $k$ is any positive integer.

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**6.** If $A = \begin{bmatrix} 1 & 2 \\ 3 & -5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$ and X is a matrix such that $A = BX$, then X=

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**7.** for what values of x:

$$\begin{bmatrix} 1 & 2 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 0 \\ 2 & 0 & 1 \\ 1 & 0 & 2 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ x \end{bmatrix} = 0?$$

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**8.** Find the matrix X so that $X[123456] = [-7-8-9246]$

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**9.** $IfA = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}, then \lim_{n \to \infty} \frac{1}{n} A^n$ is

A. (A) an identity matrix

B. (B) [0 10 -1 0 ]

C. (C) a null matrix

D. (D) none of these

**Answer: Zero Matrix**

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**10.** $A = \begin{bmatrix} 3 & a & -1 \\ 2 & 5 & c \\ b & 8 & 2 \end{bmatrix}$ is symmetric and $B = \begin{bmatrix} d & 3 & a \\ b-a & e & -2b-c \\ -2 & 6 & -f \end{bmatrix}$ is skew-symmetric, then find AB.

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## CAE 13.4

**1.** If $A$ and $B$ are matrices of the same order, then $AB^T - BA^T$ is a (a) skew-symmetric matrix (b) null matrix (c) unit matrix (d) symmetric matrix

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**2.** If A and B are square matrices such that $AB = BA$ then prove that $A^3 - B^3 = (A - B)\left(A^2 + AB + B^2\right)$.

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**3.** If A is a square matrix such that $A^2 = I$, then

$(A - I)^3 + (A + I)^3 - 7A$ is equal to

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**4.** If $B, C$ are square matrices of order $n and$ if $A = B + C, BC = CB, C^2 = O,$ then without using mathematical induction, show that for any positive integer $p, A^{p-1} = B^p[B + (p+1)C]$ .

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**5.** Let A be any $3 \times 2$ matrix. Then prove that det. $\left(AA^T\right) = 0.$

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**6.** Let A be a matrix of order 3, such that $A^T A = I$. Then find the value of det. $\left(A^2 - I\right)$.

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**7.** A and B are different matrices of order n satisfying $A^3 = B^3$ and $A^2B = B^2A$. If det. $(A - B) \neq 0$, then find the value of det. $\left(A^2 + B^2\right)$.

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**8.** Statement 1: if $D = \text{diag}[d_1, d_2, , d_n]$,then $D^{-1} = \text{diag}\left[d_1^{-1}, d_2^{-1}, \ldots, d_n^{-1}\right]$ Statement 2: if $D = \text{diag}[d_1, d_2, , d_n]$,then $D^n = \text{diag}\left[d_1^n, d_2^n, \ldots, d_n^n\right]$

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**9.** Point P(x, y) is rotated by an angle $\theta$ in anticlockwise direction. The new position of point P is $Q(x_1, y_1)$. If $\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = A\begin{bmatrix} x \\ y \end{bmatrix}$, then find matrix A.

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**10.** How many different diagonal matrices of order n can be formed which are involuntary ?

A. A. $2^n$

B. B.$2^n - 1$

C. C. $2^{n-1}$

D. D. n

**Answer:** $2^n$

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**11.** How many different diagonal matrices of order n can be formed which are idempotent ?

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**12.** If A and B are n-rowed unitary matrices,then AB and BA are also unitary matrices.

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## CAE 13.5

**1.** By the method of matrix inversion, solve the system.

$$\begin{bmatrix}1 & 1 & 1\\ 2 & 5 & 7\\ 2 & 1 & -1\end{bmatrix}\begin{bmatrix}x_1 & y_1\\ x_2 & y_2\\ x_3 & y_3\end{bmatrix}=\begin{bmatrix}9 & 2\\ 52 & 15\\ 0 & -1\end{bmatrix}$$

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**2.** Let $A=\begin{bmatrix}2 & 0 & 7\\ 0 & 1 & 0\\ 1 & -2 & 1\end{bmatrix}$ and $B=\begin{bmatrix}-x & 14x & 7x\\ 0 & 1 & 0\\ x & -4x & -2x\end{bmatrix}$ are two matrices such that $AB=(AB)^{-1}$ and $AB\neq I$ then $Tr\left((AB)+(AB)^2+(AB)^3+(AB)^4+(AB)^5+(AB)^6\right)=$

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3. Find $A^{-1}$ if $A = \begin{vmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{vmatrix}$ and show that $A^{-1} = \frac{A^2 - 3I}{2}$

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4. For the matrix $A = \begin{bmatrix} 3 & 1 \\ 7 & 5 \end{bmatrix}$, find $x$ and $y$ so that $A^2 + xI = yA$.

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5. If $A^3 = O$, then prove that $(I - A)^{-1} = I + A + A^2$.

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6. If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}, B = \begin{bmatrix} \cos 2\beta & \sin 2\beta \\ \sin\beta & -\cos\beta \end{bmatrix}$ where $0 < \beta < \frac{\pi}{2}$, then prove that $BAB = A^{-1}$. Also, find the least value of $\alpha$ of which $BA^4B = A^{-1}$

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7. If $A=\begin{bmatrix}1 & 2 & 2\\ 2 & 2 & 3\\ 1 & -1 & 3\end{bmatrix}, C=\begin{bmatrix}2 & 1 & 1\\ 2 & 2 & 1\\ 1 & 1 & 1\end{bmatrix}, D=\begin{bmatrix}10\\ 13\\ 9\end{bmatrix}$, and $CB=D$.

Solve the equation $AX=B$.

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8. If A is a $2\times 2$ matrix such that $A^2-4A+3I=O$, then prove that $(A+3I)^{-1}=\frac{7}{24}I-\frac{1}{24}A$.

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9. For two unimobular complex numbers $z_1$ and $z_2$, find $\begin{bmatrix}\bar{z}_1 & -z_2\\ \bar{z}_2 & z_1\end{bmatrix}^{-1}\begin{bmatrix}z_1 & z_2\\ -\bar{z}_2 & \bar{z}_1\end{bmatrix}^{-1}$

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10. Prove that inverse of a skew-symmetric matrix (if it exists) is skew-symmetric.

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11. If square matrix a is orthogonal, then prove that its inverse is also orthogonal.

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12. If $A$ is a skew symmetric matrix, then $B=(I-A)(I+A)^{-1}$ is (where $I$ is an identity matrix of same order as of $A$)

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13. Prove that $(\text{adj. } A)^{-1}=(\text{adj. } A^{-1})$.

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**14.** Using elementary transformation, find the inverse of the matrix

$$A = \begin{bmatrix} a & b \\ c & \left(\frac{1+bc}{a}\right) \end{bmatrix}.$$

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**15.** If A and P are the square matrices of the same order and if P be invertible, show that the matrices A and `P^(-1) have the same characteristic roots.

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**16.** Show that the characteristics roots of an idempotent matrix are either 0 or 1

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**17.** If $\alpha$ is a characteristic root of a nonsin-gular matrix, then prove that $\frac{|A|}{\alpha}$ is a characteristic root of adj A.

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## Exercises

**1.** If A is symmetric as well as skew-symmetric matrix, then A is

A. diagonal matrix

B. null matrix

C. triangular materix

D. none of these

**Answer: B**

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**2.** Elements of a matrix $A$ or orddr $10 \times 10$ are defined as $a_{ij} = w^{i+j}$ (where $w$ is cube root of unity), then trace $(A)$ of the matrix is a.0 b. $1$ c. $3$ d. none of these

A. 0

B. 1

C. 3

D. none of these

**Answer: D**

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**3.** If $A_1, A_2, , A_{2n-1} aren$ skew-symmetric matrices of same order, then $B = \sum_{r=1}^{n} (2r-1)\left(A^{2r-1}\right)^{2r-1}$ will be symmetric skew-symmetric neither symmetric nor skew-symmetric data not adequate

A. symmetric

B. skew-symmetric

C. neither symmetric nor skew-symmetric

D. data not adequate

**Answer: B**

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**4.** The equation $[1xy]\begin{bmatrix}1 & 3 & 1\\ 0 & 2 & -1\\ 0 & 0 & 1\end{bmatrix}\begin{bmatrix}1\\ x\\ y\end{bmatrix}=[0]$ has

i)for y=0 (p) rational roots

ii) for y=-1 (q) irrational roots

(r) integral roots

A. $\begin{matrix}\text{(i)} & (ii)\\ (p) & \text{(r)}\end{matrix}$

B. $\begin{matrix}\text{(i)} & (ii)\\ (q) & \text{(p)}\end{matrix}$

C. $\begin{matrix}\text{(i)} & (ii)\\ (p) & \text{(q)}\end{matrix}$

D. $\begin{matrix}\text{(i)} & (ii)\\ (r) & \text{(p)}\end{matrix}$

**Answer: C**

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**5.** Let $A and B$ be two $2 \times 2$ matrices. Consider the statements (i) $AB = O \Rightarrow A = O \text{ or } B = O$ (ii) $AB = I_2 \Rightarrow A = B^{-1}$ (iii) $(A + B)^2 = A^2 + 2AB + B^2$ (a)(i) and (ii) are false, (iii) is true (b)(ii) and (iii) are false, (i) is true (c)(i) is false (ii) and, (iii) are true (d)(i) and (iii) are false, (ii) is true

A. (i) and (ii) are false, (iii) is true

B. (ii) and (iii) are false, (i) is true

C. (i) is false, (ii) and (iii) are true

D. (i) and (iii) are false, (ii) is true

**Answer: D**

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**6.** The number of diagonal matrix, $A$ or order$n$ which $A^3 = A$ is a. is a a. 1 b. 0 c. $2^n$ d. $3^n$

A. 1

B. 0

C. $2^n$

D. $3^n$

**Answer: D**

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**7.** $A$ is a $2 \times 2$ matrix such that $A\begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$ and $A^2\begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$. The sum of the elements of $A$ is a.$-1$ b. 0 c. 2 d. 5

A. $-1$

B. 0

C. 2

D. 5

**Answer: D**

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**8.** If $\theta - \phi = \frac{\pi}{2}$, prove that,

$$\begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}\begin{bmatrix} \cos^2\phi & \cos\phi\sin\phi \\ \cos\phi\sin\phi & \sin^2\phi \end{bmatrix} = 0$$

A. $2n\pi, \ \in Z$

B. $n\frac{\pi}{2}, n \in Z$

C. $(2n+1)\frac{\pi}{2}, n \in X$

D. $n\pi, n \in Z$

**Answer: C**

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**9.** If $A = [ab0a]$ is nth root of $I_2$, then choose the correct statements: If $n$ is odd, $a = 1, b = 0$ If $n$ is odd, $a = -1, b = 0$ If $n$ is even, $a = 1, b = 0$ If $n$ is even, $a = -1, b = 0$ a. i, ii, iii, iv b.ii, iii, iv c. i, ii, iii, iv d. i, iii, iv

A. i, ii, iii

B. ii, iii, iv

C. i, ii, iii, iv

D. i, iii, iv

**Answer: D**

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**10.** If $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is to be square root of two-rowed unit matrix, then $\alpha, \beta$ and $\gamma$ should satisfy the relation. a. $1 - \alpha^2 + \beta\gamma = 0$ b. $\alpha^2 + \beta\gamma = 0$ c. $1 + \alpha^2 + \beta\gamma = 0$ d. $1 - \alpha^2 - \beta\gamma = 0$

A. $1-\alpha^2+\beta\gamma=0$

B. $\alpha^2+\beta\gamma-1=0$

C. $1+\alpha^2+\beta\gamma=0$

D. $1-\alpha^2-\beta\gamma=0$

**Answer: B**

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**11.** If $A=\begin{bmatrix} i & -i \\ -i & i \end{bmatrix}$ and $B=\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$, $then$, $A^8$ equals a.$4B$ b. $128B$ c. $-128B$ d. $-64B$

A. 4B

B. 128B

C. $-128$ B

D. $-64$B

**Answer: B**

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**12.** If $\begin{bmatrix} 2 & -1 \\ 1 & 0 \\ -3 & 4 \end{bmatrix} A = \begin{bmatrix} -1 & -8 & -10 \\ 1 & -2 & -5 \\ 9 & 22 & 15 \end{bmatrix}$, then sum of all the elements of matrix $A$ is

A. 0

B. 1

C. 2

D. $-3$

**Answer: B**

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**13.** For each real $x, -1 < x < 1$. Let A(x) be the matrix $(1-x)^{-1}\begin{bmatrix} 1 & -x \\ -x & 1 \end{bmatrix}$ and $z = \dfrac{x+y}{1+xy}$. Then

A. $A(z) = A(x)A(y)$

B. $A(z) = A(x) - A(y)$

C. $A(z) = A(x) + A(y)$

D. $A(z) = A(x)[A(y)]^{-1}$

**Answer: A**

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**14.** Let A = $\begin{bmatrix} 0 & -\tan\alpha/2 \\ \tan\alpha/2 & 0 \end{bmatrix}$ and I, the indentity matrix of order 2.

