



MATHS

BOOKS - ARIHANT MATHS (ENGLISH)

MATRICES

Examples

1. IF a matrix has 12 elements, what are the possible orders it can have?

What, if it has 7 elements?



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2. Construct a 2×3 matrix $A = [a_{ij}]$, whose elements are given by

$$a_{ij} = \frac{(i + 2j)^2}{2}$$



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3. Construct a 2×3 matrix $A = [a_{ij}]$, whose elements are given by $a_{ij} = \frac{1}{2}|2i - 3j|$.

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4. construct a 2×3 matrix $A = [a_{ij}]$, whose elements are give by $a_{ij} = \begin{cases} i - j, & \geq j \\ i + j, & < j \end{cases}$

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5. Construct a 2×3 matrix $A = [a_{ij}]$, whose elements are give by $a_{ij} = \left[\frac{i}{j} \right]$, where $[.]$ denotes the greatest integer function.

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6. Construct a 2×3 matrix $A = [a_{ij}]$, whose elements are given by

$$a_{ij} = \left\{ \frac{2i}{3j} \right\}$$

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7. construct a 2×3 matrix $A = [a_{ij}]$, whose elements are give by

$$a_{ij} = \left(\frac{3i + 4j}{2} \right)$$

where $(.)$ denotes the least integer function.

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8. construct a 2×3 matrix $A = [a_{ij}]$, whose elements are give by

$$a_{ij} = \left(\frac{3i + 4j}{2} \right)$$

where $(.)$ denotes the least integer function.

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9. If $\begin{bmatrix} x + 3 & 2y + x \\ z - 1 & 4w - 8 \end{bmatrix} = \begin{bmatrix} -x - 1 & 0 \\ 3 & 2w \end{bmatrix}$, then find the value of $|x + y| + |z + w|$.

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10. If $\begin{bmatrix} 2\alpha + 1 & 3\beta \\ 0 & \beta^2 - 5\beta \end{bmatrix} = \begin{bmatrix} \beta + 3 & \beta^2 + 2 \\ 0 & -6 \end{bmatrix}$

find the equation whose roots are alpha and beta.

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11. Given, $A = \begin{bmatrix} 1 & 3 & 5 \\ -2 & 0 & 2 \\ 0 & 0 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 3 \\ -2 & 0 \\ 0 & -4 \end{bmatrix}$

and $C = \begin{bmatrix} 4 & 1 & -2 \\ 3 & 2 & 1 \\ 2 & -1 & 7 \end{bmatrix}$, find (whichever defined)

(i)A+B. (ii)A+C.

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12. If a, b, c , and c , are the roots of $x^2 - 4x + 3 = 0$, $x^2 - 8x + 15 = 0$ and $x^2 - 6x + 5 = 0$,

$$\begin{bmatrix} a^2 & +c^2 & a^2 + b^2 \\ b^2 & +c^2 & a^2 + c^2 \end{bmatrix} + \begin{bmatrix} 2ac & -2ab \\ -2bc & -2ac \end{bmatrix}$$



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13. Determine the matrix A, when

$$A = 4 \begin{bmatrix} 1 & 2 & 3 \\ -1 & -2 & -3 \\ 4 & 2 & 6 \end{bmatrix} + 2 \begin{bmatrix} 5 & 4 & 1 \\ 3 & 2 & 4 \\ 3 & 8 & 2 \end{bmatrix}$$

A. $\begin{bmatrix} -14 & 16 & 14 \\ -2 & -4 & -4 \\ 22 & 24 & 28 \end{bmatrix}$

B. $\begin{bmatrix} 14 & -16 & 14 \\ 2 & -4 & -4 \\ 22 & 24 & 28 \end{bmatrix}$

C. $\begin{bmatrix} 14 & 16 & 14 \\ 2 & -4 & -4 \\ 22 & 24 & 28 \end{bmatrix}$

D. $\begin{bmatrix} -14 & 16 & 14 \\ 2 & -4 & -4 \\ -22 & 24 & -28 \end{bmatrix}$

Answer: C

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14. If $A = \begin{bmatrix} 0 & 2 \\ 3 & -4 \end{bmatrix}$ and $kA = \begin{bmatrix} 0 & 3a \\ 2b & 24 \end{bmatrix}$, then find the value of $b-a-k$.

