MATHS

BOOKS - CENGAGE MATHS (HINGLISH)

MATRICES

Examples

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).

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. Statement 1: If $A = \left(\left[a_{ij}\right]\right)_{n \times n}$ is such that $(a)_{ij} = a_{ji}, \forall i, j and A^2 = O$, then 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 2×2 matrix such that $PP^T = I$, where I is an identity matrix of order 2. If $Q = PAP^T$ and $R = \left[r_{ij}\right]_{2 \times 2} = P^TQ^8P$, 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 $\det.(A) = -2$ and $\det.(B) = 1$, then $\det.\left(A^{-1}adjB^{-1}.\,adj\left(2A^{-1}\right)\right)$ is equal to

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

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11. Construct a 2×2 matrix, where

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

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

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

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14. 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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15. For $\alpha, \beta, \gamma \in R$, let

$$A = \begin{bmatrix} \alpha^2 & 6 & 8 \\ 3 & \beta^2 & 9 \\ 4 & 5 & \gamma^2 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2\alpha & 3 & 5 \\ 2 & 2\beta & 6 \\ 1 & 4 & 2\gamma - 3 \end{bmatrix}$$

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16. 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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17. 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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18. $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ and $A + A^T = I$, find the value of α.

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19. Let A be a square matrix. Then prove that $(i) A + A^T$ is a symmetric matrix,$(ii) A - A^T$ is a skew-symmetric matrix and$(iii) \forall^T$ and $A^T A$ are symmetric matrices.

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20. If $A = [2 - 131]$ and $B = [1472]$, find $3A - 2B$

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21. Find non-zero values of x satisfying the matrix equation:

$x[2x23x] + 2[85x44x] = 2\left[x^2 + 824106x\right]$

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22. Let $A + 2B = \begin{bmatrix} 1 & 2 & 0 \\ 6 & -1 & 3 \\ -5 & 3 & 1 \end{bmatrix}$ 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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23. 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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24. 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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25. 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 8×8 and 3×13, respectively (C) $AB = BA$ (D) None of these

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26. 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 AB and BA are defined and equal.

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27. 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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28. Find the values of $x, \; y, \; z$ if the matrix $A = [02yzxy - zx - yz]$ satisfy the equation $A^T A = I_3$.

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29. If $A = [\cos\theta\sin\theta - \sin\theta\cos\theta]$, then prove that $A^n = [\cos n\theta\sin n\theta - \sin n\theta\cos n\theta], n \in N$.

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30. 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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31. 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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32. Show that the solution of the equation $\begin{bmatrix} x & y \\ z & t \end{bmatrix}^2 = O$ is $\begin{bmatrix} x & y \\ z & t \end{bmatrix} = \begin{bmatrix} \pm\sqrt{\alpha\beta} & -\beta \\ \alpha & \pm\sqrt{\alpha\beta} \end{bmatrix}$ where α, β are arbitrary.

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33. Let a be square matrix. Then prove that AA^T and A^TA are symmetric matrices.

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34. 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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35. If a and B are square matrices of same order such that $AB + BA = O$, then prove that $A^3 - B^3 = (A + B)\left(A^2 - AB - B^2\right)$.

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

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37. 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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38. If A and B are square matrices of the same order such that $AB = BA$, then proveby induction that $AB^n = B^n A$. Further, prove that $(AB)^n = A^n B^n$ for all $n \in N$.

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

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

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42. 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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43. Given a matrix $A = [abcbcacab], wherea, b, c$ are real positive numbers $abc = 1andA^TA = I,$ then find the value of $a^3 + b^3 + c^3$.

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44. If M is a 3×3 matrix, where det $M = 1andMM^T = 1, whereI$ is an identity matrix, prove theat det $(M - I) = 0.$

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45. Consider point P(x, y) in first quadrant. Its reflection about x-axis is $Q\left(x_1, y_1\right)$. 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

(i) reflection about y-axis

(ii) reflection about the line $y = x$

(iii) reflection about origin

(iv) reflection about line $y = (\tan\theta)x$

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46. 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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47. 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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48. The matrix $A = [- 5 - 8035012 -]$ is a. idempotent matrix b. involutory matrix c. nilpotent matrix d. none of these

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

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

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52. 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 $S^TP^{10}S$.

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

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54. 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

(i) $|A|$ (ii) adj. A

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55. 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 α is :

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56. 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}, the matrix X satifying $A^{-1}XA = B$.

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57. 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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58. 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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59. Let p be a non singular matrix, and $I + P + p^2 + \ldots + p^n = 0$, then find p^{-1}.

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60. 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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61. 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) $C^TAC = A$

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

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

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

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66. 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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67. Using elementary transformations, find the inverse of the matrix :

(20 - 1510013)

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68. Let a be a 3×3 matric such that

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

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

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70. 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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71. $A = \begin{bmatrix} a & 1 & 0 \\ 1 & b & d \\ 1 & b & c \end{bmatrix}, B = \begin{bmatrix} a & 1 & 1 \\ 0 & d & c \\ f & g & h \end{bmatrix}, U = \begin{bmatrix} f \\ g \\ h \end{bmatrix}, V = \begin{bmatrix} a^2 \\ 0 \\ 0 \end{bmatrix}$ If there is a vector matrix X, such that $AX = U$ has infinitely many solutions, then prove that $BX = V$ cannot have a unique solution. If $afd \neq 0$. Then,prove that $BX = V$ has no solution.

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72. 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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73. Show that if $\lambda_1, \lambda_2, \ldots., lamnda_n$ 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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74. If A is nonsingular, prove that the eigenvalues of A^{-1} are the reciprocals of the eigenvalue of A.

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75. If one of the eigenvalues of a square matrix a order 3×3 is zero, then prove that det $A = 0$.

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Exercise 13 1

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

(ii) $a_{ij} = 2i - j$

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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 3×3 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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Exercise 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 λ 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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Exercise 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 $x \varepsilon N$ 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:

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

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

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9. $IfA = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}, then \ \text{Lim}_{x_{>}\infty} \frac{1}{n}A^n$ is

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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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Exercise 13 4

1. If A and B are matrices of the same order, then $AB^T - B^TA$ 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 3×2 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 $A^2 B = B^2 A$. If det. $(A - B) \neq 0$, then find the value of det. $\left(A^2 + B^2\right)$.

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8. If $D = diag\left[d_1, d_2, d_n\right]$, then prove that $f(D) = diag\left[f\left(d_1\right), f\left(d_2\right), , f\left(d_n\right)\right], where f(x)$ is a polynomial with scalar coefficient.

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9. Point P(x, y) is rotated by an angle θ in anticlockwise direction. The new position of point P is $Q\left(x_1, y_1\right)$. 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 idempotent ?

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

A. 2^n

B. $2^n - 1$

C. 2^{n-1}

D. n

Answer: A

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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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Exercise 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 $A^{-1} = \dfrac{A^2 - 3I}{2}$

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4. For the matrix $A = [3175]$, 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 $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, $B = \begin{bmatrix} \cos 2\beta & \sin 2\beta \\ \sin 2\beta & -\cos 2\beta \end{bmatrix}$ where $0 < \beta < \frac{\pi}{2}$ then prove that $BAB = A^{-1}$ Also find the least positive value of α for 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 2×2 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 $(\text{adj. } A)^{-1} = \left(\text{adj. } A^{-1}\right)$.

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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. Show that the two matrices A, $P^{-1}AP$ have the same characteristic roots.

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

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

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Exercise Single

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 of order 10 x 10 are defined as $a_{ij} = \omega^{i+j}$ (where omega is cube root unity), then tr(A) of matrix is

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

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

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

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

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

Answer: C

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5. Let $AandB$ be two 2×2 matrices. Consider the statements $AB = OA + O$ or $B = O$ $AB = I_2A = B^{-1}$ $(A + B)^2 = A^2 + 2AB + B^2$ (i) and (ii) are false, (iii) is true (ii) and (iii) are false, (i) is true (i) is false (ii) and, (iii) are true (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. 1

B. 0

C. 2^n

D. 3^n

Answer: D

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7. A is a 2×2 matrix such that $A[1 - 1] = [- 12]andA^2[1 - 1] = [10]$ The sum of the elements of A is -1 b. 0 c. 2 d. 5

A. -1

B. 0

C. 2

D. 5

Answer: D

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8. If $\begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}\begin{bmatrix} \cos^2\phi & \cos\phi\sin\phi \\ \cos\phi\sin\phi & \sin^2\phi \end{bmatrix} = O$ 'then value of ' $\theta - \phi$ *equals*,

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

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

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

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 $[\alpha\beta\gamma - \alpha]$ is to be square root of two-rowed unit matrix, then $\alpha, \beta and \gamma$ should satisfy the relation. $1 - \alpha^2 + \beta\gamma = 0$ 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 $A = [i - i - ii] and B = [1 - 1 - 11], then A^8$ equals $4B$ b. $128B$ c. $-128B$ d. $-64B$

A. 4B

B. 128B

C. -128 B

D. -64B

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 $A = [0 - \tan(\alpha/2)\tan(\alpha/2)0]$ and I be the identity matrix of order 2. Show that $I + A = (I - A)[\cos\alpha - \sin\alpha\sin\alpha\cos\alpha]$.