A. $-I + A$

B. $I - A$

C. $-I - A$

D. none of these

**Answer: B**

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**15.** The number of solutions of the matrix equation $X^2 = [1123]$ is a. more than2 b. $2$ c. $0$ d. $1$

A. more then 2

B. 2

C. 0

D. 1

**Answer: A**

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**16.** If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ (where $bc \neq 0$ ) satisfies the equations $x^2 + k = 0, then$

A. $a + d = 0$

B. $k = -|A|$

C. $k = |A|$

D. none of these

**Answer: C**

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**17.** Consider three matrices $A = \begin{bmatrix} 2 & 1 \\ 4 & 1 \end{bmatrix}, B = \begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix}$. Then the value of the sum

$$tr(A) + tr\left(\frac{ABC}{2}\right) + tr\left(\frac{A(BC)^2}{4}\right) + tr\left(\frac{A(BC)^3}{8}\right) + \ldots\ldots + \infty$$

is

(A) $6$ (B) $9$ (C) $12$ (D) none of these

A. 6

B. 9

C. 12

D. none of these

**Answer: A**

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**18.** If $\begin{bmatrix} \frac{\cos(2\pi)}{7} & -\frac{\sin(2\pi)}{7} \\ \frac{\sin(2\pi)}{7} & \frac{\cos(2\pi)}{7} \end{bmatrix}^k = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then the least positive integral value of $k$ is (a) 3 (b) 4 (c) 6 (d) 7

A. 3

B. 6

C. 7

D. 14

**Answer: C**

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**19.** If A and B are square matrices of order $n,$ then prove that $A and B$ will commute iff $A - \lambda I and B - \lambda I$ commute for every scalar $\lambda$.

A. $AB = BA$

B. $AB + BA = O$

C. $A = -B$

D. none of these

**Answer: A**

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**20.** Matrix $A$ such that $A^2 = 2A - I, where I$ is the identity matrix, the for $n \geq 2. A^n$ is equal to $2^{n-1}A - (n-1)l$ b. $2^{n-1}A - I$ c. $nA - (n-1)l$ d. $nA - I$

A. $2^{n-1}A - (n-1)I$

B. $2^{n-1}A - I$

C. $nA-(n-1)I$

D. $nA-I$

**Answer: C**

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**21.** Let $A=\begin{bmatrix}0&\alpha\\0&0\end{bmatrix}$ and $(A+I)^{50}=50A=\begin{bmatrix}a&b\\c&d\end{bmatrix}$ Then the value of $a+b+c+d$ is (A) $2$ (B) $1$ (C) $4$ (D) none of these

A. 2

B. 1

C. 4

D. none of these

**Answer: A**

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**22.** If $Z$ is an idempotent matrix, then $(I+Z)^n$ $I+2^n Z$ b. $I+(2^n-1)Z$

c. $I-(2^n-1)Z$ d. none of these

A. $I+2^n Z$

B. $I+(2^n-1)Z$

C. $I-(2^n-1)Z$

D. none of these

**Answer: B**

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**23.** if $A$ and $B$ are squares matrices such that $A^{2006}=O$ and $AB=A+B, then, \det(B)$ equals a.0 b. $1$ c. $-1$ d. none of these

A. 0

B. 1

C. $-1$

D. none of these

**Answer: A**

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**24.** If matrix $A$ is given by $A = \begin{vmatrix} 6 & 11 \\ 2 & 4 \end{vmatrix}$, then the determinant of $A^{2005} - 6A^{2004}$ is a. $2^{2006}$ b. $(-11)2^{2005}$ c. $-2^{2005}$ d. $(-9)2^{2004}$

A. $2^{2006}$

B. $(-11)2^{2005}$

C. $-2^{2005}.7$

D. $(-9)2^{2004}$

**Answer: B**

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**25.** If $A$ is non-diagonal involuntary matrix, then a. $A-I=O$ b. $A+I=O$ c. $A-I$ is nonzero singular d. none of these

A. $A-I=O$

B. $A+I=O$

C. $A-I$ is nonzero singular

D. none of these

**Answer: C**

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**26.** If $A and B$ are two nonzero square matrices of the same ordr such that the product $AB=O$, then both A and B must be singular exactly one of them must be singular both of them are non singular none of these

A. both A and B must be singular

B. exactly one of them must be singular

C. both of them are nonsingular

D. none of these

**Answer: A**

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**27.** If $A and B$ are symmetric matrices of the same order and $X = AB + BA and Y = AB - BA, then (XY)^T$ is equal to $XY$ b. $YX$ c. $-YX$ d. none of these

A. $XY$

B. $YX$

C. $-YX$

D. none of these

**Answer: C**

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**28.** If $A, B, A + I, A + B$ are idempotent matrices, then $AB$ is equal to

a.$BA$ b. $-BA$ c. $I$ d. $O$

A. $BA$

B. $-BA$

C. $I$

D. $O$

**Answer: B**

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**29.** If $A = \begin{bmatrix} 0 & x \\ y & 0 \end{bmatrix}$ and $A^3 + A = O$ then sum of possible values of xy is

A. 0

B. $-1$

C. 1

D. 2

**Answer: B**

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**30.** Which of the following is an orthogonal matrix ? ( ⌈ | ⌊ 6 / 7 2 / 7 − 3 / 7 2 / 7 3 / 7 6 / 7 3 / 7 − 6 / 7 2 / 7 ⌉ | ⌋ (b) ⌈ | ⌊ 6 / 7 2 / 7 3 / 7 2 / 7 − 3 / 7 6 / 7 3 / 7 6 / 7 − 2 / 7 ⌉ | ⌋ (c) ⌈ | ⌊ − 6 / 7 − 2 / 7 − 3 / 7 2 / 7 3 / 7 6 / 7 − 3 / 7 6 / 7 2 / 7 ⌉ | ⌋ (d) ⌈ | ⌊ 6 / 7 − 2 / 7 3 / 7 2 / 7 2 / 7 − 3 / 7 − 6 / 7 2 / 7 3 / 7 ⌉ | ⌋

A. $\begin{bmatrix} 6/7 & 2/7 & -3/7 \\ 2/7 & 3/7 & 6/7 \\ 3/7 & -6/7 & 2/7 \end{bmatrix}$

B. $\begin{bmatrix} 6/7 & 2/7 & 3/7 \\ 2/7 & -3/7 & 6/7 \\ 3/7 & 6/7 & -2/7 \end{bmatrix}$

C. $\begin{bmatrix} -6/7 & -2/7 & -3/7 \\ 2/7 & 3/7 & 6/7 \\ -3/7 & 6/7 & 2/7 \end{bmatrix}$

D. $\begin{bmatrix} 6/7 & -2/7 & 3/7 \\ 2/7 & 2/7 & -3/7 \\ -6/7 & 2/7 & 3/7 \end{bmatrix}$

**Answer: A**

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**31.** Let A and B be two square matrices of the same size such that $AB^T + BA^T = O$. If A is a skew-symmetric matrix then BA is

A. a symmetric matrix

B. a skew-symmetric matrix

C. an orthogonal matrix

D. an invertible matrix

**Answer: B**

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**32.** In which of the following type of matrix inverse does not exist always?

a. idempotent b. orthogonal c. involuntary d. none of these

A. idempotent

B. orthogonal

C. involuntary

D. none of these

**Answer: A**

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**33.** Let $A$ be an nth-order square matrix and $B$ be its adjoint, then $|AB + KI_n|$ is (where $K$ is a scalar quantity) a. $(|A| + K)^{n-2}$ b. $(|A| + K)^{n}$ c. $(|A| + K)^{n-1}$ d. none of these

A. $(|A| + K)^{n-2}$

B. $(|A| + K)^{n}$

C. $(|A|+K)^{n-1}$

D. none of these

**Answer: B**

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**34.** If $A=\begin{bmatrix} a & b & c \\ x & y & z \\ p & q & r \end{bmatrix}, B=\begin{bmatrix} q & -b & y \\ -p & a & -x \\ r & -c & z \end{bmatrix}$ and if $A$ is invertible, then which of the following is not true? (a) $|A|=|B|$ (b) $|A|=-|B|$ (c) $|adjA|=|adjB|$ (d) $A$ is invertible if and only if $B$ is invertible

A. $|A|=|B|$

B. $|A|=-|B|$

C. $|\text{adj A}|=|\text{adj B}|$

D. A is invertible if and only if B is invertible

**Answer: A**

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**35.** If $A(\alpha, \beta) = \left[\cos \alpha s \in \alpha 0 - s \in \alpha \cos \alpha 000 e^{\beta}\right], then A(\alpha, \beta)^{-1}$ is equal to $A(-\alpha, -\beta)$ b. $A(-\alpha, \beta)$ c. $A(\alpha, -\beta)$ d. $A(\alpha, \beta)$

A. $A(-\alpha, -\beta)$

B. $A(-\alpha, \beta)$

C. $A(\alpha, -\beta)$

D. $A(\alpha, \beta)$

**Answer: A**

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**36.** If $A = \begin{bmatrix} a+ib & c+id \\ -c+id & a-ib \end{bmatrix}$ and $a^2+b^2+c^2+d^2=1, then, A^{-1}$ is equal to a. $\begin{bmatrix} a+ib & -c+id \\ c+id & a-ib \end{bmatrix}$ b. $\begin{bmatrix} a-ib & -c-id \\ -c-id & a+ib \end{bmatrix}$ c. $\begin{bmatrix} a+ib & -c-id \\ -c+id & a-ib \end{bmatrix}$ d. none of these

A. $\begin{bmatrix} a-ib & -c-id \\ c-id & a+ib \end{bmatrix}$

B. $\begin{bmatrix} a+ib & -c+id \\ -c+id & a-ib \end{bmatrix}$

C. $\begin{bmatrix} a-ib & -c-id \\ -c-id & a+ib \end{bmatrix}$

D. none of these

**Answer: A**

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**37.** Id $\begin{bmatrix} \frac{1}{25} & 0 \\ x & \frac{1}{25} \end{bmatrix} = \begin{bmatrix} 5 & 0 \\ -a & 5 \end{bmatrix}^{-2}$, then the value of $x$ is

a. $\dfrac{a}{125}$

b. $\dfrac{2a}{125}$

c. $\dfrac{2a}{25}$

d. none of these

A. $a/125$

B. $2a/125$

C. $2a/25$

D. none of these

**Answer: B**

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**38.** If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and $f(x) = \frac{1+x}{1-x}$, then $f(A)$ is

A. $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

B. $\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}$

C. $\begin{bmatrix} -1 & -1 \\ -1 & -1 \end{bmatrix}$

D. none of these

**Answer: C**

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**39.** There are two possible values of A in the solution of the matrix equation

$$\begin{bmatrix} 2A+1 & -5 \\ -4 & A \end{bmatrix}^{-1} \begin{bmatrix} A-5 & B \\ 2A-2 & C \end{bmatrix} = \begin{bmatrix} 14 & D \\ E & F \end{bmatrix}$$

where A, B, C, D, E and F are real numbers. The absolute value of the difference of these two solutions, is

A. $\frac{8}{3}$

B. $\frac{19}{3}$

C. $\frac{1}{3}$

D. $\frac{11}{3}$

**Answer: B**

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**40.** If $A$ and $B$ are two square matrices such that $B = -A^{-1}BA, then(A+B)^2$ is equal to a.$A^2+B^2$ b. $O$ c. $A^2+2AB+B^2$ d. $A+B$

A. $A^2+B^2$

B. $O$

C. $A^2+2AB+B^2$

D. $A + B$

**Answer: A**

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**41.** If $A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$, show that $A^T A^{-1} = \begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$

.