A. 1

B. 0

C. 10

D. 5

Answer: A

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15. If $A = \begin{bmatrix} 1 & 2 & -3 \\ 5 & 0 & 2 \\ 1 & -1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & -1 & 2 \\ 4 & 2 & 5 \\ 2 & 0 & 3 \end{bmatrix}$ then find matrix C

such that $A + 2C = B$

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16. 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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17. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 2 & 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 \\ -1 & 0 \\ 2 & -1 \end{bmatrix}$ obtain the product AB and

explain why BA is not defined?



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18. If $A = \begin{bmatrix} 0 & -\tan\left(\frac{\alpha}{2}\right) \\ \tan\left(\frac{\alpha}{2}\right) & 0 \end{bmatrix}$ and I is 2×2 unit matrix, then

$(I - A) \begin{bmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{bmatrix}$ is



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19. If $A = \begin{bmatrix} 1 & 2 \\ -2 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 1 \\ 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} -3 & 1 \\ 2 & 0 \end{bmatrix}$, verify that $(AB)C = A(BC)$ and $A(B+C) = AB+AC$.

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20. If $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ p & q & r \end{bmatrix}$, show that $A^3 = pI + qA + rA^2$

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21. The value of x so that $\begin{bmatrix} 1 & x & 1 \end{bmatrix} \begin{bmatrix} 1 & 3 & 2 \\ 0 & 5 & 1 \\ 0 & 3 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = 0$ is

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22. show that the matrix

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

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23. show that $\begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix} = A$ is nilpotent matrix of order 3.

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24. show that the matrix

$A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$ is involutory.

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25. If $A = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$, then find the values of θ satisfying the equation $A^T + A = I_2$.

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26. the square matrix $A = [a_{ij}]_m \times m$ given by $a_{ij} = (i - j)^n$, show that A is symmetric and skew-symmetric matrices according as n is even or odd, respectively.

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27. Express A as the sum of a symmetric and a skew-symmetric matrix, where $A = \begin{bmatrix} 3 & 5 \\ -1 & 2 \end{bmatrix}$

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28. If $\begin{bmatrix} 0 & 2\beta & \gamma \\ \alpha & \beta & -\gamma \\ \alpha & -\beta & \gamma \end{bmatrix}$ is orthogonal, then find the value of $2\alpha^2 + 6\beta^2 + 3\gamma^2$.

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29. if $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is a matrix satisfying $AA' = 9I_3$, find the value of $|a| + |b|$.

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30. Express A as the sun of a hermitian and skew-hermitian matrix, where

$$A = \begin{bmatrix} 2 + 3i & 7 \\ 1 - i & 2i \end{bmatrix}, i = \sqrt{-1}.$$

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31. Verify that the matrix $\frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is unitary, where $i = \sqrt{-1}$

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32. If A, B and C are square matrices of order n and $\det(A)=2$, $\det(B)=3$ and $\det(C)=5$, then find the value of $10\det(A^3B^2C^{-1})$.

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33. If $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$, $abc = 1$, $A^T A = I$, then find the value of $a^3 + b^3 + c^3$.

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34. If $\omega \neq 1$ is a complex cube root of unity, then prove that

$$\begin{bmatrix} 1 + 2\omega^{2017} + \omega^{2018} & \omega^{2018} & 1 \\ 1 & 1 + 2\omega^{2018} + \omega^{2017} & \omega^{2017} \\ \omega^{2017} & \omega^{2018} & 2 + 2\omega^{2017} + \omega^{2018} \end{bmatrix} \text{ is}$$

singular

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35. find the real value of x for which the matrix

$$= \begin{bmatrix} x + 1 & 3 & 5 \\ 1 & x + 3 & 5 \\ 1 & 3 & x + 5 \end{bmatrix} \text{ is non-singular.}$$

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36. find the cofactor of a_{23} in $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & -1 \\ 1 & -3 & 5 \end{bmatrix}$

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37. find the adjoint of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 5 & 0 \\ 2 & 4 & 3 \end{bmatrix}$

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38. If $A = \begin{bmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 1 & 1 & -1 \end{bmatrix}$ find the values of

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

(iii) $|\text{adj}(3A)|$ (iv) $\text{adj adj } A$

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39. If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$ and B is the adjoint of A, find the value of

$|AB + 2I|$, where I is the identity matrix of order 3.