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 $A = [abcd]$ (where $bc \neq 0$) satisfies the equations $x^2 + k = 0, then$

$a + d = 0$ b. $K = -|A|$ c. $k = |A|$ d. none of these

A. $a + d = 0$

B. $k = -|A|$

C. $k = |A|$

D. none of these

Answer: C

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17. $A = \begin{bmatrix} 2 & 1 \\ 4 & 1 \end{bmatrix}; B = \begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$ & $c = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix}$,

$tr(A) + tr\left[\frac{ABC}{2}\right] + tr\left[\frac{A(BC)^2}{4}\right] + tr\left[\frac{A(BC)^2}{8}\right] + \ldots . \infty$ is:

A. 6

B. 9

C. 12

D. none of these

Answer: A

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18. If $\begin{bmatrix} \cos\frac{2\pi}{7} & -\sin\frac{2\pi}{7} \\ \sin\frac{2\pi}{7} & \cos\frac{2\pi}{7} \end{bmatrix}^k = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then the least positive integral value of k, is

A. 3

B. 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 λ.

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

Answer: A

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22. If Z is an idempotent matrix, then $(I+Z)^n$

A. $I+2^nZ$

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

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

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 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 $A = \begin{bmatrix} 6 & 11 \\ 2 & 4 \end{bmatrix}$ then determinant of $A^{2005} - 6A^{2004}$ is

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 a non-diagonal involutory matrix, then

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 order such that the product $AB = O$, then

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 : (A) XY (B) YX (C) $-YX$ (D) non 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

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 ?

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

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 $\left|AB + KI_n\right|$ is (where K is a scalar quantity) $(|A| + K)^{n-2}$ 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 $A = \begin{bmatrix} a & b & c \\ x & y & x \\ p & q & r \end{bmatrix}$, $B = \begin{bmatrix} q & -b & y \\ -p & a & -x \\ r & -c & z \end{bmatrix}$ and If A is invertible, then which of the following is not true ?

A. $|A| = |B|$

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

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

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

Answer: A

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35. If $A(\alpha, \beta) = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & e^{\beta} \end{bmatrix}$, then $A(\alpha, \beta)^{-1}$ is equal to

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

Answer: A

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37. Id $[1/250x1/25] = [50 - a5]^{-2}$, then the value of x is $a/125$ b. $2a/125$ c. $2a/25$ 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 $f(x) = \dfrac{1 + x}{1 - x}$, 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. $A + B$

Answer: A

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41. If $A = [1\tan x - \tan x 1]$, show that $A^T A^{-1} = [\cos 2x - \sin 2x \sin 2x \cos 2x]$

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 3 square matrix such that $|A| = 2$, then $|\text{adj (adj (adj A))}|$ is

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 $A^{-1} = \begin{bmatrix} 1/2 & -1/2 & 1/2 \\ -4 & 3 & c \\ 5/2 & -3/2 & 1/2 \end{bmatrix}$, then the values of a and c are equal to

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 $|\text{adj (adj A)}|$ is

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 $A = (a 0 0 b)$, then $(\lim)_{n \vec{\infty}} A^{-n}$ 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 $A = \left[a_{\text{ij}}\right]_{4 \times 4}$, such that $a_{\text{ij}} = \begin{cases} 2, & \text{when } i = j \\ 0, & \text{when } i \neq j \end{cases}$, then $\left\{ \frac{\det(\text{adj}(\text{adj A}))}{7} \right\}$ is (where $\{ \cdot \}$ represents fractional part function)

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 $A = [01 - 14 - 343 - 34]$, 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 nonsingular matrix such that $AA^T = A^TA$ and $B = A^{-1}A^T$, then matrix B is

A. involuntary

B. orthogonal

C. idempotent

D. none of these

Answer: B

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49. If P is an orthogonal matrix and $Q = PAP^T andx = P^T$ 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 $AandB$ are two non-singular matrices of the same order such that $B^r = I,$ for some positive integer $r > 1, thenA^{-1}B^{r-1}A = A^{-1}B^{-1}A =$ I b. $2I$ c. O d. -I

A. I

B. $2I$

C. O

D. $-I$

Answer: C

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

A. PQ

B. QAP

C. PAQ

D. $PA^{-1}Q$

Answer: C

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

OI 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 $A^3 = O$, $thenf(A)$ is $I + A + A^2$ 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. if $\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then $A = ?$

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) $A + I$ (B) A (C) $A - I$ (D) $I - A$

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. $F\left(x^{-1}\right)G\left(y^{-1}\right)$

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

Answer: B

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57. If $AandB$ are square matrices of the same order and A is non-singular, then for a positive integer n, $\left(A^{-1}BA\right)^{n}$ is equal to $A^{-n}B^{n}A^{n}$ b. $A^{n}B^{n}A^{-n}$ c. $A^{-1}B^{n}A$ d. $n\left(A^{-1}B^{A}\right)$

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

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

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

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

Answer: C

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58. If $k \in R_o thendet\left\{adj\left(kI_n\right)\right\}$ 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 that 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(adj A) 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 true ?

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 $\left|A - A^T\right| \neq 0$ and $B =$ adj. (A), then adj. $\left(B^2 A^{-1} B^{-1} A\right)$ 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. $\left(\text{adj. } A^{-1}\right)$ 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. $\left(2B^{-1}\right)$, 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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Exercise Multiple

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

A. $-A$

B. A^{-1}

C. adj A

D. ωA, where ω is cube root of unity

Answer: B::C

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2. Let $A = a_{ij}$ be a matrix of order 3, where $a_{ij} = \{(x, , \text{if } i = j, x \in R,), (1, , \text{if } |i - j| = 1, , , \text{then which of the following}), (0, , \text{o}$

hold (s) good :

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 $A = \begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}, B = \begin{bmatrix} a & 1 \\ b & -1 \end{bmatrix}$ and $(A + B)^2 = A^2 + B^2 + 2AB$, then

A. $a = -1$

B. $a = 1$

C. $b = 2$

D. $b = -2$

Answer: A::D

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4. If AB=A and BA=Bm then which of the following is/are true ?

A. A is idempotent

B. B is idempotent

C. A^T is idempotent

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

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 tranpose matrices of A and B, respectively, then which of the following are coorect ?

A. B^TAB is symmetric matrix if A is symmetric

B. B^TAB is symmetric matrix if B is symmetric

C. B^TAB is skew-symmetric matrix for every matrix A

D. B^TAB 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. $A^2 = A$

B. $A^2 = I$

C. $AB = O$

D. $BA = O$

Answer: A::C::D

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8. If $A_1 = [0001001001001000], A_2 = [000i00 - i00i00 - i000], thenA_iA_k + A_kA_i$ is equal to $2l \quad \text{if} \quad i = k$ b. $O \quad \text{if} \quad i \neq k$ c. $2l \quad \text{if} \quad i \neq k$ d. O always

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

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

D. none of these

Answer: A::B::C

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10. If α, β, γ 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

Answer: A::B::D

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

A. D_1D_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

Answer:

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12. Let A be the 2×2 matrix given by $A = \left[a_{\text{ij}}\right]$ where $a_{\text{ij}} \in \{0, 1, 2, 3, 4\}$ 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.

Answer:

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

A. symmetric matrix

B. diagonal matrix

C. invertible matrix

D. singular matrix

Answer:

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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

Answer:

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

C. A^3 is not invertible

D. A^2 is invertible

Answer:

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16. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, then

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

Answer:

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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

Answer:

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18. If $A = \left(\left(a_{ij}\right)\right)_{n \times n}$ and f is a function, we define $f(A) = \left(\left(f\left(a_{ij}\right)\right)\right)_{n \times n'}$ Let $A = (\pi/2 - \theta\theta - \theta\pi/2 - \theta)$. Then $\sin A$ is invertible b. $\sin A = \cos A$ c. $\sin A$ is orthogonal d. $\sin(2A) = 2A\sin A\cos A$

A. $\sin A$ is invertible

B. $\sin A = \cos A$

C. $\sin A$ is orthogonal

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

Answer:

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19. If a is matrix such that $A^2 + A + 2I = O$, then which of the following is/are true ?

A. A is nonsingular

B. A is symmetric

C. A cannot be skew-symmetric

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

Answer:

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20. If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, then adj (adj A) is

A. $adj(adjA) = A$

B. $|adj(adjA)| = 1$

C. $|adjA| = 1$

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. $b = -1$

Answer:

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

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

Answer:

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23. If A is an invertible matrix, tehn $\left(adj\dot{A}\right)^{-1}$ is equal to $adj\dot{A}^{-1}$ b. $\dfrac{A}{det\dot{A}}$ c. A d. $(\det A)A$

A. adj. $\left(A^{-1}\right)$

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

C. A

D. (det. A) A

Answer:

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

Answer:

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25. If A, B, and C are three square matrices of the same order, then $AB = AC \Rightarrow B = C$. Then

A. $|A| \neq 0$

B. A is invertible

C. A may be orthogonal

D. A is symmetric

Answer:

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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

Answer:

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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 idensity matrix of order 3.