A. $\begin{bmatrix} -\cos 2x & \sin 2x \\ -\sin 2x & \cos 2x \end{bmatrix}$

B. $\begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$

C. $\begin{bmatrix} \cos 2x & \cos 2x \\ \cos 2x & \sin 2x \end{bmatrix}$

D. none of these

**Answer: B**

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**42.** If $A$ is order 2 square matrix such that $|A| = 2,$ then |(adj(adj(adjA)))| is a. $512$ b. $256$ c. $64$ d. none of these

A. 512

B. 256

C. 64

D. none of these

**Answer: B**

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**43.** If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & a & 1 \end{bmatrix}$ and $A^{-1}\begin{bmatrix} 1/2 & -1/2 & 1/2 \\ -4 & 3 & b \\ 5/2 & -3/2 & 1/2 \end{bmatrix}$ then find $a$ and $b$

A. 1, 1

B. 1, -1

C. 1, 2

D. $-1, 1$

**Answer: B**

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**44.** If nth-order square matrix $A$ is a orthogonal, then |adj(adjA) is always $-1 \quad \text{if} \quad n is even$ b. always $1 \quad \text{if} \quad n is odd$ c. always 1 d. none of these

A. always -1 if n is even

B. always 1 if n is odd

C. always 1

D. none of these

**Answer: B**

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**45.** Let $a and b$ be two real numbers such that $a > 1, b > 1$. If $A = (a00b)$ , then $(\lim)_{n \to \infty} A^{-n}$ is a. unit matrix b. null matrix c. $2l$ d. none of these

A. unit matrix

B. null matrix

C. $2I$

D. none of these

**Answer: B**

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**46.** If $A = ([a_{ij}])_{4 \times 4}$, such that $a_{ij} = \{2, when i = j 0, when i \neq j, then \left\{ \frac{\det(adj(adj A))}{7} \right\}$ is (where {.} represents fractional part function) $1/7$ b. $2/7$ c. $3/7$ d. none of these

A. $1/7$

B. $2/7$

C. $3/7$

D. none of these

**Answer: A**

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**47.** $A$ is an involuntary matrix given by $A = \begin{vmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{vmatrix}$, then the inverse of $A/2$ will be $2A$ b. $\frac{A^{-1}}{2}$ c. $\frac{A}{2}$ d. $A^2$

A. $2A$

B. $\frac{A^{-1}}{2}$

C. $\frac{A}{2}$

D. $A^2$

**Answer: A**

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**48.** If $A$ is a non-singular matrix such that $AA^T = A^T A$ and $B = A^{-1}A^T$, the matrix $B$ is a. involuntary b. orthogonal c. idempotent d. none of these

A. involuntary

B. orthogonal

C. idempotent

D. none of these

**Answer: B**

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**49.** If $P$ is an orthogonal matrix and $Q = PAP^T and x = P^T$ $A$ b. $I$ c. $A^{1000}$ d. none of these

A. $A$

B. $I$

C. $A^{1000}$

D. none of these

**Answer: B**

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**50.** If $A and B$ are two non-singular matrices of the same order such that $B^r = I,$ for some positive integer $r > 1, then A^{-1}B^{r-1}A - A^{-1}B^{-1}A =$ a. $I$ b. $2I$ c. $O$ d. -I

A. $I$

B. $2I$

C. $O$

D. $-I$

**Answer: C**

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**51.** If adj$B = A, |P| = |Q| = 1, then. adj(Q^{-1}BP^{-1})$ is

a.$PQ$ b. $QAP$ c. $PAQ$ d. $PA^{-1}Q$

A. $PQ$

B. $QAP$

C. $PAQ$

D. $PA^{-1}Q$

**Answer: C**

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**52.** If $A$ is non-singular and $(A - 2I)(A - 4I) = 0, then, \frac{1}{6}A + \frac{4}{3}A^{-1}$ is equal to

a.$0I$ b. $2I$ c. $6I$ d. $I$

A. $O$

B. $I$

C. $2I$

D. $6I$

**Answer: B**

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**53.** Let $f(x)=\frac{1+x}{1-x}$ . If $A$ is matrix for which $A^3=0$,then $f(A)$ is (a) $I+A+A^2$ (b) $I+2A+2A^2$ (c) $I-A-A^2$ (d) none of these

A. $I+A+A^2$

B. $I+2A+2A^2$

C. $I-A-A^2$

D. none of these

**Answer: B**

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**54.** Find the matrix A satisfying the matrix equation

$$\begin{bmatrix}2 & 1\\ 3 & 2\end{bmatrix}A\begin{bmatrix}-3 & 2\\ 5 & -3\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$$

A. $\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}$

B. $\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$

C. $\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}$

D. $-\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}$

**Answer: A**

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**55.** If $A^2 - A + I = 0$, then the inverse of $A$ is a. $A^{-2}$ b. $A + I$ c. $I - A$ d. $A - I$

A. $A^{-2}$

B. $A+I$

C. $I-A$

D. $A-I$

**Answer: C**

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**56.** If $f(x)=\begin{bmatrix}\cos x & -\sin x & 0\\ \sin x & \cos x & 0\\ 0 & 0 & 1\end{bmatrix}$ and $g(y)=\begin{bmatrix}\cos y & 0 & \sin y\\ 0 & 1 & 0\\ -\sin y & 0 & \cos y\end{bmatrix}$, then $[f(x)g(y)]^{-1}$ is equal to (a) $f(-x)g(-y)$ (b) $g(-y)f(-x)$ (c) $f(x^{-1})g(y^{-1})$ (d) $g(y^{-1})f(x^{-1})$

A. $F(-x)G(-y)$

B. $G(-y)F(-x)$

C. $F(x^{-1})G(y^{-1})$

D. $G(y^{-1})F(x^{-1})$

**Answer: B**

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**57.** about to only mathematics

A. $A^{-n}B^nA^n$

B. $A^nB^nA^{-n}$

C. $A^{-1}B^nA$

D. $n(A^{-1}BA)$

**Answer: C**

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**58.** If $k \in R_o then \det\{adj(kI_n)\}$ is equal to $K^{n-1}$ b. $K^{n(n-1)}$ c. $K^n$ d. $k$

A. $k^{n-1}$

B. $k^{n(n-1)}$

C. $k^n$

D. $k$

**Answer: B**

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59. Given the matrix $A = \begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}$. If $xyz = 60$ and $8x + 4y + 3z = 20$, then $A(adjA)$ is equal to

A. $\begin{bmatrix} 64 & 0 & 0 \\ 0 & 64 & 0 \\ 0 & 0 & 64 \end{bmatrix}$

B. $\begin{bmatrix} 88 & 0 & 0 \\ 0 & 88 & 0 \\ 0 & 0 & 88 \end{bmatrix}$

C. $\begin{bmatrix} 68 & 0 & 0 \\ 0 & 68 & 0 \\ 0 & 0 & 68 \end{bmatrix}$

D. $\begin{bmatrix} 34 & 0 & 0 \\ 0 & 34 & 0 \\ 0 & 0 & 34 \end{bmatrix}$

**Answer: C**

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**60.** Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 0 & 5 \\ 0 & 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 \\ -3 \\ 1 \end{bmatrix}$. Which of the following is a true? a.$AX = B$ has a unique solution b.$AX = B$ has exactly three solutions c.$Ax = B$ has infinitely many solutions d.$AX = B$ is inconsistent

A. $AX = B$ has a unique solution

B. $AX = B$ has exactly three solutions

C. $AX = B$ has infinitelt many solutions

D. $AX = B$ is inconsistent

**Answer: A**

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**61.** If A is a square matrix of order less than 4 such that $|A - A^T| \neq 0$ and $B =$ adj. (A), then adj. $(B^2 A^{-1} B^{-1} A)$ is

A. $A$

B. $B$

C. $|A|A$

D. $|B|B$

**Answer: A**

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**62.** Let A be a square matrix of order 3 such that det. $(A) = \frac{1}{3}$, then the value of det. $(\text{adj. } A^{-1})$ is

A. $1/9$

B. $1/3$

C. $3$

D. $9$

**Answer: D**

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**63.** If A and B are two non-singular matrices of order 3 such that $AA^T = 2I$ and $A^{-1} = A^T - A$. Adj. $(2B^{-1})$, then det. (B) is equal to

A. 4

B. $4\sqrt{2}$

C. 16

D. $16\sqrt{2}$

**Answer: D**

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**64.** If A is a square matric of order 5 and $2A^{-1} = A^T$, then the remainder when $|\text{adj. (adj. (adj. A))}|$ is divided by 7 is

A. 2

B. 3

C. 4

D. 5

**Answer: A**

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65. Let $P = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & -1 \\ 3 & 1 & 1 \end{bmatrix}$. If the product PQ has inverse $R = \begin{bmatrix} -1 & 0 & 1 \\ 1 & 1 & 3 \\ 2 & 0 & 2 \end{bmatrix}$ then $Q^{-1}$ equals

A. $\begin{bmatrix} 3 & 2 & 9 \\ -1 & 1 & 1 \\ 0 & 1 & 8 \end{bmatrix}$

B. $\begin{bmatrix} 5 & 2 & 9 \\ -1 & 1 & 1 \\ 0 & 1 & 7 \end{bmatrix}$

C. $\begin{bmatrix} 2 & -1 & 0 \\ 10 & 6 & 3 \\ 8 & 6 & 4 \end{bmatrix}$

D. none of these

**Answer: C**

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## Multiple Correct Answer

**1.** If $A$ is unimodular, then which of the following is unimodular?

a. $-A$ b. $A^{-1}$ c. $adjA$ d. $\omega A$, where $\omega$ is cube root of unity

A. $-A$

B. $A^{-1}$

C. adj A

D. $\omega A$, where $\omega$ is cube root of unity

**Answer: B::C**

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**2.** Let $A = a_0$ be a matrix of order 3, where $a_{ij} = x;$ if $i = j, x \in R, 1$ if $|i - j| = 1, 0; otherwise$ then when of the following Hold (s) good: for$x = 2$ , (a) $A$ is a diagonal matrix (b) $A$ is a symmetric matrix for$x = 2$ , (c) det $A$ has the value equal to 6 (d) Let $f(x) =$ , det $A,$ then the function $f(x)$ has both the maxima and minima.

A. for x = 2, A is a diagonal matrix

B. A is a symmetric matrix

C. for x = 2, det A has the value equal to 6

D. Let $f(x) =$ det A, then the function f(x) has both the maxima and minima

**Answer: B::D**

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**3.** If

$A = [1 - 121], B = [a1b - 1]and(A + B)^2 = A^2 + b^2 + 2AB, then$

$a = \ -1$ b. $a = 1$ c. $b = 2$ d. $b = \ -2$

A. $a = \ -1$

B. $a = 1$

C. $b = 2$

D. $b = \ -2$

**Answer: A::D**

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**4.** If $AB = AandBA = B$, then which of the following is/are true? $A$ is idempotent b. $B$ is idempotent c. $A^T$ is idempotent d. none of these

A. (a) A is idempotent

B. (b) B is idempotent

C. (c) $A^T$ is idempotent

D. (d) none of these

**Answer: A::B::C**

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**5.** If $A(\theta)=\begin{bmatrix}\sin\theta & i\cos\theta \\ i\cos\theta & \sin\theta\end{bmatrix}$, then which of the following is not true ?