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40. Compute the inverse of the matrix $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & 1 & 2 \end{bmatrix}$

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41. If A and B are symmetric non-singular matrices of same order, $AB = BA$ and $A^{-1}B^{-1}$ exist, prove that $A^{-1}B^{-1}$ is symmetric.

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42. Matrices A and B satisfy $AB = B^{-1}$, where $B = \begin{bmatrix} 2 & -2 \\ -1 & 0 \end{bmatrix}$, find the value of λ for which $\lambda A - 2B^{-1} + 1 = O$, Without finding B^{-1} .



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43. If A, B and C are three non-singular square matrices of order 3 satisfying the equation $A^2 = A^{-1}$ let $B = A^8$ and $C = A^2$, find the value of $\det(B-C)$



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44. Transform $\begin{bmatrix} 1 & 3 & 3 \\ 2 & 4 & 10 \\ 3 & 8 & 4 \end{bmatrix}$ into a unit matrix.



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45. Given $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 4 & 1 \\ 2 & 3 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$. Find P such that $BPA =$

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



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46. find the inverse of the matrix $\begin{bmatrix} 1 & 2 & 5 \\ 2 & 3 & 1 \\ -1 & 1 & 1 \end{bmatrix}$, using elementary row operations.

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47. If $A = \begin{bmatrix} k & l \\ m & n \end{bmatrix}$ and $kn \neq lm$, show that $A^2 - (k+n)A + (kn - lm)I = O$. Hence, find A^{-1} .

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48. For the matrix $A = \begin{bmatrix} 3 & 2 \\ 1 & 1 \end{bmatrix}$, find the numbers a and b such that $A^2 + aA + bI = O$. Hence, find A^{-1} .

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49. Let $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ show that $(aI + bA)^n = a^n I + na^{n-1}bA$, where I is the identity matrix of order 2 and $n \in \mathbb{N}$.

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50. On principle of mathematical induction

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51. Solve the system of equations $x + 2y + 3z = 1$, $2x + 3y + 2z = 2$ and $3x + 3y + 4z = 1$ with the help of matrix inversion.

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52. solve the system of equations $x + y + z = 6$, $x + 2y + 3z = 14$ and $x + 4y + 7z = 30$ with the help of matrix method.



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53. Determine whether the following equations will have non-trivial solutions, if so solve them:

$$x + 3y - 2z = 0, 2x - y + 4z = 0, x - 11y + 14z = 0$$

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54. Solve the system of equations $2x + 3y - 3z = 0$, $3x - 3y + z = 0$ and $3x - 2y - 3z = 0$

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55. Find the rank of $\begin{bmatrix} 3 & -1 & 2 \\ -3 & 1 & 2 \\ -6 & 2 & 4 \end{bmatrix}$

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56. . For what values of λ and μ the system of equations $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$ has (i) Unique solution (ii) No solution (iii) Infinite number of solutions



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57. The point $p(3, 4)$ undergoes a reflection in the X-axis followed by a reflection in the y-axis. Show that their combined effect is the same as the single reflection of $p(3,4)$ in the origin.



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58. Find the image of the $(-2, -7)$ under the transformations (x,y) to $(x - 2y, -3x + y)$.



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59. the image of the point $A(2, 3)$ by the line mirror $y=x$ is the point B and the image of B by the line mirror $y=0$ is the point (α, β) , find α and β



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60. Find the image of the point $(-\sqrt{2}, \sqrt{2})$ by the line mirror $y = x \tan\left(\frac{\pi}{8}\right)$.



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61. Find the matrices of transformation T_1T_2 and T_2T_1 when T_1 is rotated through an angle 60° and T_2 is the reflection in the Y-axis Also, verify that $T_1T_2 \neq T_2T_1$.



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62. Write down 2×2 matrix A which corresponds to a counterclockwise rotation of 60° about the origin. In the diagram OB of $2\sqrt{2}$ units in length. The square is rotated counterclockwise about O through 60° find the coordinates of the vertices of the square after rotating.

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63. Let matrix $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$, Find the non-zero column vector X such that $AX = \lambda X$ for some scalar λ .

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64. If A and P are the square matrices of the same order and if P be invertible, show that the matrices A and P^{-1} have the same characteristic roots.