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

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

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

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

Answer:

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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 $A^n - B^n = A^{n+1} - B^{n+1} = A^{n+1} - B^{n+2}$, then

A. $I - A$ is non-singular

B. $I - B$ is non-singular

C. $I - A$ is singular

D. $I - B$ is singular

Answer:

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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 $(A + B)^5 = 16(A + B)$.

Answer:

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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 maximum value of $\det(A)$ is

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

Answer:

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33. Which of the following matericeshave 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. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Answer:

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Exercise Comprehension

1. Let a be a matrix of order 2×2 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 2×2 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 2×2 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 3×3 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 3×3so 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 3×3 which satisfy $AB = A$ and $BA = B$, then

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

A. $I + 60I$

B. $I + 16A$

C. $I + 31A$

D. none of these

Answer: C

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7. Consider an arbitarary 3×3 non-singular matrix $A\left[a_{ij}\right]$. A maxtrix $B = \left[b_{ij}\right]$ is formed such that b_{ij} is the sum of all the elements except a_{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 3×3 matrix and $B = [b_{ij}]$ be 3×3 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 $A^n = A^{n-1} + A^2 - I$ 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 $U_{3 \times 3}$ with its column as U_1, U_2, U_3 such that

$$A^{50} U_1 = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50} U_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50} U_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

The values of $|A^{50}|$ 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 $A^n = A^{n-1} + A^2 - I$ 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 $U_{3 \times 3}$ with its column as U_1, U_2, U_3 such that

$$A^{50} U_1 = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50} U_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50} U_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

Trace of A^{50} 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 $U_{3\times 3}$ with its column as U_1, U_2, U_3 such that

$$A^{50}U_1 = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50}U_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50}U_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

The value of $|U|$ 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. 3

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. $\left(2A^{100}B^3 - A^{99}B^4\right)$ 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.

$AB^{-1} =$

A. $B^{-1}A$

B. AB^{-1}

C. A^TB^{-1}

D. B^TA^{-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. 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

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

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

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

$$\Rightarrow \quad x - u = 1 \qquad y - v = 0 \qquad z - w = 0$$
$$x + u = 0 \qquad y + v = 1 \qquad z + w = 0$$
$$2x + 3u = 0 \quad 2y + 3v = 0 \quad 2z + 3w = 1$$

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

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

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

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.,

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

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

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

Answer: C

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Exercise Matrix

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 $A = \left[a_{\text{ij}}\right]$ of order 3×3 such that $a_{\text{ij}} = (k)^{i+j}$ 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 $\lim\limits_{n\to\infty} (\lvert M_2\rvert + \lvert M_3\rvert + ...\lvert M_n\rvert) =$	**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 $C = (BAB^{-1})(B^{-1}A^TB)$, 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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Exercise Numerical

1. $A = [0130] and A^8 + A^6 + A^2 + IV = [011](where I is$ the 2×2 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 $\sum\left(\cos^x\theta + \sin^x\theta\right), \theta \in R$

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4. $A = [1 tan x - tan x 1] and f(x)$ is defined as $f(x) = det A^T A^{-1}$ en the value of $\left(f(f(f(ff(x))))\right.$ is $(n \geq 2)$ ________.

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5. The equation $\begin{bmatrix} 1 & 2 & 2 \\ 1 & 3 & 4 \\ 3 & 4 & k \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ 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, $(I - 0.4A)^{-1} = I - \alpha A, where I$ 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

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

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

$$\begin{vmatrix} a_{11}+4 & a_{12} & a_{13} \\ a_{21} & a_{22}+4 & a_{23} \\ a_{31} & a_{32} & a_{33}+4 \end{vmatrix} + 5\lambda \begin{vmatrix} a_{11}+1 & a_{12} & a_{13} \\ a_{21} & a_{22}+1 & a_{23} \\ a_{31} & a_{32} & a_{33}+1 \end{vmatrix} = 0$$

then the value of λ is

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10. Let S be the set which contains all possible vaues fo I, m, n, p, q, r for which $A = \left[I^2 - 3p00m^2 - 8qr0n^2 - 15\right]$ 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 3×3 is commutative with every square matrix of order 3×3 under multiplication and trace (A)=12, then

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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 ______.

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15. Let $A = \left[a_{ij}\right]$ be 3×3 matrix and $B = \left[b_{ij}\right]$ be 3×3 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 ______ .

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

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18. If A is a square matrix of order 2×2 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 aquare matrix of order 2 and det. $A = 10$, then $\left((tr.\,A)^2 - tr.\left(A^2\right)\right)$ 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. $\left(\left(\text{adj.}\left(B^{-1}A^{-1}\right)\right)^{-1}\right)$ 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 ______.

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

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23. A, B and C are three square matrices of order 3 such that A= diag. (x, y, x), 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 $A = \left[a_{ij}\right]$ 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 _____ .

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Jee Main Previous Year

1. Let A be 2 x 2 matrix.Statement I $adj(adjA) = A$ Statement II $|adjA| = A$

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 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. at least 7

B. less than 4

C. 5

D. 6

Answer: A

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3. Let A be a 2×2 matrix with non-zero entries and let A^2=I, where i is a 2×2 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

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 3×3 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 x 3 matrix A and $|A| = 4$, then α is equal to

A. 4

B. 11

C. 5

D. 0

Answer: B

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8. If A is an 3×3 non-singular matrix such that $\forall' = A'A$ and $B = A^{-1}A'$, then BB equals (1) $I + B$ (2) I (3) B^{-1} (4) $\left(B^{-1}\right)'$

A. $I + B$

B. I

C. B^{-1}

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

Answer: B

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9. If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is a matrix satisfying the equation $\forall^T = 9I$, where I is 3×3 identity matrix, then the ordered pair (a, b) is equal to :

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 $A \operatorname{adj} A = AA^T$, then $5a + b$ is equal to:

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 Previous Year

1. The number of 3×3 matrices A whose entries are either $0 \text{ or } 1$ and for which the system $A[xyz] = [100]$ 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 $\left[1ab\omega 1c\omega^2\theta 1\right]$, $where$ each of $a, b, andc$ is either ω or ω^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 3×3 matrix and let $Q = [b_{ij}]$, where $b_{ij} = 2^{i+j}a_{ij}$ for $1 \leq i, j \leq 3$. If the determinant of P is 2, then the determinant of the matrix Q is

A. 2^{10}

B. 2^{11}

C. 2^{12}

D. 2^{13}

Answer: D

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4. Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 16 & 4 & 1 \end{bmatrix}$ and I be the identity matrix of order 3. If $Q = [qij]$ is a matrix, such that P^{50} - $Q = I$, then $\frac{q_{31} + q_{32}}{q_{21}}$ equals

A. 52

B. 103

C. 201

D. 205

Answer: B

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5. How many 3×3 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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6. Let $MandN$ be two 3×3 non singular skew-symmetric matrices such that $MN = NM^{\cdot}$ If P^T denote the transpose of P, then $M^2N^2\left(M^TN^{-1}\right)^T$ 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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7. Let ω be a complex cube root of unity with $\omega \neq 1 andP = \left[p_{ij}\right]$ be a $n \times n$ matrix withe $p_{ij} = \omega^{i+j}$ Then $p^2 \neq O, whe \cap =$ a.57 b. 55 c. 58 d. 56

A. 57

B. 55

C. 58

D. 56

Answer: B::C::D

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8. For 3×3 matrices $MandN,$ which of the following statement (s) is (are) NOT correct ? $N^T MN$ is symmetricor skew-symmetric, according as m is symmetric or skew-symmetric. $MN - NM$ is skew-symmetric for all symmetric matrices $M and N$ MN is symmetric for all symmetric matrices $M and N$ $(adj M)(adj N) = adj(MN)$ for all invertible matrices $M and N$

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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9. Let M be a 2×2 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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10. Let m and N be two 3x3 matrices such that MN=NM. Further if $M \ne N^2$ 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 3×3 non-zero matrix U such that $\left(M^2 + MN^2\right)U$ is the zero matrix

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

D. for a 3×3 matrix U, is the zero matrix

Answer: A::B

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11. Let $XandY$ be two arbitrary, 3×3 , non-zero, skew-symmetric matrices and Z be an arbitrary 3×3 , non-zero, symmetric matrix. Then which of the following matrices is (are) skew symmetric? a.$Y^3Z^4Z^4Y^3$ b. $x^{44} + Y^{44}$ c. $X^4Z^3 - Z^3X^4$ d. $X^{23} + Y^{23}$

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

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

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

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

Answer: C::D

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12. 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 (P adj (Q)) $= 2^9$

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

Answer: B::C

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13. Which of the following is (are) NOT the square of a 3×3 matrix with real entries ?