A. $A(\theta)^{-1}=A(\pi-\theta)$

B. $A(\theta)+A(\pi+\theta)$ is a null matrix

C. $A(\theta)$ is invertible for all $\theta \in R$

D. $A(\theta)^{-1}=A(-\theta)$

**Answer: A::B::C**

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**6.** Let $A and B$ be two nonsingular square matrices, $A^T and B^T$ are the transpose matrices of $A and B$, respectively, then which of the following options are correct? (correct option may be more than one) $(a)$. $B^T AB$ is symmetric matrix $(b)$. if $A$ is symmetric $B^T AB$ is symmetric matrix $(c)$. if $B$ is symmetric $B^T AB$ is skew-symmetric matrix for every matrix $A$ $(d)$. $B^T AB$ is skew-symmetric matrix if $A$ is skew-symmetric

A. $B^T AB$ is symmetric matrix if A is symmetric

B. $B^T AB$ is symmetric matrix if B is symmetric

C. $B^T AB$ is skew-symmetric matrix for every matrix A

D. $B^T AB$ is skew-symmetric matrix if A is skew-symmetric

**Answer: A::D**

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**7.** If $B$ is an idempotent matrix, and $A = I - B$, then $A^2 = A$ b. $A^2 = I$ c. $AB = O$ d. $BA = O$

A. $A^2 = A$

B. $A^2 = I$

C. $AB = O$

D. $BA = O$

**Answer: A::C::D**

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**8.** If $A_1 = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}, A_2 = \begin{bmatrix} 0 & 0 & 0 & i \\ 0 & 0 & -i & 0 \\ 0 & i & 0 & 0 \\ -i & 0 & 0 & 0 \end{bmatrix}, then A_i A_k + A_k A_i$

is equal to

A. $2I$ if $i = k$

B. $O$ if $i \neq k$

C. $2I$ if $i \neq k$

D. $O$ always

**Answer: A::B**

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**9.** Suppose $a_1, a_2, ....$ Are real numbers, with $a_1 \neq 0$. If $a_1, a_2, a_3, ...$ Are in A.P., then

A. 1) $A = \begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_5 & a_6 & a_7 \end{bmatrix}$ is singular (where $i = \sqrt{-1}$)

B. 2) the system of equations

$$a_1x + a_2y + a_3z = 0, a_4x + a_5y + a_6z = 0, a_7x + a_8y + a_9z = 0$$

has infinite number of solutions

C. 3) $B \begin{bmatrix} a_1 & ia_2 \\ ia_2 & a_1 \end{bmatrix}$ is nonsingular

D. 4) All of these

**Answer: A::B::C**

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**10.** If $\alpha, \beta, \gamma$ are three real numbers and $A = \begin{bmatrix} 1 & \cos(\alpha - \beta) & \cos(\alpha - \gamma) \\ \cos(\beta - \alpha) & 1 & \cos(\beta - \gamma) \\ \cos(\gamma - \alpha) & \cos(\gamma - \beta) & 1 \end{bmatrix}$, then which of following is/are true? a. $A$ is singular b. $A$ is symmetric c. $A$ is orthogonal d. $A$ is not invertible

A. A is singular

B. A is symmetric

C. A is orthogonal

D. A is not invertible

**Answer: A::B::D**

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**11.** If $D_1$ and $D_2$ are two $3 \times 3$ diagonal matrices, then which of the following is/are true ?

A. $D_1 D_2$ is a diagonal matrix

B. $D_1D_2 = D_2D_1$

C. $D_1^2 + D_2^2$ is a diagonal matrix

D. none of these

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**12.** Let A be the $2 \times 2$ matrix given by $A = [a_{ij}]$ where $a_{ij} \in \{0, 1, 2, 3, 4\}$ such theta $a_{11} + a_{12} + a_{21} + a_{22} = 4$ then which of the following statement(s) is/are true ?

A. Number of matrices A such that the trace of A equal to 4, is 5

B. Number of matrices A, such that A is invertible is 18

C. Absolute difference between maximum value and minimum value of det (A) is 8

D. Number of matrices A such that A is either symmetric (or) skew symmetric and det (A) is divisible by 2, is 5.

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**13.** If $S=\begin{bmatrix}0&1&1\\1&0&1\\1&1&0\end{bmatrix} and A=\begin{bmatrix}b+c&c+a&b-c\\c-b&c+b&a-b\\b-c&a-c&a+b\end{bmatrix}(a, b, c \ne 0), then SAS^{-1}$ is

A. symmetric matrix

B. diagonal matrix

C. invertible matrix

D. singular matrix

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**14.** P is a non-singular matrix and A, B are two matrices such that $B=P^{-1}AP$. The true statements among the following are

A. A is invertible iff B is invertib,e

B. $B^n = P^{-1}A^nP \forall n \in N$

C. $\forall \lambda \in R, B - \lambda I = P^{-1}(A - \lambda I)P$

D. A and B are both singular matrices

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**15.** Let $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$. Then

A. $A^2 - 4A - 5I_3 = O$

B. $A^{-1} = \frac{1}{5}(A - 4I_3)$

C. $A^3$ is not invertible

D. $A^2$ is invertible

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**16.** If $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, then which is true (a) $A^3 - A^2 = A - I$ (b) det. $\left(A^{100} - I\right) = 0$ (c) $A^{200} = \begin{bmatrix} 1 & 0 & 0 \\ 100 & 1 & 0 \\ 100 & 0 & 1 \end{bmatrix}$ (d) $A^{100} = \begin{bmatrix} 1 & 1 & 0 \\ 50 & 1 & 0 \\ 50 & 0 & 1 \end{bmatrix}$

A. $A^3 - A^2 = A - I$

B. det. $\left(A^{100} - I\right) = 0$

C. $A^{200} = \begin{bmatrix} 1 & 0 & 0 \\ 100 & 1 & 0 \\ 100 & 0 & 1 \end{bmatrix}$

D. $A^{100} = \begin{bmatrix} 1 & 1 & 0 \\ 50 & 1 & 0 \\ 50 & 0 & 1 \end{bmatrix}$



**17.** If Ais symmetric and B is skew-symmetric matrix, then which of the following is/are CORRECT ?

A. $ABA^T$ is skew-symmetric matrix

B. $AB^T + BA^T$ is symmetric matrix

C. $(A+B)(A-B)$ is skew-symmetric

D. $(A+I)(B-I)$ is symmetric

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**18.** If $A = (a_{ij})_{n \times n}$ and $f$ is a function, we define $f(A) = ((f(a_{ij})))_{n \times n}$, Let $A = \begin{pmatrix} \pi/2 - \theta & \theta \\ -\theta & \pi/2 - \theta \end{pmatrix}$. Then

A. $\sin A$ is invertible

B. $\sin A = \cos A$

C. $\sin A$ is orthogonal

D. $\sin(2A) = 2 \sin A \cos A$

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**19.** If $A$ is a matrix such that $A^2 + A + 2I = O$; the which of the following is/are true? (a) A is non-singular (b) A is symmetric (c) A cannot be skew-symmetric (d) $A^{-1} = -\frac{1}{2}(A + I)$

A. A is nonsingular

B. A is symmetric

C. A cannot be skew-symmetric

D. $A^{-1} = -\frac{1}{2}(A + I)$

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**20.** If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, then the trace of the matrix $Adj(AdjA)$ is

A. $adj(adjA) = A$

B. |adj (adj A)|=1

C. |adj A|=1

D. none of these

**Answer: B**

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**21.** If $\begin{bmatrix} 1 & -\tan\theta \\ \tan\theta & 1 \end{bmatrix}\begin{bmatrix} 1 & \tan\theta \\ -\tan\theta & 1 \end{bmatrix}^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then

A. $a = \cos 2\theta$

B. $a = 1$

C. $b = \sin 2\theta$

D. $b = -1$

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**22.** If $A^{-1} = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 3 & 1 \\ 0 & 0 & -\frac{1}{3} \end{bmatrix}$, then $|A| = -1$ b. $adjA = \begin{bmatrix} -1 & 1 & -2 \\ 0 & -3 & -1 \\ 0 & 0 & \frac{1}{3} \end{bmatrix}$ c. $A = \begin{bmatrix} 1 & \frac{1}{3} & 7 \\ 0 & \frac{1}{3} & 1 \\ 0 & 0 & -3 \end{bmatrix}$ d. $A = \begin{bmatrix} 1 & -\frac{1}{3} & -7 \\ 0 & -3 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

A. $|A| = -1$

B. adj $A = \begin{bmatrix} -1 & 1 & -2 \\ 0 & -3 & -1 \\ 0 & 0 & 1/3 \end{bmatrix}$

C. $A = \begin{bmatrix} 1 & 1/3 & 7 \\ 0 & 1/3 & 1 \\ 0 & 0 & -3 \end{bmatrix}$

D. $A = \begin{bmatrix} 1 & -1/3 & -7 \\ 0 & -3 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

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**23.** If $A$ is an invertible matrix, then $\left(adj\dot{A}^{-1}\right)$ is equal to a. $\left[adj\dot{A}^{-1}\right]$

b. $\frac{A}{det\dot{A}}$ c. $A$ d. $(\det A)A$

A. adj. $(A^{-1})$

B. $\frac{A}{\text{det. A}}$

C. $A$

D. (det. A) A

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**24.** If A and B are two invertible matrices of the same order, then adj (AB) is equal to

A. adj (B) adj (A)

B. $|B||A|B^{-1}A^{-1}$

C. $|B||A|A^{-1}B^{-1}$

D. $|A||B|(AB)^{-1}$

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25. If $A and B$ are three square matrices of the same order, then $AB = ACB = C\cdot$ Then $|A| \neq 0$ b. $A$ is invertible c. $A$ may be orthogonal d. is symmetric

A. $|A| \neq 0$

B. A is invertible

C. A may be orthogonal

D. A is symmetric

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**26.** If $A$ and $B$ are two non singular matrices and both are symmetric and commute each other, then

A. $A^{-1}B$

B. $AB^{-1}$

C. $A^{-1}B^{-1}$

D. none of these

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**27.** If A and B are square matrices of order 3 such that $A^3 = 8B^3 = 8I$ and det. $(AB - A - 2B + 2I) \neq 0$, then identify the correct statement(s), where $I$ is identity matrix of order 3. (A) $A^2 + 2A + 4I = O$ (B) $A^2 + 2A + 4I \neq O$ (C) $B^2 + B + I = O$ (D) $B^2 + B + I \neq O$

A. $A^2 + 2A + 4I = O$

B. $A^2 + 2A + 4I \neq O$

C. $B^2 + B + I = O$

D. $B^2 + B + I \neq O$

**Answer: A^(2)+2A+4I=O** and **B^(2)+B+I=O`**

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**28.** Let A, B be two matrices different from identify matrix such that $AB = BA$ and $A^n - B^n$ is invertible for some positive integer n. If $A^n - B^n = A^{n+1} - B^{n+1} = A^{n+2} - B^{n+2}$, then

A. $I - A$ is non-singular

B. $I - B$ is non-singular

C. $I - A$ is singular

D. $I - B$ is singular

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**29.** Let A and B be square matrices of the same order such that $A^2 = I$ and $B^2 = I$, then which of the following is CORRECT ?

A. IF A and B are inverse to each other, then $A = B$.

B. If $AB = BA$, then there exists matrix $C = \frac{AB + BA}{2}$ such that $C^2 = C$.

C. If $AB = BA$, then there exists matrix $D = AB - BA$ such that $D^n = O$ for some $n \in N$.

D. If $AB = BA$ then $(A + B)^5 = 16(A + B)$.

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**30.** Let B is an invertible square matrix and B is the adjoint of matrix A such that $AB = B^T$. Then

A. A is an identity matrix

B. B is symmetric matrix

C. A is a skew-symmetric matrix

D. B is skew symmetic matrix

**Answer: A**

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**31.** First row of a matrix A is $[1, 3, 2]$. If

adj $A = \begin{bmatrix} -2 & 4 & \alpha \\ -1 & 2 & 1 \\ 3\alpha & -5 & -2 \end{bmatrix}$, then a det (A) is

A. $-2$

B. $-1$

C. 0

D. 1

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**32.** Let A be a square matrix of order 3 satisfies the relation $A^3 - 6A^2 + 7A - 8I = O$ and $B = A - 2I$. Also, det. $A = 8$, then

A. det. $\left(\text{adj. } \left(I - 2A^{-1}\right) = \frac{25}{16}\right.$

B. adj. $\left(\left(\frac{B}{2}\right)^{-1}\right) = \frac{B}{10}$

C. det. $\left(\text{adj. } \left(I - 2A^{-1}\right)\right) = \frac{75}{32}$

D. adj. $\left(\left(\frac{B}{2}\right)^{-1}\right) = \frac{2B}{5}$

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**33.** Which of the following matrices have eigen values as 1 and -1 ?

A. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

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**34.** Let $MandN$ be two $3 \times 3$ non singular skew-symmetric matrices such that $MN = NM$. If $P^T$ denote the transpose of $P$, then $M^2N^2(M^TN^{-1})^T$ is equal to $M^2$ b. $-N^2$ c. $-M^2$ d. $MN$

A. $M^2$

B. $-N^2$

C. $-M^2$

D. $MN$

**Answer: C**

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**35.** Let $\omega$ be a complex cube root of unity with $\omega \neq 1 and P = [p_{ij}]$ be a $n \times n$ matrix withe $p_{ij} = \omega^{i+j}$. Then $p^2 \neq O, n = a.\ 57 b.\ 55 c.\ 58 d.\ 56$`

A. 57

B. 55

C. 58

D. 56

**Answer: B::C::D**

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**36.** For $3 \times 3$ matrices $M\ and\ N,$ which of the following statement (s) is (are) NOT correct ?

Statement - I : $N^T MN$ is symmetric or skew-symmetric, according as $M$ is symmetric or skew-symmetric.

Statement - II : $MN - NM$ is skew-symmetric for all symmetric matrices $M and N.$

Statement - III : $MN$ is symmetric for all symmetric matrices $MandN$.