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65. Show that the characteristic roots of an idempotent matrix are either zero or unity.

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66. If $3, -2$ are the eigen values of a non-singular matrix A and $|A| = 4$, find the eigen values of $adj(A)$

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67. Find the characteristic equation of the matrix $A = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$ and hence find its inverse using Cayley-hamilton theorem.

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68. If A is a square matrix of order 2 such that $A \begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$ and $A^2 \begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ the sum of elements

and product of elements of A are S and P, $S + P$ is

A. (a)-1

B. (b)2

C. (c)4

D. (d)5

Answer:



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

A. A

B. A^{1000}

C. 1

D. None of these

Answer:



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70. If A is a diagonal matrix of order 3×3 is commutative with every square matrix of order 3×3 under multiplication and $\text{trace}(A)=12$, then find $|A|$

A. $|A| = 64$

B. $|A| = 16$

C. $|A| = 12$

D. $|A| = 4$

Answer:



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71. let $A = \{a_{ij}\}_{3 \times 3}$ such that $a_{ij} = \{3, i = j$ and $0, i \neq j$. then $\left\{ \frac{\det(\text{adj}(\text{adj}A))}{5} \right\}$ equals: (where $\{ \}$ represents fractional part)

A. $\frac{1}{7}$

B. $\frac{2}{7}$

C. $\frac{3}{7}$

D. $\frac{4}{7}$

Answer:



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72. If $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ and $\det(A^n - 1) = 1 - \lambda^n, n \in \mathbb{N}$, then the value of λ is

A. 1

B. 2

C. 3

D. 4

Answer: B

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

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

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

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

D. None of these

Answer: C

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

A. more than 2

B. 2

C. 0

D. 1

Answer: A



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75. For a matrix $A = \begin{bmatrix} 1 & 2r - 1 \\ 0 & 1 \end{bmatrix}$ then $\prod_{r=1}^{60} \begin{bmatrix} 1 & 2r - 1 \\ 0 & 1 \end{bmatrix} =$

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

B. $\begin{bmatrix} 1 & 4950 \\ 0 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 5050 \\ 0 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 2500 \\ 0 & 1 \end{bmatrix}$

Answer: D



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76. If $A_1, A_3, \dots, A_{2n-1}$ are n skew-symmetric matrices of same order,

then $B = \sum_{r=1}^n (2r - 1)(A_{2r-1})^{2r-1}$ will be

A. symmetric

B. skew-symmetric

C. neither symmetric nor skew-symmetric

D. data not adequate

Answer: B



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77. Elements of a matrix A of order 10×10 are defined as $a_{ij} = \omega^{i+j}$ (where ω is imaginary cube root of unity), then trace (A) of the matrix is

- A. 0
- B. 1
- C. 3
- D. None of these

Answer: D



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

- A. $a + d = 0$
- B. $k = -|A|$
- C. $k = |A|$

D. None of these

Answer: A::C

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

A. $\sin A$ is invertible

B. $\sin A = \cos A$

C. $\sin A$ is orthogonal

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

Answer: A::C

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80. Let A and B be two square idempotent matrices such that $AB \pm BA$ is a null matrix, the value of $\det(A - B)$ can be equal

A. -1

B. 0

C. 1

D. 2

Answer: A::B::C



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81. if $AB = A$ and $BA = B$, then

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

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

C. $ABA = A$

D. $BAB = B$

Answer: A::B::C::D



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82. If A is a square matrix of order 3 and I is an Identity matrix of order 3 such that $A^3 - 2A^2 - A + 2I = 0$, then A is equal to

A. I

B. $2I$

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

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

Answer: A::B::D



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83. If $A_0 = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ and $B_0 = \begin{bmatrix} -4 & -4 & -4 \\ 1 & 0 & 1 \\ 4 & 4 & 3 \end{bmatrix}$ then find

$$A_0 + B_0$$

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84. If $A_0 = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ and $B_0 = \begin{bmatrix} -4 & -4 & -4 \\ 1 & 0 & 1 \\ 4 & 4 & 3 \end{bmatrix}$ then find

$$A_0 - B_0$$

A. B_0

B.

C.

D.