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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14. 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. The, 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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15. Let A be the set of all 3×3 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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16. Let A be the set of all 3×3 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

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

has a unique solution is

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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17. Let A be the set of all 3×3 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. 0

B. more than 2

C. 2

D. 1

Answer: B

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18. Let p be an odd prime number and T_p, be the following set of 2×2 matrices $T_p = \left\{A = \begin{bmatrix} a & b \\ c & a \end{bmatrix} : a, b, c \in \{0, 1, 2, ...p - 1\}\right\}$ 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. $(p - 1)^2$

B. $2(p - 1)$

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

D. $2p - 1$

Answer: D

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19. Let P be an odd prime number and T_p be the following set of 2×2 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. $(p - 1)\left(p^2 - p + 1\right)$

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

C. $(p - 1)^2$

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

Answer: C

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20. Let p be an odd prime number and T_p, be the following set of 2×2 matrices $T_p = \left\{A = \begin{bmatrix} a & b \\ c & a \end{bmatrix} : a, b, c \in \{0, 1, 2, ...p - 1\}\right\}$ 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. $2p^2$

B. $p^3 - 5p$

C. $p^3 - 3p$

D. $p^3 - p^2$

Answer: D

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21. 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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22. 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 ω be a solution of $x^3 - 1 = 0$ with $Im(\omega) > 0. Ifa = 2$ with b nd c satisfying (E) then the vlaue of $\frac{3}{\omega^a} + \frac{1}{\omega^b} + \frac{3}{\omega^c}$ is equa to (A) -2 (B) 2 (C) 3 (D) -3

A. -2

B. 2

C. 3

D. -3

Answer: A

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23. Let $a,$ b and c be three real numbers satisfying $[a, b, c]\begin{bmatrix}1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7\end{bmatrix} = [0, 0, 0]$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. ∞

Answer: B

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24. Let K be a positive real number and $A = \left[2k - 12\sqrt{k}2\sqrt{k}2\sqrt{k}1 - 2k - 2\sqrt{k}2k - 1\right] andB = \left[02k - 1\sqrt{k}1 - 2k02 - \sqrt{k} - 2\sqrt{k}$

. If det $(adjA) + \det(adjB) = 10^6, then[k]$ is equal to. [Note: $adjM$ denotes the adjoint of a square matix M and $[k]$ denotes the largest integer less than or equal to K].

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25. Let M be a 3×3 matrix satisfying $M[010] = M[1 - 10] = [11 - 1], andM[111] = [0012]$ Then the sum of the diagonal entries of M is _______.

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26. let $z = \dfrac{-1+\sqrt{3i}}{2}$, $wherei = \sqrt{-1}$ and $r, s\varepsilon P1, 2, 3\}$. $LetP = \begin{bmatrix} (-z)^r & z^{2s} \\ z^{2s} & z^r \end{bmatrix}$

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

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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. $A^2 + B^2$

Answer: D

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2. If the value of prod_(k=1)^(50)[{:(1,2k-1),(0,1):}]$isequal \rightarrow$ [{:(1,r),(0,1):}]$then$

r` is equal to

A. 62500

B. 2500

C. 1250

D. 12500

Answer: B

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

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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 $A = [a_{ij}]_{3\times3}$, matrix $B = [b_{ij}]_{3\times3}$, 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. $M = \begin{bmatrix} a^{2m} & b^{2m} \\ b^{2m} & -a^{2m} \end{bmatrix}$

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

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

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 $A = \left[a_{ij}\right]_{m \times n}$ and $a_{ij} = \left(i^2 + j^2 - ij\right)(j - i)$, 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

Answer: D

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10. $|A - B| \neq 0, A^4 = B^4, C^3A = C^3B, B^3A = A^3B$, then $\left|A^3 + B^3 + C^3\right| =$

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. $(A - B)\left(A^2 + AB + B^2\right)$

B. $(A - B)\left(A^2 - AB - B^2\right)$

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

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

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. symmetric

B. skew symmetric

C. $I - XY$

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 $\left|A^2 + P^2\right|$ is equal to

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 2×2 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

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 $A^T C^n A$ equals to $\left(n \in I^+\right)$

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 3×3 matrix given by $A = \left(a_{ij}\right)_{3 \times 3}$. If for every column vector X satisfies $X' AX = 0$ and $a_{12} = 2008$, $a_{13} = 1010$ 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. Suppose A and B are two non singular matrices such that $B \neq I, A^6 = I$ and $AB^2 = BA$. Find the least value of k for $B^k = 1$

A. 31

B. 32

C. 64

D. 63

Answer: D

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20. Let A be a 2×3 matrix, whereas B be a 3×2 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. 1

B. 3

C. 0

D. 6

Answer: B

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

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

B. $|A| = |B|$

C. $A^2 = B^2$

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 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)

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 the trace of the matrix $Adj(AdjA)$ is

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 same order as that of A then the value of α is

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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Multiple Correct Answer

1. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, then

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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2. 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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3. 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 λ is a scalar, then values of λ can be

A. 3

B. 6

C. 12

D. 15

Answer: A::D

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4. 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. $AB = BA$

B. $|A - I| = 0$

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

D. $|A - B| = 0$

Answer: A::C

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5. 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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6. If the matrix A and B are of 3×3 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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7. If A is a square matrix such that $A \cdot (AdjA) = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then

A. $|A| = 4$

B. $|adjA| = 16$

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

D. $|adj2A| = 128$

Answer: A::B::C

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Solved Examples And Exercises

1. In which of the following type of matrix inverse does not exist always? a. idempotent b. orthogonal c. involuntary d. none of these

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2. If both $A - \frac{1}{2}IandA + \frac{1}{2}$ are orthogonal matices, then (a)A is orthogonal (b)A is skew-symmetric matrix of even order (c)$A^2 = \frac{3}{4}I$ (d)none of these

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3. If nth-order square matrix A is a orthogonal, then |adj(adjA)| is (a)always -1 if n is even (b) always 1 if n is odd (c) always 1 (d) none of these

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4. If P is an orthogonal matrix and $Q = PAP^T and x = P^T Q^{1000} P$ then x^{-1} is , where A is involutary matrix. A b. I c. A^{1000} d. none of these

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5. If A is a nilpotent matrix of index 2, then for any positive integer $n, A(I + A)^n$ is equal to A^{-1} b. A c. A^n d. I_n

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6. If $A and B$ are two matrices such that $AB = B and BA = A, then$ $\left(A^5 - B^5\right)^3 = A - B$ b. $\left(A^5 - B^5\right)^3 = A^3 - B^3$ c. $A - B$ is idempotent d. none of these

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7. If Z is an idempotent matrix, then $(I + Z)^n$ $I + 2^nZ$ b. $I + \left(2^n - 1\right)Z$ c. $I - \left(2^n - 1\right)Z$ d. none of these

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8. If A is an orthogonal matrix then A^{-1} equals A^T b. A c. A^2 d. none of these

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9. If $A^2 = 1,$ then the value of det$(A - I)$ is (where A has order 3) 1 b. -1 c. 0 d. cannot say anything

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10. Let A be an nth-order square matrix and B be its adjoint, then $\left|AB + KI_n\right|$ is (where K is a scalar quantity) $(|A| + K)^{n-2}$ b. $(|A| +)K^n$ c.

$(|A| + K)^{n-1}$ d. none of these

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11. $A = \begin{bmatrix} a & 1 & 0 \\ 1 & b & d \\ 1 & b & c \end{bmatrix}, B = \begin{bmatrix} a & 1 & 1 \\ 0 & d & c \\ f & g & h \end{bmatrix}, U = \begin{bmatrix} f \\ g \\ h \end{bmatrix}, V = \begin{bmatrix} a^2 \\ 0 \\ 0 \end{bmatrix}$ If there is a vector matrix X, such that $AX = U$ has infinitely many solutions, then prove that $BX = V$ cannot have a unique solution. If $afd \neq 0$. Then,prove that $BX = V$ has no solution.

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12. If M is a 3×3 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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13. If A is a diagonal matrix of order 3×3 is commutative with every square matrix or order 3×3 under multiplication and $tr(A) = 12$, then the value of $|A|^{1/2}$ is _____.

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14. Let S be the set which contains all possible vaues fo I, m, n, p, q, r for which $A = \left[I^2 - 3p00m^2 - 8qr0n^2 - 15\right]$ be non-singular idempotent matrix. Then the sum of all the elements of the set S is _______.

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15. Given a matrix $A = [abcbcacab], wherea, b, c$ are real positive numbers $abc = 1andA^TA = I$, then find the value of $a^3 + b^3 + c^3$.

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16. 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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17. Let $A = \begin{bmatrix} 3x^2 \\ 1 \\ 6x \end{bmatrix}$, $B = [a, b, c]$and $C = \begin{bmatrix} (x+2)^2 & 5x^2 & 2x \\ 5x^2 & 2x & (x+2)^2 \\ 2x & (x+2)^2 & 5x^2 \end{bmatrix}$ be three given matrices, where $a, b, candx \in R$. Given that tr(AB)=tr(C). If $f(x) = ax^2 + bx + c$, then the value of $f(1)$ is _____.

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

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

then the value of 10λ is ______.