Statement - IV : $(adjM)(adjN) = adj(MN)$ for all invertible matrices $MandN$.

A. $N^T MN$ is symmetric or skew-symmetric, according as M is symmetric or skew-symmetric

B. $MN - NM$ is skew0symmetric for all symmetric matrices M and N

C. MN is symmetric for all symmetric matrices M and N

D. (adj M ) (adj N) = adj (MN) for all inveriblr matrices M and N.

**Answer: C::D**

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**37.** Let $M$ be a $2 \times 2$ symmetric matrix with integer entries. Then $M$ is invertible if The first column of $M$ is the transpose of the second row of $M$ The second row of $M$ is the transpose of the first column of $M$ $M$ is a diagonal matrix with non-zero entries in the main diagonal The product of entries in the main diagonal of $M$ is not the square of an integer

A. the first column of M is the transpose of the second row of M

B. the second row of M is the transpose of the column of M

C. M is a diagonal matrix with non-zero entries in the main diagonal

D. the product of entries in the main diagonal of M is not the square of an integer

**Answer: C::D**

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**38.** Let m and N be two 3x3 matrices such that MN=NM. Further if $M \neq N^2$ and $M^2 = N^4$ then which of the following are correct.

A. determinant of $\left(M^2 + Mn^2\right)$ is 0

B. there is a $3 \times 3$ non-zero matrix U such that $\left(M^2 + MN^2\right)U$ is the zero matrix

C. determinant of $\left(M^2 + MN^2\right) \geq 1$

D. for a $3 \times 3$ matrix $U$, is the zero matrix

**Answer: A::B**

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**39.** Let $X \, and \, Y$ be two arbitrary, $3 \times 3$ , non-zero, skew-symmetric matrices and $Z$ be an arbitrary $3 \times 3$ , non-zero, symmetric matrix. Then which of the following matrices is (are) skew symmetric?

A. $Y^3 Z^4 - Z^4 Y^3$

B. $X^{44} + Y^{44}$

C. $X^4 Z^3 - Z^3 X^4$

D. $X^{23} + Y^{23}$

**Answer: C::D**

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**40.** Let $p = \begin{bmatrix} 3 & -1 & -2 \\ 2 & 0 & \alpha \\ 3 & -5 & 0 \end{bmatrix}$, where $\alpha \in \mathbb{R}$. Suppose $Q = [q_{ij}]$ is a matrix such that $PQ = kI$, where $k \in \mathbb{R}, k \neq 0$ and $I$is the identity matrix of order 3. If $q_{23} = -\frac{k}{8}$ and $\det(Q) = \frac{k^2}{2}$, then

A. $\alpha = 0, k = 8$

B. $4\alpha - k + 8 = 0$

C. det $(\text{P adj (Q)}) = 2^9$

D. det $(\text{Q adj (P)}) = 2^{13}$

**Answer: B::C**

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**41.** Which of the following is(are) NOT of the square of a $3 \times 3$ matrix with real enteries?

A. $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

C. $\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

**Answer: A::C**

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**42.** Let S be the set of all column matrices $\begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$ such that $b_1, b_2, b_2 \in R$ and the system of equations (in real variables)

$-x + 2y + 5z = b_1$

$2x - 4y + 3z = b_2$

$x - 2y + 2z = b_3$

has at least one solution. Then, which of the following system (s) (in real variables) has (have) at least one solution for each $\begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} \in S$ ?

A. $x+2y+3z=b_1, 4y+5z=b_2$ and $x+2y+6z=b_3$

B. $x+y+3z=b_1, 5x+2y+6z=b_2$ and $-2x-y-3z=b_3$

C. $x+2y-5z=b_1, 2x-4y+10z=b_2$ and $x-2y+5z=b_3$

D. $x+2y+5z=b_1, 2x+3z=b_2$ and $x+4y-5z=b_3$

**Answer: A::D**

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**43.** If $A=\begin{bmatrix}1&0&0\\1&0&1\\0&1&0\end{bmatrix}$, then which is true (a) $A^3-A^2=A-I$ (b) det. $\left(A^{100}-I\right)=0$ (c) $A^{200}=\begin{bmatrix}1&0&0\\100&1&0\\100&0&1\end{bmatrix}$ (d) $A^{100}=\begin{bmatrix}1&1&0\\50&1&0\\50&0&1\end{bmatrix}$

A. $A^3-A^2=A-I$

B. $Det\left(A^{2010}-I\right)=0$

C. $A^{50}=\begin{bmatrix}1&0&0\\25&1&0\\25&0&1\end{bmatrix}$

D. $A^{50} = \begin{bmatrix} 1 & 1 & 0 \\ 25 & 1 & 0 \\ 25 & 0 & 1 \end{bmatrix}$

**Answer: A::B::C**

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**44.** If the elements of a matrix $A$ are real positive and distinct such that $\det\left(A + A^T\right)^T = 0$ then

A. $\det A > 0$

B. $\det A \geq 0$

C. $\det\left(A - A^T\right) > 0$

D. $\det\left(A.\ A^T\right) > 0$

**Answer: A::C::D**

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**45.** If $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ and $X$ is a non zero column matrix such that $AX = \lambda X$, where $\lambda$ is a scalar, then values of $\lambda$ can be

A. $3$

B. $6$

C. $12$

D. $15$

**Answer: A::D**

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**46.** If $A,\ B$ are two square matrices of same order such that $A + B = AB$ and $I$ is identity matrix of order same as that of $A$,$B$ , then

A. A. $AB = BA$

B. B. $|A - I| = 0$

C. C. $|B - I| \neq 0$

D. D. $|A - B| = 0$

**Answer: A::C**

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47. If $A$ is a non-singular matrix of order $n \times n$ such that $3ABA^{-1} + A = 2A^{-1}BA$, then

A. $A$ and $B$ both are identity matrices

B. $|A + B| = 0$

C. $\left|ABA^{-1} - A^{-1}BA\right| = 0$

D. $A + B$ is not a singular matrix

**Answer: B::C**

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**48.** If the matrix $A$ and $B$ are of $3 \times 3$ and $(I - AB)$ is invertible, then which of the following statement is/are correct ?

A. $I - BA$ is not invertible

B. $I - BA$ is invertible

C. $I - BA$ has for its inverse $I + B(I - AB)^{-1}A$

D. $I - BA$ has for its inverse $I + A(I - BA)^{-1}B$

**Answer: B::C**

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**49.** Let a be square matrix such that $A(\text{adj. A}) = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

then find the value of

(i) $|\text{adj. A}|$ (ii) $|\text{adj. (adj. A)}|$ (iii) $|\text{adj. (3A)}|$

A. $|A| = 4$

B. $|adjA| = 16$

C. $\frac{|adj(adjA)|}{|adjA|} = 16$

D. $|adj2A| = 128$

**Answer: A::B::C**

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## Linked Comprehension Type

**1.** Let A be a matrix of order $2 \times 2$ such that $A^2 = O$.

$A^2 - (a + d)A + (ad - bc)I$ is equal to

A. $I$

B. $O$

C. $-I$

D. none of these

**Answer: B**

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**2.** Let A be a matrix of order $2 \times 2$ such that $A^2 = O$.

tr (A) is equal to

A. $1$

B. $0$

C. $-1$

D. none of these

**Answer: B**

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**3.** Let A be a matrix of order $2 \times 2$ such that $A^2 = O$.

$(I + A)^{100} =$

A. 100 A

B. $100(I + A)$

C. $100I + A$

D. $I + 100A$

**Answer: D**

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**4.** If A and B are two square matrices of order $3 \times 3$ which satify $AB = A$ and $BA = B$, then

Which of the following is true ?

A. If matrix A is singular, then matrix B is nonsingular.

B. If matrix A is nonsingular, then materix B is singular.

C. If matrix A is singular, then matrix B is also singular.

D. Cannot say anything.

**Answer: C**

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**5.** if $A$ and $B$ are two matrices of order $3 \times 3$so that $AB = A$ and $BA = B$ then $(A+B)^7 =$

A. $7(A+B)$

B. $7. I_{3 \times 3}$

C. $64(A+B)$

D. $128I$

**Answer: C**

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**6.** If A and B are two square matrices of order $3 \times 3$ which satify $AB = A$ and $BA = B$, then

$(A+I)^5$ is equal to (where I is idensity matric)

A. $I + 60A$

B. $I + 16A$

C. $I + 31A$

D. none of these

**Answer: C**

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**7.** Consider an arbitarary $3 \times 3$ non-singular matrix $A[a_{\text{ij}}]$. A matrix $B = [b_{\text{ij}}]$ is formed such that $b_{\text{ij}}$ is the sum of all the elements except $a_{\text{ij}}$ in the ith row of A. Answer the following questions :

If there exists a matrix X with constant elemts such that AX=B`, then X is

A. skew-symmetric

B. null matrix

C. diagonal matrix

D. none of these

**Answer: D**

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**8.** Let $A = [a_{ij}]$ be $3 \times 3$ matrix and $B = [b_{ij}]$ be $3 \times 3$ matrix such that $b_{ij}$ is the sum of the elements of $i^{th}$ row of A except $a_{ij}$. If det, $(A) = 19$, then the value of det. (B) is _______ .

A. $|A|$

B. $|A|/2$

C. $2|A|$

D. none of these

**Answer: C**

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**9.** Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ satisfies $A^n = A^{n-2} + A^2 - I$ for $n \geq 3$. And trace of a square matrix X is equal to the sum of elements in its proncipal diagonal.

Further consider a matrix $\underset{3 \times 3}{\cup}$ with its column as $\cup_1$ , $\cup_2$ , $\cup_3$ such that

$$A^{50}\cup_1 = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50}\cup_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50}\cup_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

The value of $|\cup|$ equals

A. 0

B. 1

C. $-1$

D. 25

**Answer: B**

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**10.** Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ satisfies $A^n = A^{n-2} + A^2 - I$ for $n \geq 3$. And trace of a square matrix X is equal to the sum of elements in its proncipal diagonal.

Further consider a matrix $\underset{3\times 3}{\cup}$ with its column as $\cup_1$ , $\cup_2$ , $\cup_3$ such that

$$A^{50}\cup_1 = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50}\cup_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50}\cup_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

The value of $|\cup|$ equals

A. 0

B. 1

C. 2

D. 3

**Answer: D**

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**11.** Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ satisfies $A^n = A^{n-2} + A^2 - I$ for $n \geq 3$. And trace of a square matrix X is equal to the sum of elements in its proncipal diagonal.

Further consider a matrix $\underset{3 \times 3}{\cup}$ with its column as $\cup_1$, $\cup_2$, $\cup_3$ such that

$$A^{50} \cup_1 = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50} \cup_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50} \cup_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

The value of $|\cup|$ equals

A. 0

B. 1

C. 2

D. $-1$

**Answer: B**

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**12.** Let for $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$, there be three row matrices $R_1$, $R_2$ and $R_3$, satifying the relations, $R_1A = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$, $R_2A = \begin{bmatrix} 2 & 3 & 0 \end{bmatrix}$ and $R_3A = \begin{bmatrix} 2 & 3 & 1 \end{bmatrix}$. If B is square matrix of order 3 with rows $R_1$, $R_2$ and $R_3$ in order, then

The value of det. $\left(2A^{100}B^3 - A^{99}B^4\right)$ is

A. $-2$

B. $-1$

C. 2

D. -27

**Answer: D**

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**13.** Let for $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$, there be three row matrices $R_1$, $R_2$ and $R_3$, satifying the relations, $R_1A = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$, $R_2A = \begin{bmatrix} 2 & 3 & 0 \end{bmatrix}$ and

$R_3A = \begin{bmatrix} 2 & 3 & 1 \end{bmatrix}$. If B is square matrix of order 3 with rows $R_1, R_2$ and $R_3$ in order, then

The value of det. (B) is

A. $-27$

B. $-9$

C. $3$

D. 9

**Answer: A**

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**14.** A and B are square matrices such that det. $(A) = 1, BB^T = I$, det $(B) > 0$, and A( adj. A + adj. B)=B.

The value of det $(A + B)$ is

A. $-2$

B. $-1$

C. 0

D. 1

**Answer: D**

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**15.** A and B are square matrices such that det. $(A) = 1, BB^T = I$, det $(B) > 0$, and A( adj. A + adj. B)=B.