Answer: C

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85. If $A_0 = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ and $B_0 = \begin{bmatrix} -4 & -4 & -4 \\ 1 & 0 & 1 \\ 4 & 4 & 3 \end{bmatrix}$ then find

$$A_0 - B_0$$

- A. unique solution
- B. infinite solution
- C. finitly many solution
- D. no solution

Answer: D

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86. 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

consider matrix U with its columns as U_1, U_2, U_3 , such that

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

The value of $|A^{50}|$ equals

A. (a)− 1

B. (b)0

C. (c)1

D. (d)25

Answer: C

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87. 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 principal 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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88. 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

consider matrix U with its columns as U_1, U_2, U_3 , such that

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

The value of $|A^{50}|$ equals

A. -1

B. 0

C. 1

D. 2

Answer: C



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89. Let A be a 3×3 diagonal matrix which commutes with every 3×3 matrix. If $\det(A) = 8$, then $\text{tr } A$ is

A.

B.

C.

D.

Answer:



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90. 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 $B^k = I$

A.

B.

C.

D.

Answer:



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91. Match the following Column I to Column II

Column I		Column II	
(A)	If A is a square matrix of order 3 and $\det(A) = 3$, then $\det(6A^{-1})$ is divisible by	(p)	3
(B)	If A is a square matrix of order 3 and $\det(A) = \frac{1}{4}$, then $\det[\text{adj}(\text{adj}(2A))]$ is divisible by	(q)	4
(C)	If A and B are square matrices of odd order and $(A + B)^2 = A^2 + B^2$, if $\det(A) = 2$, then $\det(B)$ is divisible by	(r)	5
		(s)	6



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	Column I		Column II
(A)	$\begin{bmatrix} 1 & 2 & a^n \\ 0 & 1 & 4 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 18 & 2007 \\ 0 & 1 & 36 \\ 0 & 0 & 1 \end{bmatrix},$ <p>then $(n + a)$ is divisible by</p>	(p)	4
(B)	<p>If A is a square matrix of order 3 such that $A = a$, $B = \text{adj}(A)$ and $B = b$, then $(ab^2 + a^2b + 1)\lambda$ is divisible by,</p> <p>where $\frac{1}{2}\lambda = \frac{a}{b} + \frac{a^2}{b^3} + \frac{a^3}{b^5} + \dots$ upto ∞ and $a = 3$</p>	(q)	6
(C)	<p>Let $A = \begin{bmatrix} a & b & c \\ p & q & r \\ 1 & 1 & 1 \end{bmatrix}$ and $B = A^2$.</p> <p>If $(a - b)^2 + (p - q)^2 = 25$, $(b - c)^2 + (q - r)^2 = 36$ and $(c - a)^2 + (r - p)^2 = 49$, then $\det\left(\frac{B}{2}\right)$ is divisible by</p>	(r)	10
		(s)	12
		(t)	15

92.



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93. Statement -1 (Assertion) and Statement - 2 (Reason)

Each of these examples also has four alternative choices,

ONLY ONE of which is the correct answer. You have to

select the correct choice as given below

Statement-1 A is singular matrix of order $n \times n$,

then adj A is singular.

Statement -2 $|\text{adj}A| = |A|^{n-1}$

A. Statement - 1 is true, Statement - 2 is true , Statement - 2

is correct explanation for Statement -1

B. Statement -1 is true, Statement - 2 is true, Statement - 2

is not 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: D



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94. Statement -1 (Assertion) and Statement - 2 (Reason)

Each of these examples also has four alternative choices,

ONLY ONE of which is the correct answer. You have to

select the correct choice as given below

Statement-1 If A and B are two matrices such

that $AB = B$, $BA = A$, then $A^2 + B^2 = A + B$.

Statement-2 A and B are idempotent matrices, then

$A^2 = A$, $B^2 = B$.

A. Statement - 1 is true, Statement - 2 is true , Statement - 2

is correct explanation for Statement -2

B. Statement -1 is true, Statement - 2 is true, Statement - 2

is not a correct explanation for Statement-2

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

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

Answer: B



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95. If $A^n = 0$, then evaluate

(i) $I + A + A^2 + A^3 + \dots + A^{n-1}$

(ii) $I - A + A^2 - A^3 + \dots + (-1)^{n-1} A^{n-1}$ for odd 'n' where I is the identity matrix having the same order of A.