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20. Let A be the set of all 3×3 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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21. If $A = [0121233a1]andA_1 = [1/212/12/-43c5/2-3/21/2]$, then the values of a anti c are equal to $1, 1$ b. $1, -1$ c. $1, 2$ d. $-1, 1$

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22. For two unimodular complex number $z_1 and z_2$ $\left[(z)_1 - z_2 (z)_2 z_1\right]^{-1}\left[(z)_1 z_2 - (z)_2 z_1\right]^{-1}$ is equal to $\left[z_1 z_2 (z)_1 (z)_2\right]$ b. $[1001]$ c. $[1/2001/2]$ d. none of these

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

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

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

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26. If matrix A is given by $A = [61124]$, then the determinant of $A^{2005} - 6A^{2004}$ is 2^{2006} b. $(- 11)2^{2005}$ c. -2^{2005} d. $(- 9)2^{2004}$

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27. If $A = [abcxyzpqr], B[q - by - pa - xr - cz]$ and if A is invertible, then which of the following is not true? $|A| = |B|$ $|A| = - |B|$ $|adjA| = |adjB|$ A is invertible if and only if B is invertible

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28. If $A and B$ are two non-singular matrices such that $AB = C, then|B|$ is equal to $\frac{|C|}{|A|}$ b. $\frac{|A|}{|C|}$ c. $|C|$ d. none of these

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29. If $A(\alpha, \beta) = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & e^{\beta} \end{bmatrix}$, then $A(\alpha, \beta)^{-1}$ is equal to

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30. 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

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31. Statement 1: $A = [404222121]B^{-1} = [133143134]$. Then $(AB)^{-1}$ does not exist. Statement 2: Since $|A| = 0, (AB)^{-1} = B^{-1}A^{-1}$ is meaning-less.

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32. Statement 1: If $f(\alpha) = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}, then\ [F(\alpha)]^{-1} = F(-\alpha)^{.}$

Statement 2: For matrix $G(\beta) = \begin{bmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{bmatrix}^{.}$ we have $[G(\beta)]^{-1} = G(-\beta)^{.}$

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33. Statement 1: if a, b, c, d are real numbers and $A = [abcd] and A^3 = O, then A^2 = O^{.}$ Statement 2: For matrix $A = [abcd]$ we have $A^2 = (a + d)A + (ad - bc)I = O^{.}$

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34. Statement 1: Matrix $3 \times 3, a_{ij} = \frac{i - j}{i + 2j}$ cannot be expressed as a sum of symmetric and skew-symmetric matrix. Statement 2: Matrix $3 \times 3, a_{ij} = \frac{i - j}{i + 2j}$ is neither symmetric nor skew-symmetric

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35. Statement 1: If A, B, C are matrices such that $\left|A_{3 \times 3}\right| = 3, \left|B_{3 \times 3}\right| = -1, and \left|C_{2 \times 2}\right| =_2, then |2ABC| = -12.$ Statement 2: For matrices A, B, C of the same order,$|ABC| = A = |A||B||C|$

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36. Statement 1: For a singular square matrix $A, AB = ACB = C$ Statement 2; $|A| = 0, thenA^{-1}$ does not exist.

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37. Statement 1: The inverse of singular matrix $A = \left(\left[a_{ij}\right]\right)_{n \times n}, where a_{ij} = 0, i \geq j is B = ([aij - 1])_{n \times n}$. Statement 2: The inverse of singular square matrix does not exist.

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38. Statement 1: The determinant of a matrix $A = \left(\left[a_{ij}\right]\right)_{5 \times 5} where a_{ij} + a_{ji} = 0$ for all $i and j$ is zero. Statement 2: The determinant of a skew-symmetric matrix of odd order is zero

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39. If $A = [1221] and f(x) = \dfrac{1 + x}{1 - x}, then f(A)$ is $[1111]$ b. $[2222]$ c. $1 - 1 - 1 - 1$ d. none of these

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40. Id $[1/250x1/25] = [50 - a5]^{-2}$, then the value of x is $a/125$ b. $2a/125$ c. $2a/25$ d. none of these

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41. If $A = [1\tan x - \tan x1]$, show that $A^T A^{-1} = [\cos 2x - \sin 2x \sin 2x \cos 2x]$.

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42. If A is a square matrix of order n such that $|adj(adjA)| = |A|^9$, then the value of n can be 4 b. 2 c. either4 or 2 d. none of these

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

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44. If $A^3 = O, then I + A + A^2$ equals a.$I - A$ b. $\left(I + A^1\right)^{-1}$ c. $(I - A)^{-1}$ d. none of these

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45. For each real x, $= 1$

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46. $(-A)^{-1}$ is always equal to (where A is nth-order square matrix) $(-A)^{-1}$ b. $-A^{-1}$ c. $(-1)^n A^{-1}$ d. none of these

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47. The matrix X for which $[1 - 43 - 2]X = [-16 - 672]$ is $[-24 - 31]$ b. $\left[-\frac{1}{5}\frac{2}{5} - \frac{3}{10}\frac{1}{5}\right]$ c. $[-161672]$ d. $\left[62\frac{11}{2}2\right]$

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48. If $A = \begin{bmatrix} 0 & -\tan\alpha \\ 2 & \tan\alpha \\ 2 & 0 \end{bmatrix}$ and I is 2×2 unit matrix, then $(I - A)\begin{bmatrix} \cos\alpha & \sin\alpha \\ \sin\alpha & \sin\alpha \end{bmatrix}$

is (a) $-I + A$ (b) $I - A$ (c) $-I - A$ (d) non of these

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49. Let $AdnB$ be 3×3 matrtrices of ral numbers, where A is symmetric, B is skew-symmetric , and $(A + B)(A - B) = (A - B)(A + B)^{.}$ If $(AB)^t = (-1)^k AB, where(AB)^t$ is the transpose of the mattix AB, then find the possible values of $k^{.}$

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50. If $\begin{bmatrix} a & b \\ c & 1-a \end{bmatrix}$ is an idempotent matrix and $f(x) = x - x^2$, $bc = \frac{1}{4}$, then the value of $1/f(a)$ is _____.

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

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52. If $A = [\alpha 011]andB = [1051]$, find the values of α for which $A^2 = B$

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53. Let a and b be two real numbers such that $a > 1, b > 1$. If $A = \begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}$, then $(\lim)_{n \to \infty} A^{-n}$ is (a) unit matrix (b) null matrix (c) $2I$ (d) non of these

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

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55. A and B are square matrices and A is non-singular matrix, then $\left(A^{-1}BA\right)^n, n \in I'$,is equal to (A) $A^{-n}B^nA^n$ (B) $A^nB^nA^{-n}$ (C) $A^{-1}B^nA$ (D) $A^{-n}BA^n$

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56. If A is a singular matrix, then adj A is a. singular b. non singular c. symmetric d. not defined

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57. The inverse of a diagonal matrix is a. a diagonal matrix b. a skew symmetric matrix c. a symmetric matrix d. none of these

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58. If P is non-singular matrix, then value of $adj\left(P^{-1}\right)$ in terms of P is (A) $\frac{P}{|P|}$ (B) $P|P|$ (C) P (D) none of these

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59. If adj$B = A, |P| = |Q| = 1, then adj\left(Q^{-1}BP^{-1}\right)$ is PQ b. QAP c. PAQ d. $PA^{1}Q$

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60. If A is non-singular and $(A - 2I)(A - 4I) = O, then \frac{1}{6}A + \frac{4}{3}A^{-1}$ is equal to OI b. $2I$ c. $6I$ d. I

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61. If $A(\alpha, \beta) = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & e^{\beta} \end{bmatrix}, thenA(\alpha, \beta)^{-1}$ is equal to a.$A(-\alpha, -\beta)$ b. $A(-\alpha, \beta)$ c. $A(\alpha, -\beta)$ d. $A(\alpha, \beta)$

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

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63. $A = [1tanx - tanx1]andf(x)$ is defined as $f(x) = detA^{T}\dot{A}^{-1}$ en the value of $\left(f(f(f(ff(x))))\right)$ is $(n \geq 2)$ ________.

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64. The equation $[12213424k][xyz] = [000]$ has a solution for (x, y, z) besides $(0, 0, 0)$. Then the value of k is ______.

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65. If $D_1 and D_2$ are two 3×3 diagonal matrices, then which of the following is/are true? $D_1 and D_2$ is a diagonal matrix b. $D_1 D_2 = D_2 D_1$ c. $D12 + D22$ is a diagonal matrix d. none of these

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66. If $AandB$ are symmetric and commute, then which of the following is/are symmetric? $A^{-1}B$ b. AB^{-1} c. $A^{-1}B^{-1}$ d. none of these

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67. If C is skew-symmetric matrix of order $nand\Xi sn \times 1$ column matrix, then $X^T CX$ is a. singular b. non-singular c. invertible d. non invertible

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68. If $S = [011101110] and A = [b + \; + ab - \; - bc + ba - \; - ca - ca + b](a, b, c \neq 0), thenSA$ is a. symmetric matrix b. diagonal matrix c. invertible matrix d. singular matrix

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69. Let $A = [122212221]$. Then $A^2 - 4A - 5I_3 = O$ b. $A^{-1} = \frac{1}{5}\left(A - 4I_3\right)$ c. A^3 is not invertible d. A^2 is invertible

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70. Let $A = a_0$ be a matrix of order 3, where $a_{ij}\{x; \quad \text{if} \quad i = j, x \in R1; \quad \text{if} \quad |i - j| = 1; 0; otherwise$ then when of the following Hold (s) good: for$x = 2$, A is a diagonal matrix A is a symmetric matrix for$x = 2$, det A has the value equal to 6 Let $f(x) =$, det A, then the function $f(x)$ has both the maxima and minima.