The value of det $(A + B)$ is

A. $B^{-1}A$

B. $AB^{-1}$

C. $A^T B^{-1}$

D. $B^T A^{-1}$

**Answer: A**

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**16.** Let A be an $m \times n$ matrix. If there exists a matrix L of type $n \times m$ such that $LA = I_n$, then L is called left inverse of A. Which of the following matrices is NOT left inverse of matrix $\begin{bmatrix} 1 & -1 \\ 1 & 1 \\ 2 & 3 \end{bmatrix}$?

A. $\begin{bmatrix} \frac{1}{2} & \frac{1}{2} & 0 \\ -\frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$

B. $\begin{bmatrix} 2 & -7 & 3 \\ -\frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$

C. $\begin{bmatrix} -\frac{1}{2} & \frac{1}{2} & 0 \\ -\frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 3 & -1 \\ -\frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$

**Answer: C**

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**17.** Let A be an $m \times n$ matrix. If there exists a matrix L of type $n \times m$ such that $LA = I_n$, then L is called left inverse of A. Similarly, if there exists a matrix R of type $n \times m$ such that $AR = I_m$, then R is called right inverse of A.

For example, to find right inverse of matrix

$A = \begin{bmatrix} 1 & -1 \\ 1 & 1 \\ 2 & 3 \end{bmatrix}$, we take $R = \begin{bmatrix} x & y & x \\ u & v & w \end{bmatrix}$

and solve $AR = I_3$, i.e.,

$$\begin{bmatrix} 1 & -1 \\ 1 & 1 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} x & y & z \\ u & v & w \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\Longrightarrow \begin{matrix} x - u = 1 & y - v = 0 & z - w = 0 \\ x + u = 0 & y + v = 1 & z + w = 0 \\ 2x + 3u = 0 & 2y + 3v = 0 & 2z + 3w = 1 \end{matrix}$$

As this system of equations is inconsistent, we say there is no right inverse for matrix A.

The number of right inverses for the matrix $\begin{bmatrix} 1 & -1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$ is

A. 0

B. 1

C. 2

D. infinite

**Answer: D**

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**18.** Let A be an $m \times n$ matrix. If there exists a matrix L of type $n \times m$ such that $LA = I_n$, then L is called left inverse of A. Similarly, if there exists a matrix R of type $n \times m$ such that $AR = I_m$, then R is called right inverse of A.

For example, to find right inverse of matrix

$A = \begin{bmatrix} 1 & -1 \\ 1 & 1 \\ 2 & 3 \end{bmatrix}$, we take $R = \begin{bmatrix} x & y & x \\ u & v & w \end{bmatrix}$

and solve$AR = I_3$, i.e.,

$$\begin{bmatrix} 1 & -1 \\ 1 & 1 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} x & y & z \\ u & v & w \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\implies \begin{matrix} x - u = 1 & y - v = 0 & z - w = 0 \\ x + u = 0 & y + v = 1 & z + w = 0 \\ 2x + 3u = 0 & 2y + 3v = 0 & 2z + 3w = 1 \end{matrix}$$

As this system of equations is inconsistent, we say there is no right inverse for matrix A.

For which of the following matrices, the number of left inverses is greater than the number of right inverses ?

A. $\begin{bmatrix} 1 & 2 & 4 \\ -3 & 2 & 1 \end{bmatrix}$

B. $\begin{bmatrix} 3 & 2 & 1 \\ 3 & 2 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 4 \\ 2 & -3 \\ 2 & -3 \end{bmatrix}$

D. None of these

**Answer: C**

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**19.** Let A be the set of all $3 \times 3$ symmetric matrices all of whose entries are either 0 or 1. Five of these entries are 1 and four of them are 0. The number of matrices in A is

A. 12

B. 6

C. 9

D. 3

**Answer: A**

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**20.** Let A be the set of all $3 \times 3$ symmetric matrices all of whose either 0 or 1. Five of these entries are 1 and four of them are 0.

The number of matrices A in A for which the system of linear equations

$$A\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}1\\0\\0\end{bmatrix}$$

is inconsistent is : (A) less than 4 (B) at least 4 but less than 7 (C) at least 7 but less than 10 (D) at least 10

A. less than 4

B. at least 4 but less than 7

C. at least 7 but less than 10

D. at leat 10

**Answer: B**

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**21.** Let A be the set of all $3 \times 3$ symmetric matrices all of whose either 0 or 1. Five of these entries are 1 and four of them are 0.

The number of matrices A in A for which the system of linear equations

$$A\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

is inconsistent is : (A) less than 4 (B) at least 4 but less than 7 (C) at least 7 but less than 10 (D) at least 10

A. 0

B. more than 2

C. 2

D. 1

**Answer: B**

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**22.** Let P be an odd prime number and $T_p$ be the following set of $2 \times 2$ matrices :

The number of A in $T_p$ such that the trace of a is not divisible by p but det (A) divisible by p is [Note : The trace of matrix is the sum of its diaginal entries].

A. $(p-1)^2$

B. $2(p-1)$

C. $(p-1)^2+1$

D. $2p-1$

**Answer: D**

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**23.** Let P be an odd prime number and $T_p$ be the following set of $2 \times 2$ matrices :

$$T_P = \left\{ A = \begin{bmatrix} a & b \\ c & a \end{bmatrix} : a, b, c \in \{0, 1, ..., p-1\} \right\}$$

The number of A in $T_P$ such that det (A) is not divisible by p is

A. $(p-1)\left(p^2-p+1\right)$

B. $p^3 - (p-1)^2$

C. $(p-1)^2$

D. $(p-1)(p^2-2)$

**Answer: C**

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**24.** Let p be an odd prime number and $T_p$, be the following set of $2 \times 2$ matrices $T_p = \left\{ A = \begin{bmatrix} a & b \\ c & a \end{bmatrix} : a, b, c \in \{0, 1, 2, \ldots\ldots..p-1\} \right\}$ The number of A in $T_p$, such that A is either symmetric or skew-symmetric or both, and det (A) divisible by p is

A. 2p-1

B. $p^3 - 5p$

C. 3p-4

D. $p^3 - p^2$

**Answer: D**

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**25.** Let a,b, and c be three real numbers satistying $[a, b, c]\begin{bmatrix}1 & 9 & 7\\ 8 & 2 & 7\\ 7 & 3 & 7\end{bmatrix} = [0, 0, 0]$ If the point $P(a, b, c)$ with reference to (E), lies on the plane $2x + y + z = 1$, the the value of $7a + b + c$ is

A. 0

B. 12

C. 7

D. 6

**Answer: D**

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**26.** Let a,b, and c be three real numbers satistying $[a, b, c]\begin{bmatrix}1 & 9 & 7\\ 8 & 2 & 7\\ 7 & 3 & 7\end{bmatrix} = [0, 0, 0]$ If the point $P(a, b, c)$ with reference to (E), lies on the plane $2x + y + z = 1$, the the value of $7a + b + c$ is

A. $-2$

B. $2$

C. $3$

D. $-3$

**Answer: A**

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**27.** Let a,b, and c be three real numbers satistying $[a, b, c]\begin{bmatrix}1 & 9 & 7\\ 8 & 2 & 7\\ 7 & 3 & 7\end{bmatrix} = [0, 0, 0]$Let b=6, with a and c satisfying (E). If $\alpha$ and

$\beta$ are the roots of the quadratic equation $ax^2 + bx + c = 0 then \sum_{n=0}^{\infty} \left(\frac{1}{\alpha} + \frac{1}{\beta}\right)^n$ is (A) 6 (B) 7 (C) $\frac{6}{7}$ (D) oo

A. 6

B. 7

C. $\frac{6}{7}$

D. $\infty$

**Answer: B**

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## Matrix Type

**1.** Match the following lists :

| List I | List II |
|---|---|
| **a.** $(I-A)^n$ is if $A$ is idempotent | **p.** $2^{n-1}(I-A)$ |
| **b.** $(I-A)^n$ is if $A$ is involuntary | **q.** $I-nA$ |
| **c.** $(I-A)^n$ is if $A$ is nilpotent of index 2 | **r.** $A$ |
| **d.** If $A$ is orthogonal, then $(A^T)^{-1}$ | **s.** $I-A$ |

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**2.** Match the following lists :

| List I | List II |
|---|---|
| **a.** If $A$ is an idempotent matrix and $I$ is an identity matrix of the same order, then the value of $n$, such that $(A+I)^n = I + 127$ is | **p.** 9 |
| **b.** If $(I-A)^{-1} = I + A + A^2 + \cdots + A^7$, then $A^n = O$, where $n$ is | **q.** 10 |
| **c.** If $A$ is matrix such that $a_{ij} = (i+j)(i-j)$, then $A$ is singular if order of matrix is | **r.** 7 |
| **d.** If a nonsingular matrix $A$ is symmetric, show that $A^{-1}$ is also symmetric, then order of $A$ can be | **s.** 8 |

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**3.** Match the following lists :

| List I ($A$, $B$, $C$ are matrices) | List II |
|---|---|
| **a.** If $\|A\| = 2$, then $\|2A^{-1}\| =$ (where $A$ is of order 3) | **p.** 1 |
| **b.** If $\|A\| = 1/8$, then $\|\text{adj}(\text{adj}(2A))\| =$ (where $A$ is of order 3) | **q.** 4 |
| **c.** If $(A+B)^2 = A^2 + B^2$, and $\|A\| = 2$, then $\|B\| =$ (where $A$ and $B$ are of odd order) | **r.** 24 |
| **d.** $\|A_{2\times 2}\| = 2$, $\|B_{3\times 3}\| = 3$ and $\|C_{4\times 4}\| = 4$, then $\|ABC\|$ is equal to | **s.** 0 |
| | **t.** does not exist |

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**4.** Consider a matrix $A = [a_{ij}]$ of order $3 \times 3$ such that $a_{ij} = (k)^{i+j}$ where $k \in I$.

Match List I with List II and select the correct answer using the codes given below the lists.

| List I | List II |
|---|---|
| a. A is singular if | p. $k \in \{0\}$ |
| b. A is null matrix if | q. $k \in \phi$ |
| c. A is skew-symmetric which is not null matrix if | r. $k \in I$ |
| d. $A^2 = 3A$ if | s. $k \in \{-1, 0, 1\}$ |

A. $\begin{matrix} a & b & c & d \\ r & p & s & q \end{matrix}$

B. $\begin{matrix} a & b & c & d \\ s & p & q & r \end{matrix}$

C. $\begin{matrix} a & b & c & d \\ r & p & q & s \end{matrix}$

D. $\begin{matrix} a & b & c & d \\ q & p & r & s \end{matrix}$

**Answer: C**

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**5.** Match the following lists :

| | List I | List II |
|---|---|---|
| a. | If $M_r = \begin{bmatrix} r-1 & \frac{1}{r} \\ 1 & \frac{1}{(r-1)^2} \end{bmatrix}$ and $\lvert M_r \rvert$ is the corresponding determinant, then $\lim_{n\to\infty}(\lvert M_2\rvert + \lvert M_3\rvert + \ldots \lvert M_n\rvert) =$ | p. 0 |
| b. | If $(A+B)^2 = A^2 + B^2$ and $\lvert A\rvert = 2$ then $\lvert B\rvert =$ (where A and B are matrices of odd order) | q. 1 |
| c. | If $A = \begin{bmatrix} 3 & 1 \\ -1 & 1 \end{bmatrix}$ and a matrix $C$ is defined as $C = (BAB^{-1})(B^{-1}A^T B)$, where $\lvert C\rvert = K^2$ $(K \in N)$ then $K =$ | r. 2 |
| d. | If $A = \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$ and $A^4 = -\lambda I$ then $\lambda - 2$ is equal to | s. 4 |

A. $\begin{matrix} a & b & c & d \\ s & r & q & p \end{matrix}$

B. $\begin{matrix} a & b & c & d \\ s & p & q & r \end{matrix}$

C. $\begin{matrix} a & b & c & d \\ q & p & s & r \end{matrix}$

D. $\begin{matrix} a & b & c & d \\ s & q & r & p \end{matrix}$

**Answer: C**

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## Numerical Value Type

**1.** $A = \begin{bmatrix} 0 & 1 \\ 3 & 0 \end{bmatrix} and \left(A^8 + A^6 + A^4 + A^2 + I\right)V = \begin{bmatrix} 0 \\ 11 \end{bmatrix} \left(where I is\right.$ the $2 \times 2$ identity matrix), then the product of all elements of matrix $V$ is _____.

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**2.** If $[abc1 - a]$ is an idempotent matrix and $f(x) = x -^2 = bc = 1/4$, then the value of $1/f(a)$ is _____.