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96. 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



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97. If the matrices $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ (a, b, c, d not all simultaneously zero) commute, find the value of $\frac{d-b}{a+c-b}$. Also show that the matrix which commutes with A is of the form $\begin{bmatrix} \alpha - \beta & \frac{2\beta}{3} \\ \beta & \alpha \end{bmatrix}$

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98. Given the matrix $A = \begin{bmatrix} -1 & 3 & 5 \\ 1 & -3 & -5 \\ -1 & 3 & 5 \end{bmatrix}$ and X be the solution set of the equation $A^x = A$, where $x \in \mathbb{N} - \{1\}$. Evaluate $\prod \left(\frac{x^3 + 1}{x^3 - 1} \right)$ where the continued extends for all $x \in X$.

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99. If P is non-singular matrix, then value of $\text{adj}(P^{-1})$ in terms of P is $P/|P|$ b. $P|P|$ c. P d. none of these

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100. Let A and B be matrices of order n . Prove that if

$(I - AB)$ is invertible, $(I - BA)$ is also invertible and

$(I - BA)^{-1} = I + B(I - AB)^{-1}A$, where I be the identity matrix of order n .



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101. If B and C are non-singular matrices and O is null matrix, then show

$$\text{that } \begin{bmatrix} A & B \\ C & O \end{bmatrix}^{-1} = \begin{bmatrix} O & C^{-1} \\ B^{-1} & -B^{-1}AC^{-1} \end{bmatrix}.$$



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102. $A = \begin{bmatrix} 3 & a & -1 \\ 2 & 5 & c \\ b & 8 & 2 \end{bmatrix}$ 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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103. 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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104. If there are three square matrix A, B, C of same order satisfying the equation $A^2 = A^{-1}$ and $B = A^{2^n}$ and $C = A^{2^{(n-2)}}$, then prove that $\det. (B - C) = 0, n \in N$.

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105. Construct an orthogonal matrix using the skew-symmetric matrix $A = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}$.

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106. If $A = \begin{bmatrix} 3 & 2 & 2 \\ 2 & 4 & 1 \\ -2 & -4 & -1 \end{bmatrix}$ and X, Y are two non-zero

column vectors such that $AX = \lambda X, AY = \mu Y, \lambda \neq \mu$, find angle between X and Y .

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Exercise For Session 1

1. If $A = \begin{vmatrix} \alpha & 2 \\ 2 & \alpha \end{vmatrix}$ and $|A|^3 = 125$, then the value of α is a. ± 1 b. ± 2 c. ± 3 d. ± 5

A. $\pm = 2$

B. $\pm = 3$

C. $\pm = 5$

D. 0

Answer: B



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2. If $A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}$, $B = \begin{bmatrix} a & -1 \\ b & -1 \end{bmatrix}$ and $(A + B)^2 = (A^2 + B^2)$ then find the values of a and b.

A. 4

B. 5

C. 6

D. 7

Answer: B



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3. if $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$ and $A^2 - \lambda A - I_2 = O$, then λ is equal to

A. -4

B. -2

C. 2

D. 4

Answer: D



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

A. 1

B. 2

C. 4

D. None of these

Answer: B



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5. if $A = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix}$, then $A^2 = I$ is true for

A. $\theta = 0$

B. $\theta = \frac{\pi}{4}$

C. $\theta = \frac{\pi}{2}$

D. None of these

Answer: A

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6. 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. $1 - \alpha^2 - \beta\gamma = 0$

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

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

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

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

Answer: B

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7. If $A = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$, then A^{100} is equal to

A. $\begin{bmatrix} 1 & 0 \\ 25 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 0 \\ 50 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 0 \\ 1/2^{100} & 1 \end{bmatrix}$

D. none of these

Answer: B



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8. If the product of n matrices

$$\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} \cdots \begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix} \text{ is equal to the matrix } \begin{bmatrix} 1 & 378 \\ 0 & 1 \end{bmatrix} \text{ the}$$

value of n is equal to

A. 26

B. 27

C. 377

D. 378

Answer: B



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9. about to only mathematics

A. $2AB$

B. $2AB$

C. $A+B$

D. AB

Answer: C



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1. If $A = \begin{bmatrix} 4 & x + 2 \\ 2x - 3 & x + 1 \end{bmatrix}$ is symmetric, then $x =$