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71. A skew-symmetric matrix A satisfies the relation $A^2 + I = O$, $whereI$ is a unit matrix then A is a. idempotent b. orthogonal c. of even order d. odd order

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72. If $AB = AandBA = B$, then a. $A^2B = A^2$ b. $B^2A = B^2$ c. $ABA = A$ d. $BAB = B$

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73. Each question has four choices a, b, c and d, out of which only one is correct. Each question contains STATEMENT 1 and STATEMENT 2. Both the statements are TRUE and STATEMENT 2 is the correct explanation of STATEMENT1. Both the statements are TRUE but STATEMENT 2 is NOT the correct explanation of STATEMENT 1. STATEMENT 1 is TRUE and STATEMENT 2 is FALSE. STATEMENT 1 is FALSE and STATEMENT 2 is TRUE. Statement 1: $|adj(adj(adjA))| - |A|^{n-1} \wedge 3$, where n is order of matrix $\dot{A}$ Statement 2: $|adjA| = |A|^{\dot{n}}$

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

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75. If A is a skew-symmetric matrix and n is odd positive integer, then A^n is a skew-symmetric matrix a symmetric matrix a diagonal matrix none of these

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76. If $f(x) = [\cos x - \sin x - \sin x \cos c 1]$ and $g(y) = [\cos y \sin y \sin y \cos y]$, then $[f(x)g(y)]^{-1}$ is equal to (a) $f(-x)g(-y)$ (b) $g(-y)f(-x)$ (c) $f\left(x^{-1}\right)g\left(y^{-1}\right)$ (d) $g\left(y^{-1}\right)f\left(x^{-1}\right)$

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77. Let $F(\alpha) = [\cos\alpha - s \in \alpha 0 s \in \alpha \cos\alpha 0001], where \alpha \in \dot{R}$ Then $(F(\alpha))^{-1}$ is equal to $F\left(\alpha^{-1}\right)$ b. $F\left(-\alpha^{\square}\right)$ c. $F(2\alpha)$ d. $-[1110]$

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

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79. If A is a 3×3 skew-symmetric matrix, then trace of A is equal to -1 b. 1 c. $|A|$ d. none of these

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

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81. The number of solutions of the matrix equation $X^2 = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$ is (A) more than 2 (B) 2 (C) 0 (D) 1

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82. If $A^2 - A + I = 0$, then the invers of A is A^{-2} b. $A + I$ c. $I - A$ d. $A - I$

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83. If $\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then $A =$ (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) $-\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

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84. If $AandB$ are two nonzero square matrices of the same ordr such that the product $AB = O$, then (a) both A and B must be singular (b) exactly one of them must be singular (c) both of them are non singular (d) none of these

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85. Let K be a positive real number and $A = \left[2k - 12\sqrt{k}2\sqrt{k}2\sqrt{k}1 - 2k - 2\sqrt{k}2k - 1\right]andB = \left[02k - 1\sqrt{k}1 - 2k02 - \sqrt{k} - 2\sqrt{k}\right.$. If det $(adjA) + \det(adjB) = 10^6, then[k]$ is equal to. [Note: $adjM$ denotes the adjoint of a square matix M and $[k]$ denotes the largest integer less than or equal to K].

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86. Let $XandY$ be two arbitrary, 3×3 , non-zero, skew-symmetric matrices and Z be an arbitrary 3×3 , non-zero, symmetric matrix. Then which of the following matrices is (are) skew symmetric? a.$Y^3Z^4Z^4Y^3$ b. $x^{44} + Y^{44}$ c. $X^4Z^3 - Z^3X^4$ d. $X^{23} + Y^{23}$

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87. Let $M and N$ be two 3×3 matrices such that $MN = NM$ Further, if $M \neq N^2 and M^2 = N^4$, then Determinant of $\left(M^2 + MN^2\right)$ is 0 There is a 3×3 non-zeero matrix U such tht $\left(M^2 + MN^2\right)U$ is the zero matrix Determinant of $\left(M^2 + MN^2\right) \geq 1$ For a 3×3 matrix U, if $\left(M^2 + MN^2\right)U$ equal the zero mattix then U is the zero matrix

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88. Let M be a 2×2 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

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89. For 3×3 matrices $MandN,$ which of the following statement (s) is (are) NOT correct ? $N^T MN$ is symmetricor skew-symmetric, according as m is symmetric or skew-symmetric. $MN - NM$ is skew-symmetric for all symmetric matrices $MandN$. MN is symmetric for all symmetric matrices $MandN$ $(adjM)(adjN) = adj(MN)$ for all invertible matrices $MandN$.

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

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

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92. If $A_1 = [0001001001001000], A_2 = [000i00 - i00i00 - i000], thenA_iA_k + A_kA_i$ is equal to $2l$ if $i = k$ b. O if $i \neq k$ c. $2l$ if $i \neq k$ d. O always

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93. Which of the following statements is/are true about square matrix A or order n? $(-A)^{-1}$ is equal to $A^{-1} whe \cap$ is odd only If

$A^n - O, then I + A + A^2 + \ + A^{n-1} = (I - A)^{-1}$ If A is skew-symmetric matrix of odd order, then its inverse does not exist. $\left(A^T\right)^{-1} = \left(A^{-1}\right)^T$ holds always.

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94. If A is an invertible matrix, tehn $\left(adjA\right)^{-1}$ is equal to $adjA^{-1}$ b. $\frac{A}{detA}$ c. A d. $(\det A)A$

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95. If $A = \left(\left(a_{ij}\right)\right)_{n\times n}$ and f is a function, we define $f(A) = \left(\left(f\left(a_{ij}\right)\right)\right)_{n\times n'}$ Let $A = (\pi/2 - \theta\theta - \theta\pi/2 - \theta)$. Then $\sin A$ is invertible b. $\sin A = \cos A$ c. $\sin A$ is orthogonal d. $\sin(2A) = 2A\sin A\cos A$

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96. Suppose $a_1, a_{,}$ are real numbers, with $a_1 \neq 0$. If $a_1, a_2, a_3,$ are in A.P., then $A = \left[a_1 a_2 a_3 a_4 a_5 a_6 a_5 a_6 a_7\right]$ is singular $\left(wherei = \sqrt{-1}\right)$ The system of equations $a_1 x + a_2 y + a_3 z = 0, a_4 x + a_5 y + a_6 z = 0, a_7 x + a_8 y + a_9 = 0$ has infinite number of solutions. $B = \left[a_1 i a_2 i a_2 a_1\right]$ is non-singular none of these

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97. If A, B, C are three square matrices of the same order, then $AB = AC \Rightarrow B = \dot{C}$ Then $|A| \neq 0$ b. A is invertible c. A may be orthogonal d. is symmetric

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98. Let $A = [1011]$. Then which of following is not true? $(\lim)_{n \vec{\infty}} \frac{1}{n^2} A^{-n} = [00 - 10]$ b. $(\lim)_{n \vec{\infty}} \frac{1}{n} A^{-n} = [00 - 10]$ c. $A^{-n} = [10 - n1] \forall n \neq N$ d. none of these

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99. If α, β, γ are three real numbers and $A = [1\cos(\alpha - \beta)\cos(\alpha - \gamma)\cos(\beta - \alpha)1\cos(\beta - \gamma)\cos(\gamma - \alpha)\cos(\gamma - \beta)1]$, then which of following is/are true? A is singular b. A is symmetric c. A is orthogonal d. A is not invertible

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100. The matrix $A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$ is (A) idempotent matrix (B) involutory matrix (C) nilpotent matrix (D) none of these

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101. If $AandB$ are square matrices of the same order and A is non-singular, then for a positive integer n, $\left(A^{-1}BA\right)^n$ is equal to $A^{-n}B^nA^n$ b. $A^nB^nA^{-n}$ c.

$A^{-1}B^nA$ d. $n\left(A^{-1}B^A\right)$

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102. If $A=[abcd]$ (where $bc\neq 0$) satisfies the equations $x^2+k=0, then$ $a+d=0$ b. $K=-|A|$ c. $k=|A|$ d. none of these

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103. If $A, B, A+I, A+B$ are idempotent matrices, then AB is equal to BA b. $-BA$ c. I d. O

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104. Given the matrix $A=[(x,3,2),(1,y,4),(2,2z)]$. If $xyz=60$ and $8x+4y+3z=20,$ then $A(adjA)$ is equal to (a) $\begin{bmatrix} 6 & 4 & 0 & 0 \\ 0 & 6 & 4 & 0 \\ 0 & 0 & 6 & 4 \end{bmatrix}$

(b) $\begin{bmatrix} 8 & 8 & 0 & 0 \\ 0 & 8 & 8 & 0 \\ 0 & 0 & 8 & 8 \end{bmatrix}$ (c) $\begin{bmatrix} 6 & 8 & 0 & 0 \\ 0 & 6 & 8 & 0 \\ 0 & 0 & 6 & 8 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 4 & 0 & 0 \\ 0 & 3 & 4 & 0 \\ 0 & 0 & 3 & 4 \end{bmatrix}$

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105. Let $Ad + 2B = [1206 - 33 - 531] and 2A - B = [2 - 150 - 16012]$. Then $Tr(B)$ has the value equal to 0 b. 1 c. 2 d. none

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106. Which of the following in an orthogonal matrix

$[6/72/7 - 3/72/73/76/73/7 - 6/72/7]$ b.