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**3.** Let $x$ be the solution set of equation $A^x = I; where A + [01 - 14 - 343 - 34] and I$ is the corresponding unit matrix and $x \subseteq N$, then the minimum value of $\sum (\cos^x \theta + \sin^x \theta), \theta \in R$.

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4. $A = \begin{bmatrix} 1 & tanx \\ -tanx & 1 \end{bmatrix}$ $and\ f(x)$ is defined as $f(x) = det(A^T A^{-1})$ for all x in domain, then the value of $(f(f(f(f.... f(x))))$ for $(n \geq 2)$ is ________.

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5. The equation $\begin{bmatrix} 1 & 2 & 2 \\ 1 & 3 & 4 \\ 2 & 4 & k \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ has $a$ solution for $(x, y, z)$ besides $(0, 0, 0)$. Then the value of $k$ is ______.

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6. If $A$ is an idempotent matrix satisfying, $(I - 0.4A)^{-1} = I - \alpha A, whereI$ is the unit matrix of the name order as that of $A,$ then th value of $|9\alpha|$ is equal to ______.

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7. Let

$A = \left[3x^2 16x\right], B = [abc], and C = \left[(x+2)^2 5x^2 2x 5x^2 2x (x+2)^2 2x (x+2$

be three given matrices, where $a, b, c and x \in R$. Given that

$f(x) = ax^2 + bx + c,$ then the value of $f(I)$ is _____.

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8. Let $A$ be the set of all $3 \times 3$ skew-symmetri matrices whose entries are either $-1, 0,$ or $1.$ If there are exactly three 0s three 1s, and there $(-1)'s$, then the number of such matrices is ________.

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9. Let $A = \left(\left[a_{ij}\right]\right)_{3 \times 3}$ be a matrix such that $\forall^T = 4I and a_{ij} + 2c_{ij} = 0, where c_{ij}$ is the cofactor of $a_{ij} and I$ is the unit matrix of order 3.

$|a_{11} + 4a_{12}a_{13}a_{21}a_{22} + 4a_{23}a_{31}a_{32}a_{33} + 4| + 5\lambda|a_{11} + 1a_{12}a_{13}a_{21}a_{22} + 1a_{23}$

then the value of $10\lambda$ is ______.

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**10.** Let $S$ be the set which contains all possible values of $l, m, n, p, q, r$

for which $A = \begin{bmatrix} l^2 - 3 & p & 0 \\ 0 & m^2 - 8 & q \\ r & 0 & n^2 - 15 \end{bmatrix}$ be non-singular idempotent

matrix. Then the sum of all the elements of the set $S$ is _______.

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**11.** If $A$ is a diagonal matrix of order $3 \times 3$ is commutative with every square matrix or order $3 \times 3$ under multiplication and $tr(A) = 12,$ then the value of $|A|^{1/2}$ is _____.

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**12.** If $A$ is a square matrix of order 3 such that $|A| = 2, then\left|\left(adjA^{-1}\right)^{-1}\right|$ is __________.

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**13.** If A and B are two matrices of order 3 such that $AB = O$ and $A^2 + B = I$, then tr. $\left(A^2 + B^2\right)$ is equal to ________.

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**14.** If a, b, and c are integers, then number of matrices $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ which are possible such that $AA^T = I$ is ______.

Watch Video Solution

**15.** Let $A = \left[a_{\text{ij}}\right]$ be $3 \times 3$ matrix and $B = \left[b_{\text{ij}}\right]$ be $3 \times 3$ matrix such that $b_{\text{ij}}$ is the sum of the elements of $i^{th}$ row of A except $a_{\text{ij}}$. If det, $(A) = 19$, then the value of det. (B) is ______ .

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**16.** A square matrix M of order 3 satisfies $M^2 = I - M$, where $I$ is an identity matrix of order 3. If $M^n = 5I - 8M$, then $n$ is equal to _____.

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**17.** Let $A = [a_{\text{ij}}]_{3 \times 3}$, $B = [b_{\text{ij}}]_{3 \times 3}$ and $C = [c_{\text{ij}}]_{3 \times 3}$ be any three matrices, where $b_{\text{ij}} = 3^{i-j} a_{\text{ij}}$ and $c_{\text{ij}} = 4^{i-j} b_{\text{ij}}$. If det. $A = 2$, then det. $(BC)$ is equal to _____ .

Watch Video Solution

**18.** If A is a square matrix of order $2 \times 2$ such that $|A| = 27$, then sum of the infinite series $|A| + \left|\frac{1}{2}A\right| + \left|\frac{1}{4}A\right| + \left|\frac{1}{8}A\right| + \ldots$ is equal to _____ .

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**19.** If A is a square matrix of order 2 and det. $A = 10$, then $\left((tr.\ A)^2 - tr.\ (A^2)\right)$ is equal to _____ .

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**20.** Let A and B are two square matrices of order 3 such that det. $(A) = 3$ and det. $(B) = 2$, then the value of det. $\left((\text{adj.}\ (B^{-1}A^{-1}))^{-1}\right)$ is equal to ______ .

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**21.** Let P, Q and R be invertible matrices of order 3 such $A = PQ^{-1}, B = QR^{-1}$ and $C = RP^{-1}$. Then the value of det. $(ABC + BCA + CAB)$ is equal to ______.

Watch Video Solution

22. If $P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is the adjoint of a $3 \times 3$ matrix A and det. $(A) = 4$, then the value of alpha is _____ .

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23. A, B and C are three square matrices of order 3 such that A= diag $(x, y, z)$, det $(B) = 4$ and det $(C) = 2$, where $x, y, z \in I^+$. If det $(adj(adj(ABC))) = 2^{16} \times 3^8 \times 7^4$, then the number of distinct possible matrices A is _______ .

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24. Let $A = [a_{ij}]$ be a matrix of order 2 where $a_{ij} \in \{-1, 0, 1\}$ and adj. $A = -A$. If det. $(A) = -1$, then the number of such matrices is _____ .

Watch Video Solution

**25.** Let K be a positive real number and $A = \begin{bmatrix} 2k-1 & 2\sqrt{k} & 2\sqrt{k} \\ 2\sqrt{k} & 1 & -2k \\ -2\sqrt{k} & 2k & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 2k-1 & \sqrt{k} \\ 1-2k & 0 & 2\sqrt{k} \\ -\sqrt{k} & -2\sqrt{k} & 0 \end{bmatrix}$. If det (adj A) + det (adj B) $= 10^6$, then $[k]$ is equal to _____ .

[Note : adj M denotes the adjoint of a square matrix M and $[k]$ denotes the largest integer less than or equal to $k$.]

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**26.** Let $M$ be a $3 \times 3$ matrix satisfying $M[010] = M[1-10] = [11-1], and M[111] = [0012]$ Then the sum of the diagonal entries of $M$ is _______.

Watch Video Solution

**27.** Let $z = \frac{-1+\sqrt{3i}}{2}, where i = \sqrt{-1}$ and $r, s \varepsilon P1, 2, 3\bigg\}. Let P = \Bigg[ \begin{matrix} (-z)^r & z \\ z^{2s} & z \end{matrix}$

and I be the idenfity matrix or order 2. Then the total number of ordered pairs (r,s) for which $P^2 = -I$ is

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## Archives (Single correct Answer type)

**1.** Let A be a $2 \times 2$ matrix

Statement -1 adj $(adjA) = A$

Statement-2 $|adjA| = |A|$

A. Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1.

B. Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1.

C. Statement 1 is true, statement 2 is false.

D. Statement 1 is false, statement 2 is true.

**Answer: B**

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**2.** The number of 3 x 3 non-singular matrices, with four entries as 1 and all other entries as 0, is:- (1) 5 (2) 6 (3) at least 7 (4) less than 4

A. 5

B. 6

C. at least 7

D. less than 4

**Answer: C**

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**3.** Let A be a $2 \times 2$ matrix with non-zero entries and let A^2=I, where i is a $2 \times 2$ identity matrix, Tr(A) i= sum of diagonal elements of A and $|A|$ =

determinant of matrix A. Statement 1:Tr(A)=0 Statement 2: $|A|$=1 . then (A) Statement 1 is false, statement 2 is true. (B) Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1. (C) Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1. (D) Statement 1 is true, statement 2 is false.

A. Statement 1 is false, statement 2 is true.

B. Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1.

C. Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1.

D. Statement 1 is true, statement 2 is false.

**Answer: D**

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**4.** Let A and B two symmetric matrices of order 3.

Statement 1 : $A(BA)$ and $(AB)A$ are symmetric matrices.

Statement 2 : $AB$ is symmetric matrix if matrix multiplication of A with B is commutative.

A. Statement 1 is false, statement 2 is true.

B. Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1.

C. Statement 1 is true, statement 2 is true, statement 2 is not a correct explanation for statement 1.

D. Statement 1 is true, statement 2 is false.

**Answer: C**

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**5.** Let $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$. If $u_1$ and $u_2$ are column matrices such that $Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ and $Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$, then $u_1 + u_2$ is equal to :

A. $\begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix}$

B. $\begin{pmatrix} -1 \\ 1 \\ -1 \end{pmatrix}$

C. $\begin{pmatrix} -1 \\ -1 \\ 0 \end{pmatrix}$

D. $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$

**Answer: D**

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**6.** Let P and Q be $3 \times 3$ matrices with $P \neq Q$ . If $P^3 = Q^3 and P^2 Q = Q^2 P$ , then determinant of $\left(P^2 + Q^2\right)$ is equal to

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

A. $-2$

B. 1

C. 0

D. $-1$

**Answer: C**

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**7.** If $P=\begin{bmatrix}1 & \alpha & 3\\ 1 & 3 & 3\\ 2 & 4 & 4\end{bmatrix}$ is the adjoint of a $3\times3$ matrix A and det. $(A)=4$, then the value of alpha is _____ .

A. 4

B. 11

C. 5

D. 0

**Answer: B**

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**8.** If A is an $3 \times 3$ non-singular matrix such that $AA^T = A^T A$ and $B = A^{-1}A^T$, then $BB^T$ equals (1) $I + B$ (2) $I$ (3) $B^{-1}$ (4) $(B^{-1})^T$

A. $I + B$

B. $I$

C. $B^{-1}$

D. $(B^{-1})'$

**Answer: B**

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**9.** If $A = [12221 - 2a2b]$ is a matrix satisfying the equation $\forall^T = 9I$, where $I$ is $3 \times 3$ identity matrix, then the ordered pair (a, b) is equal to :

(1) $(2, -1)$ (2) $(-2, 1)$ (3) (2, 1) (4) $(-2, -1)$

A. (2, -1)

B. (-2, 1)

C. (2, 1)

D. (-2, -1)

**Answer: D**

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**10.** If $A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$ and $A adj A = AA^T$ , then $5a + b$ is equal to: (1) $-1$ (2) 5 (3) 4 (4) 13

A. 5

B. 4

C. 13

D. $-1$

**Answer: A**

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**11.** if $A=\begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$ then $\left(3A^2+12A\right)=\ ?$

A. $\begin{bmatrix} 72 & -63 \\ -84 & 51 \end{bmatrix}$

B. $\begin{bmatrix} 72 & -84 \\ -63 & 51 \end{bmatrix}$

C. $\begin{bmatrix} 51 & 63 \\ 84 & 72 \end{bmatrix}$

D. $\begin{bmatrix} 51 & 84 \\ 63 & 72 \end{bmatrix}$

**Answer: C**

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## JEE Advanced (Single Correct Answer Type)

**1.** The number of $3 \times 3$ matrices $A$ whose entries are either $0$ or $1$ and for which the system $A\begin{vmatrix} x \\ y \\ z \end{vmatrix} = \begin{vmatrix} 1 \\ 0 \\ 0 \end{vmatrix}$ has exactly two distinct solution is a. 0 b. $2^9 - 1$ c. $168$ d. $2$

A. 0

B. $2^9 - 1$

C. 168

D. 2

**Answer: A**

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**2.** Let $\omega \neq 1$ be cube root of unity and $S$ be the set of all non-singular matrices of the form $\begin{bmatrix} 1 & a & b \\ \omega & 1 & c \\ \omega^2 & \omega & 1 \end{bmatrix}$, where each of $a, b,$ and $c$ is either $\omega$

or $\omega^2$. Then the number of distinct matrices in the set $S$ is (a) $2$ (b) $6$ (c) $4$ (d) $8$