$[6/72/73/72/7 - 3/76/73/76/7 - 2/7]$ c.

$[- 6/7 - 2/7 - 3/72/73/76/7 - 3/76/72/7]$ d.

$[6/7 - 2/73/72/73/7 - 3/7 - 6/72/73/7]$

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107. If $k \in R_o$ then $\det\left\{adj\left(kI_n\right)\right\}$ is equal to (A) K^{n-1} (B) $K^{(n-1)n}$ (C) K^n (D) k

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

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109. Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 0 & 5 \\ 0 & 2 & 1 \end{bmatrix} andB = [0, -3, 1]$. Which of the following is true? $AX = B$ has a unique solution $AX = B$ has exactly three solutions $AC = B$ has infinitely many solutions $AX = B$ is inconsistent

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

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111. Show that every square matrix A can be uniquely expressed as $P + iQ, where P and Q$ are Hermitian matrices.

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112. Express A as the sum of a Hermitian and a skew-Hermitian matrix, where $A = [2 + 3i25 - 3 - i73 - i3 - 2ii2 + i]$

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113. Statement 1: If $A = \left(\left[a_{ij}\right]\right)_{n \times n}$ is such that $\overline{(a)_{ij}} = a_{ji}, \forall i, j and A^2 = O,$ then matrix A null matrix. Statement 2: $|A| = 0.$

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114. Statement 1: If A is an orthogonal matrix of order 2, then $|A| = \pm 1.$

Statement 2: Every two-rowed real orthogonal matrix is of any one of the forms $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ or $\begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{bmatrix}.$

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115. Show that the solutions of the equation $[xyzt]^2 = O are [xyzt] = \left[\pm\sqrt{\alpha\beta} - \beta\alpha \pm \sqrt{\alpha\beta}\right], where \alpha, \beta$ are libitrary.

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116. If $A = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix}$, 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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117. 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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118. If$D = diag\left[d_1, d_2, d_n\right]$, then prove that $f(D) = diag\left[f\left(d_1\right), f\left(d_2\right), , f\left(d_n\right)\right], wheref(x)$ is a polynomial with scalar coefficient.

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119. If S is a real skew-symmetric matrix, then prove that $I - S$ is non-singular and the matrix $A = (I + S)(I - S)^{-1}$ is orthogonal.

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120. If $BandC$ are non-singular matrices and O is null matrix, then show that $[ABCO]^{-1} = \left[OC^{-1}B^{-1} - B^{1}AC^{-1}\right]^{.}$

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121. Find the possible square roots of the two rowed unit matrix I. Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ be squar root of the matrix $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. Then $A^2 = I$.

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122. If $A = [122212221]$, then show that $A^2 - 4A - 5I = O, whereIand0$ are the unit matrix and the null matrix of order 3, respectively. Use this result to find A^{-1}.

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123. Let M be a 3×3 matrix satisfying $M\begin{bmatrix}0\\1\\0\end{bmatrix} = \begin{bmatrix}-1\\2\\3\end{bmatrix}, M\begin{bmatrix}1\\-1\\0\end{bmatrix} = \begin{bmatrix}1\\1\\-1\end{bmatrix}$

,and $M\begin{bmatrix}1\\1\\1\end{bmatrix} = \begin{bmatrix}0\\0\\12\end{bmatrix}$ Then the sum of the diagonal entries of M is ________.

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124. If A is unimodular, then which of the following is unimodular? $-A$ b. A^{-1} c. $adjA$ d. ωA, where ω is cube root of unity

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125. 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 ghe 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

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126. 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

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127. If $A = \begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}, B = \begin{bmatrix} a & 1 \\ b & -1 \end{bmatrix} and (A + B)^2 = A^2 + B^2 + 2AB, then$ a. $a = -1$ b. $a = 1$ c. $b = 2$ d. $b = -2$

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128. Let $A and B$ be two nonsinular square matrices, $A^T and B^T$ are the transpose matrices of $A and B$, respectively, then which of the following are correct? $B^T AB$ is symmetric matrix if A is symmetric $B^T AB$ is symmetric matrix if B is symmetric $B^T AB$ is skew-symmetric matrix for every matrix A $B^T AB$ is skew-symmetric matrix if A is skew-symmetric

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129. If $A = \frac{1}{3}[12221 - 2a2b]$ is an orthogonal matrix, then $a = -2$ b. $a = 2, b = 1$ c. $b = -1$ d. $b = 1$

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

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131. If $A(\theta) = \left[s\int h\eta i\cos\theta i\cos\theta s\int h\eta\right]$, then which of the following is not true? $A(\theta)^{-1} = A(\pi - \theta)$ $A(\theta) + A(\pi + \theta)$ is a null matrix $A(\theta)^{-1}$ is invertible for all $\theta \in R$ $A(\theta)^{-1} = A(-\theta)$

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132. If $(1 - tan\theta tan\theta 1)(1tan\theta - tan\theta 1) = [a - \mathbf{a}]$, then $a = \cos 2\theta$ b. $a = 1$ c. $b = s \in 2\theta$ d. $b = -1$

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133. If $A = [3 - 342 - 340 - 11]$, then $adj(adjA) = A$ b. $|adj(adjA)| = 1$ c. $|adjA = I$ d. none of these

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134. If $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is to be square root of two-rowed unit matrix, then α, β and γ 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. $1 - \alpha^2 - \beta\gamma = 0$

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135. If $A = [a_{\text{ij}}]_{4 \times 4}$, such that $a_{\text{ij}} = \begin{cases} 2, & \text{when } i = j \\ 0, & \text{when } i \neq j \end{cases}$, then $\left\{ \dfrac{\det(\text{adj}(\text{adj A}))}{7} \right\}$ is (where $\{\cdot\}$ represents fractional part function)

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136. Statement 1: Let A, B be two square matrices of the same order such that $AB = BA, A^m = O, ndB^n = O$ for some positive integers m, n, then

there exists a positive integer r such that $(A+B)^r = O$ Statement 2: If $AB = BAthen(A+B)^r$ can be expanded as binomial expansion.

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137. Statement 1 :If the matrices, $A, B, (A+B)$ are non-singular, then $\left[A(A+B)^{-1}B\right]^{-1} = B^{-1} + A^{-1}$ Statement 2: $\left[A(A+B)^{-1}B\right]^{-1} = \left[A\left(A^{-1}+B^{-1}\right)B\right]^{-1}$ $= \left[\left(I+^{A}B^{-1}\right)B\right]^{-1}$ $= \left[\left(B^{+}AB^{-1}\right)B\right]^{-1} = \left[\left(B^{+}AI\right)\right]^{-1} = \left[\left(B^{+}A\right)\right]^{-1} = B^{-1} \wedge +A^{-1}$

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138. Let $AandB$ be two 2×2 matrices. Consider the statements (i) $AB = O \Rightarrow A = O$ or $B = O$ (ii)$AB = I_2 \Rightarrow A = B^{-1}$ (iii) $(A+B)^2 = A^2 + 2AB + B^2$ (i) and (ii) are false, (iii) is true (ii) and (iii) are false, (i) is true (i) is false (ii) and, (iii) are true (i) and (iii) are false, (ii) is true

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139. The inverse of a skew-symmetric matrix of odd order a. is a symmetric matrix b. is a skew-symmetric c. is a diagonal matrix d. does not exist

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140. 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

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141. The equation $[1xy][13402 - 1001] = [0]$ has for$y = 0$ b. rational roots for $y = \ - 1$ d. integral roots Then (ii) a. (p) (r) b. (q) (p) c. (p) (q) d. (r) (p)

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142. A is a 2×2 matrix such that $A[1 - 1] = [-12] and A^2[1 - 1] = [10]$ The sum of the elements of A is -1 b. 0 c. 2 d. 5

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143. 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

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144. Let A, B be two matrices such that they commute, then for any positive integer n, $AB^n = B^n A$ $(AB)^n A^n B^n$ only (i) and (ii) correct both (i) and (ii) correct only (ii) is correct none of (i) and (ii) is correct

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145. The product of matrices $A = \begin{bmatrix} \cos^2\theta & \cos\theta \\ \sin\theta\cos\theta & \sin\theta\sin^2\theta \end{bmatrix}$ and $B = \begin{bmatrix} \cos^2\phi\cos\phi & \sin\phi\cos\phi \\ \sin\phi & \sin^2\phi \end{bmatrix}$ is a null matrix if θ - ϕ = (A) $2n\pi, n \in Z$ (B) $\frac{n\pi}{2}, n \in Z$ (C) $(2n+1)\frac{\pi}{2}, n \in Z$ (D) $n\pi, n \in Z$

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146. If A is an upper triangular matrix of order $n \times nandB$ is a lower triangular matrix of order $n \times nandB$ is a lower triangular matrix of order $n \times n$, then prove that $\left(A' + B\right) \times (A + B')$ will be a diagonal matrix of order $n \times n$ [assume all elements of A and dB to e non-negative and a element of $\left(A' + B\right) \times \left(A + B'\right) asC_{ij}$].