A. 2

B. 6

C. 4

D. 8

**Answer: A**

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**3.** Let $P = [a_{ij}]$ be a $3 \times 3$ matrix and let $Q = [b_{ij}], where b_{ij} = 2^{i+j} a_{ij} f$ or $1 \le i, j \le 3$. If the determinant of $P$ is 2, then the determinant of the matrix $Q$ is $2^{10}$ b. $2^{11}$ c. $2^{12}$ d. $2^{13}$

A. $2^{10}$

B. $2^{11}$

C. $2^{12}$

D. $2^{13}$

**Answer: D**

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**4.** Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$ and Q = $[q_{ij}]$ be two $3 \times 3$ matrices such that $Q - P^5 = I_3$. Then $\frac{q_{21} + q_{31}}{q_{32}}$ is equal to

A. 52

B. 103

C. 201

D. 205

**Answer: B**

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**5.** How many $3 \times 3$ matrices $M$ with entries from $\{0, 1, 2\}$ are there, for which the sum of the diagonal entries of $M^T Mis5?$ 126 (b) 198 (c) 162 (d) 135

A. 198

B. 126

C. 135

D. 162

**Answer: A**

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## Single correct Answer

**1.** If $A = \begin{bmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{bmatrix}$ and $B = \begin{bmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{bmatrix}$, then $(A+B)^2 =$

(a) $A$ (b) $B$ (c) $I$ (d) $A^2 + B^2$

A. $A$

B. $B$

C. $I$

D. $A^2 + B^2$

**Answer: D**

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**2.** If the value of $\prod_{k=1}^{50} \begin{bmatrix} 1 & 2k-1 \\ 0 & 1 \end{bmatrix}$ is equal to $\begin{bmatrix} 1 & r \\ 0 & 1 \end{bmatrix}$ then $r$ is equal to

A. A. $62500$

B. B. $2500$

C. C. $1250$

D. D. $12500$

**Answer: B**

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Watch Video Solution

**3.** A square matrix P satisfies $P^2 = I - P$, where I is identity matrix. If $P^n = 5I - 8P$, then n is :

A. $4$

B. $5$

C. $6$

D. $7$

**Answer: C**

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**4.** $A$ and $B$ are two square matrices such that $A^2B = BA$ and if $(AB)^{10} = A^kB^{10}$, then $k$ is

A. $1001$

B. $1023$

C. $1042$

D. none of these

**Answer: B**

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**5.** If matrix $A = [a_{ij}]_{3 \times 3}$, matrix $B = [b_{ij}]_{3 \times 3}$, where $a_{ij} + a_{ji} = 0$ and $b_{ij} - b_{ji} = 0 \, \forall i, j$, then $A^4 \cdot B^3$ is

A. Singular

B. Zero matrix

C. Symmetric

D. Skew-Symmetric matrix

**Answer: A**

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**6.** If $A\begin{pmatrix}1 & 3 & 4 \\ 3 & -1 & 5 \\ -2 & 4 & -3\end{pmatrix}=\begin{pmatrix}3 & -1 & 5 \\ 1 & 3 & 4 \\ +4 & -8 & 6\end{pmatrix}$, then $A=$

A. $\begin{pmatrix}1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -2\end{pmatrix}$

B. $\begin{pmatrix}0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1\end{pmatrix}$

C. $\begin{pmatrix}1 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -2\end{pmatrix}$

D. $\begin{pmatrix}0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -2\end{pmatrix}$

**Answer: D**

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**7.** Let $A=\begin{bmatrix}-5 & -8 & -7 \\ 3 & 5 & 4 \\ 2 & 3 & 3\end{bmatrix}$ and $B=\begin{bmatrix}x \\ y \\ 1\end{bmatrix}$. If $AB$ is a scalar multiple of $B$, then the value of $x+y$ is

A. $-1$

B. $-2$

C. $1$

D. $2$

**Answer: B**

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8. $A=\begin{bmatrix} a & b \\ b & -a \end{bmatrix}$ and $MA=A^{2m}$, $m \in N$ for some matrix $M$, then which one of the following is correct ?

A. A. $M=\begin{bmatrix} a^{2m} & b^{2m} \\ b^{2m} & -a^{2m} \end{bmatrix}$

B. B. $M=\left(a^2+b^2\right)^m\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

C. C. $M=\left(a^m+b^m\right)\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

D. D. $M=\left(a^2+b^2\right)^{m-1}\begin{bmatrix} a & b \\ b & -a \end{bmatrix}$

**Answer: D**

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**9.** If $A = [a_{ij}]_{m \times n}$ and $a_{ij} = (i^2 + j^2 - ij)(j - i)$, $n$ odd, then which of the following is not the value of $Tr(A)$ (a) $0$ (b) $|A|$ (c) $2|A|$ (d) none of these

A. $0$

B. $|A|$

C. $2|A|$

D. none of these

**Answer: D**

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**10.** If det, $(A - B) \neq 0$, $A^4 = B^4$, $C^3 A = C^3 B$ and $B^3 A = A^3 B$, then find the value of det. $(A^3 + B^3 + C^3)$.

A. $0$

B. $1$

C. $3|A|^3$

D. $6$

**Answer: A**

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11. If $AB + BA = 0$, then which of the following is equivalent to $A^3 - B^3$

A. A. $(A - B)(A^2 + AB + B^2)$

B. B. $(A - B)(A^2 - AB - B^2)$

C. C. $(A + B)(A^2 - AB - B^2)$

D. D. $(A + B)(A^2 + AB - B^2)$

**Answer: C**

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**12.** $A, B, C$ are three matrices of the same order such that any two are symmetric and the $3^{rd}$ one is skew symmetric. If $X = ABC + CBA$ and $Y = ABC - CBA$, then $(XY)^T$ is

A. A. symmetric

B. B. skew symmetric

C. C. $I - XY$

D. D. $-YX$

**Answer: D**

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**13.** If $A$ and $P$ are different matrices of order $n$ satisfying $A^3 = P^3$ and $A^2P = P^2A$ (where $|A - P| \neq 0$) then $|A^2 + P^2|$ is equal to (A) $n$ (B) $0$ (C) $|A||P|$ (D) $|A + P|$

A. $n$

B. $0$

C. $|A||P|$

D. $|A+P|$

**Answer: B**

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**14.** Let $A, B$ are square matrices of same order satisfying $AB = A$ and $BA = B$ then $\left(A^{2010} + B^{2010}\right)^{2011}$ equals.

A. $A+B$

B. $2010(A+B)$

C. $2011(A+B)$

D. $2^{2011}(A+B)$

**Answer: D**

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**15.** The number of $2 \times 2$ matrices $A$, that are there with the elements as real numbers satisfying $A + A^T = I$ and $AA^T = I$ is (a) zero (b) one (c) two (d) infinite

A. zero

B. one

C. two

D. infinite

**Answer: C**

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**16.** If the orthogonal square matrices $A$ and $B$ of same size satisfy $\det A + \det B = 0$ then the value of $\det(A + B)$

A. $-1$

B. $1$

C. $0$

D. none of these

**Answer: C**

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**17.** If $A=\begin{bmatrix}\cos\theta & \sin\theta\\ \sin\theta & -\cos\theta\end{bmatrix}, B=\begin{bmatrix}1 & 0\\ -1 & 1\end{bmatrix}, C=ABA^T,$ then $A^TC^nA, n\in I^+$ equals to

A. $\begin{bmatrix}-n & 1\\ 1 & 0\end{bmatrix}$

B. $\begin{bmatrix}1 & -n\\ 0 & 1\end{bmatrix}$

C. $\begin{bmatrix}0 & 1\\ 1 & -n\end{bmatrix}$

D. $\begin{bmatrix}1 & 0\\ -n & 1\end{bmatrix}$

**Answer: D**

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**18.** Let $A$ be a $3 \times 3$ matrix given by $A = (a_{ij})_{3 \times 3}$. If for every column vector $X$ satisfies $X'AX = 0$ and $a_{12} = 2008$, $a_{13} = 2010$ and $a_{23} = -2012$. Then the value of $a_{21} + a_{31} + a_{32} =$

A. $-6$

B. $2006$

C. $-2006$

D. $0$

**Answer: C**

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**19.** Let A and B be two non-singular matrices such that $A \neq I, B^3 = I \text{ and } AB = BA^2$, where I is the identity matrix, the least value of k such that $A^k$ = I is

A. $4$

B. $5$

C. $10$

D. $7$

**Answer: D**

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**20.** Let $A$ be a $2 \times 3$ matrix, whereas $B$ be a $3 \times 2$ amtrix. If $\det.\ (AB) = 4$, then the value of $\det.\ (BA)$ is

A. $-4$

B. $2$

C. $-2$

D. $0$

**Answer: D**

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**21.** Let $A$ be a square matrix of order $3$ so that sum of elements of each row is $1$. Then the sum elements of matrix $A^2$ is

A. A. $1$

B. B. $3$

C. C. $0$

D. D. $6$

**Answer: B**

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**22.** $A$ and $B$ be $3 \times 3$ matrices such that $AB + A + B = 0$, then

A. A. $(A + B)^2 = A^2 + 2AB + B^2$

B. B. $|A| = |B|$

C. C. $A^2 = B^2$

D. D. none of these

**Answer: A**

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**23.** If $(A+B)^2 = A^2 + B^2$ and $|A| \neq 0$, then $|B| =$ (where $A$ and $B$ are matrices of odd order)

A. $2$

B. $-2$

C. $1$

D. $0$

**Answer: D**

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**24.** If $A$ is a square matrix of order $3$ such that $|A| = 5$, then $|Adj(4A)| =$

A. $5^3 \times 4^2$

B. $5^2 \times 4^3$

C. $5^2 \times 16^3$

D. $5^3 \times 16^2$

**Answer: C**

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**25.** If $A$ and $B$ are two non singular matrices and both are symmetric and commute each other, then

A. Both $A^{-1}B$ and $A^{-1}B^{-1}$ are symmetric.

B. $A^{-1}B$ is symmetric but $A^{-1}B^{-1}$ is not symmetric.

C. $A^{-1}B^{-1}$ is symmetric but $A^{-1}B$ is not symmetric.

D. Neither $A^{-1}B$ nor $A^{-1}B^{-1}$ are symmetric

**Answer: A**

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**26.** If $A$ is a square matrix of order $3$ such that $|A| = 2$, then $\left|\left(adjA^{-1}\right)^{-1}\right|$ is

A. $1$

B. $2$

C. $4$

D. $8$

**Answer: C**

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**27.** Let matrix $A = \begin{bmatrix} x & y & -z \\ 1 & 2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$, where $x, y, z \in N$. If $|adj(adj(adj(adjA)))| = 4^8 \cdot 5^{16}$, then the number of such $(x, y, z)$ are

A. 28

B. 36

C. 45

D. 55

**Answer: B**

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**28.** A be a square matrix of order 2 with $|A| \neq 0$ such that $|A + |A|adj(A)| = 0$, where $adj(A)$ is a adjoint of matrix $A$, then the value of $|A - |A|adj(A)|$ is

A. 1

B. $2$

C. $3$

D. $4$

**Answer: D**

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**29.** If S is a real skew-symmetric matrix and det. $(I - S) \neq 0$, then prove that matrix $A = (I + S)(I - S)^{-1}$ is orthogonal.

A. idempotent matrix

B. symmetric matrix

C. orthogonal matrix

D. none of these

**Answer: C**

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**30.** If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, then

A. $1$

B. $2$

C. $3$

D. $4$

**Answer: A**

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**31.** If $A = \begin{bmatrix} 1 & -1 & 1 \\ 0 & 2 & -3 \\ 2 & 1 & 0 \end{bmatrix}$ and $B = (adjA)$ and $C = 5A$, then find the value of $\frac{|adjB|}{|C|}$

A. $25$

B. $2$

C. $1$

D. $5$

**Answer: C**

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**32.** Let $A$ and $B$ be two non-singular square matrices such that $B \neq I$ and $AB^2 = BA$. If $A^3 - B^{-1}A^3B^n$, then value of $n$ is

A. $4$

B. $5$

C. $8$

D. $7$

**Answer: C**

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**33.** If $A$ is an idempotent matrix satisfying, $(I - 0.4A)^{-1} = I - \alpha A, where I$ is the unit matrix of the name order as that of $A$, then th value of $|9\alpha|$ is equal to ______.

A. $-1/3$

B. $1/3$

C. $-2/3$

D. $2/3$

**Answer: C**

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**34.** If $A$ and $B$ are two non-singular matrices which commute, then $\left(A(A+B)^{-1}B\right)^{-1}(AB) =$

A. $A + B$

B. $A^{-1} + B^{-1}$

C. $A^{-1} + B$

D. none of these

**Answer: A**

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