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147. If $X = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$, then prove that $(pI + qX)^m = p^m I + mp^{m-1} qX, \forall p, q \in R$,where I is a two rowed unit matrix and $m \in N$.

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148. Let $\omega \neq 1$ be cube root of unity and S be the set of all non-singular matrices of the form $\begin{bmatrix} 1 & a & b \\ \omega & 1 & c \\ \omega^2 & \theta & 1 \end{bmatrix}$, where each of $a, b,$ and c is either ω or ω^2. Then the number of distinct matrices in the set S is (a) 2 (b) 6 (c) 4 (d) 8

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149. Let $P = [a_{ij}]$ be a 3×3 matrix and let $Q = [b_{ij}]$, $where b_{ij} = 2^{i+j} a_{ij} f$ or $1 \leq i, j \leq 3$. 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}

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150. If $P = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}, A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ and $Q = PAP^T$ and $X = P^T Q^{2005} P$, then X equal to:

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151. The number of 3×3 matrices A whose entries are either 0 or 1 and for which the system $A\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ has exactly two distinct solutions, is

a. 0

b. $2^9 - 1$

c. 168

d. 2

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152. If $A = [\alpha 22\alpha] and \left|A^3\right| = 125$, then the value of α is a.± 1 b. ± 2 c. ± 3 d. ± 5

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153. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & -2 & 4 \end{bmatrix}, I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $A^{-1} = \left[\frac{1}{6}\left(A^2 + cA + dI\right)\right]$

Then value of c and d are (a) $(= 6, -11)$ (b) $(6, 11)$ (c) $(-6, 11)$ (d) $(6, -11)$

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154. A is an involuntary matrix given by $A = [01 - 14 - 343 - 34]$, then the inverse of $A/2$ will be $2A$ b. $\frac{A^{-1}}{2}$ c. $\frac{A}{2}$ d. A^2

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

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

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157. Let ω be a complex cube root of unity with $\omega \neq 1andP = \left[p_{ij}\right]$ be a $n \times n$ matrix withe $p_{ij} = \omega^{i+j}$. Then $p^2 \neq O, whe \cap \; = \;$ a.57 b. 55 c. 58 d. 56

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158. If $A = [i - i - ii] andB = [1 - 1 - 11], thenA^8$ equals $4B$ b. $128B$ c. $-128B$ d. $-64B$

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159. If $[2 - 110 - 34]A = [- 1 - 8 - 101 - 2 - 592215]$, then sum of all the elements of matrix A is 0 b. 1 c. 2 d. -3

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160. If $A = \frac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1 + i \\ 1 - i & 1 \end{bmatrix}$ then $A\left(\bar{A}^T\right)$ equals : a. O b. I c. -I d. 2I

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161. Identity the incorrect statement in respect of two square matrices $AandB$ conformable for sum and product : a.$t_r(A + B) = t_r(A) + t_r(B)$ b. $t_r(\alpha A) = \alpha t_r(A), \; \in R$ c. $t_r\left(A^T\right) = t_r(A)$ d. none of these

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162. If A is a square matrix such that $A^2 = A$, then write the value of $7A - (I + A)^3$, where I is the identity matrix.

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

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164. Matrix A such that $A^2 = 2A - I$, where I is the identity matrix, Then for $n \geq 2. A^n$ is equal to

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

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

c. $nA - (n - 1)l$

d. $nA - I$

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

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Question Bank

1. If matrix $A = \left[\left[\frac{1}{\sqrt{2}}, \right]\left[\frac{1}{\sqrt{2}}\right], \left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]\right]$ and B, is a matrix such that $B^T A = A^T$ and $KB^T = 2A^T - \sqrt{2}I$. (where I is unit matrix of order 2 and $K \in R^l$) then the value of K^4 is

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2. If X is a non-zero column matrix, such that $AX = \lambda X$ where λ is a scalar and the matrix A is $\begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$ then sum of distinct values of λ is

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3. Let $A = \begin{bmatrix} \sqrt{3} & 1 & 0 \\ 1 & -\sqrt{3} & 0 \\ 0 & 0 & 2 \end{bmatrix}$ and $d = \det\left(2A^T \div AA^T + adjA\right)$then $\sqrt{d}$ is

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4. If Δ denotes the 'value of the determinant of the inverse of the matrix $\begin{bmatrix} -4 & -5 \\ 2 & 2 \end{bmatrix}$ then 2Δ is equal to

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5. Let $A = [[1, 0, 2], [2, 0, 1][1, 1, 2]]$, then det $\left((A - I)^3 - 4A\right)$ is

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6. $\begin{bmatrix}1 & 1\\0 & 1\end{bmatrix}^{-1}\begin{bmatrix}1 & 2\\0 & 1\end{bmatrix}^{-\begin{bmatrix}1 & 3\\0 & 1\end{bmatrix}} \wedge -1\ldots\begin{bmatrix}1 & 100\\0 & 1\end{bmatrix}^{-1} = \begin{bmatrix}1 & a\\b & 1\end{bmatrix}$ then absolute value of a+b is.

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7. Let A be a squàre matrix of order 2 sụch that $A^2 - 4A + 4I = O$ where I is an identity matrix of order 2. If $B = A^5 + 4A^4 + 6A^3 + 4A^2 + A$, then $\det(B)$ is equal to

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8. If $P = \begin{bmatrix} 1 & c & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is the adjoint of a 3×3 matrix Q and det. $(Q)^{=}4$, then c is equal to

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9. If A is a 3×3 matrix with real entries such that det. adj A=16 , then det. adj(adj A)) is equal to

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10. If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, then the number of values of αin $(0, \pi)$ satisfying $A + A^T = I_,$ is [Note: I is an identity matrix of order 2 and P^T denotes transpose of matrix P.]

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11. For $\lambda \in R, f(\lambda) = \det(A - \lambda I)$ where $A = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$ and I is an identity matrix of order 2 . The minimum value of $f(\lambda)$ is equal to

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12. For $\alpha, \beta, \gamma \in R$, let $A = \begin{bmatrix} \alpha^2 & 6 & 8 \\ 3 & \beta^2 & 9 \\ 4 & 5 & \gamma^2 \end{bmatrix}$ and $B = [[2, \alpha, 3, 5], [2, 2\beta, 6], [1, 4, 2\gamma - 3]]$. If trace A=trace B, then the value of (alpha^-1+beta^-1+gamma^-1) is equal to

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13. Let the matrix A and B be defined as $A = \begin{bmatrix} 3 & 2 \\ 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 1 \\ 7 & 3 \end{bmatrix}$ then the absolute value of det. $\left(2A^9B^{-1}\right)$ is

A. 1

B. 2

C. -2

D. 4

Answer: C

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14. Let D_k be the $k \times k$ matrix with 0's in the main diagonal, unity as the element of 1^{st} row and $(f(k))^{th}$ column and k for all other entries. If $f(x) = x - x$ where x denotes the tional part function then the value of det. $\left(D_2\right)$ + det.(D_3)` equals

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15. 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 matrix A , then alpha is

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16. 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 Tr(A)-Tr(B) has the value equal to

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17. If the product of n matrices $\left[[1, n][0, 1]\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix}\right]$ is equal to the matrix $\begin{bmatrix} 1 & 378 \\ 0 & 1 \end{bmatrix}$ then the value of n is equal to

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18. If A and B are non-singular matrices of order three such that adj(A B) = [[1, 1, 1], [1 , p, 1], [1, 1, p]] and |B^2 adj(A)|=p^(2)-3`, then

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19. Let $A_r = \begin{bmatrix} r & 3r - 1 \\ 0 & \frac{1}{2^r} \end{bmatrix}$, *thenthevalueof* lim _n rarr oo underset(r =1)overset (n) sum det(A_r) ` is equal to

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20. Let A=[[1, 2], [3 , 4]] and B = [[a, b],[c, d]] *betwomatricessuchtt̂heyarecomμtative* and c ne 3 b*thenthevalueof*|(a-d)/(2 b-c)|` is

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21. Let $A = \begin{bmatrix} 2 & 1 & 3 \\ 5 & 6 & 1 \\ 7 & 2 & 9 \end{bmatrix}$ if $A^3 + pA^2 + qA + rI = O$ (where O is null matrix), then value of $|p|$ is

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22. Let $A = \begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ If adj. $A = kA^T$ theri the value of 'K' is

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23. If $A = \begin{bmatrix} 0 & -1 & -2 \\ 2 & 4 & 3 \\ 1 & 1 & 1 \end{bmatrix}$ then trace (adj A) is equal to.

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