A. 2

B. 3

C. 4

D. 5

Answer: D



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2. If A and B are symmetric matrices, then ABA is (a) symmetric matrix (b) skew-symmetric matrix (c) diagonal matrix (d) scalar matrix

A. symmetric matrix

B. skew-symmetric matrix

C. diagonal matrix

D. scalar matrix

Answer: A



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3. if A and B are symmetric matrices of the same order and

$P = AB + BA$ and $Q = AB - BA$, then $(PQ)'$ is equal to

A. PQ

B. QP

C. $-QP$

D. none of these

Answer: C



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4. 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

A. a skew-symmetric matrix

B. a symmetric matrix

C. a diagonal matrix

D. none of these

Answer: A



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

A. diagonal matrix

B. null matrix

C. triangular matrix

D. nono of these

Answer: B



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6. If A is square matrix order 3, then $|(A - A')^{2015}|$ is

A. $|A|$

B. $|A'|$

C. 0

D. none of these

Answer: C



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7. Find the maximum number of different elements required to form a symmetric matrix of order 6 is

A. 15

B. 17

C. 19

D. 21

Answer: D



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8. A and B are square matrices of order 3×3 , A is an orthogonal matrix and B is a skew symmetric matrix. Which of the following statement is not true

A. (a) $|AB| = 1$

B. (b) $|AB| = 0$

C. (c) $|AB| = -1$

D. (d) none of these

Answer: B



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9. the matrix $A = \begin{bmatrix} i & 1 - 2i \\ -1 - 2i & 0 \end{bmatrix}$, where $I = \sqrt{-1}$, is

A. symmetric matrix

B. skew-symmetric matrix

C. hermitian

D. skew-hermitian

Answer: D



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10. if A and B are square matrices of same order such that $A^* = A$ and $B^* = B$, where A^* denotes the conjugate transpose of A, then $(AB - BA)^*$ is equal to

- A. null matrix
- B. $AB - BA$
- C. $BA - AB$
- D. none of these

Answer: C



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11. if matrix $A = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & i \\ -i & a \end{bmatrix}$, $i = \sqrt{-1}$ is unitary matrix, a is equal to

- A. 2
- B. -1
- C. 0

D. 1

Answer: B



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12. If A is a 3×3 matrix and $\det(3A) = k\{\det(A)\}$, k is equal to

A. 9

B. 6

C. 1

D. 27

Answer: D



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13. If A and B are square matrices of order 3 such that $|A| = -1$, $|B| = 3$, then $|3AB|$ equals

A. -9

B. 81

C. -27

D. 81

Answer: B



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14. if A is a square matrix such that $A^2 = A$, then $\det(A)$ is equal to

A. 0 or 1

B. -2 or 2

C. -3 or 3

D. none of these

Answer: A



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15. If I is a unit matrix of order 10, then the determinant of I is equal to

A. 10

B. 1

C. $\frac{1}{10}$

D. 9

Answer: B



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16. If $A_i = \begin{bmatrix} 2^{-i} & 3^{-i} \\ 3^{-i} & 2^{-i} \end{bmatrix}$, then $\sum_{i=1}^{\infty} \det(A_i)$ is equal to

A. $\frac{3}{4}$

B. $\frac{5}{24}$

C. $\frac{5}{4}$

D. $\frac{7}{144}$

Answer: B



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17. The number of values of x for which the matrix

$$A = \begin{bmatrix} 3-x & 2 & 2 \\ 2 & 4-x & 1 \\ -2 & -4 & -1-x \end{bmatrix} \text{ is singular, is}$$

A. 0

B. 1

C. 2

D. 3

Answer: C



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18. For how many values of 'x' in the closed interval $[-4, -1]$ is the

matrix $\begin{bmatrix} 3 & -1+x & 2 \\ 3 & -1 & x+2 \\ x+3 & -1 & 2 \end{bmatrix}$ singular? (A) 2 (B) 0 (C) 3 (D) 1

A. 0

B. 1

C. 2

D. 3

Answer: B



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19. The value of x for which the matrix $\begin{vmatrix} -x & x & 2 \\ 2 & x & -x \\ x & -2 & -x \end{vmatrix}$ will be non-singular, are

A. $-2 \leq x \leq 2$

B. for all x other than 2 and -2

C. $x \geq 2$

D. $x \leq -20$

Answer: B

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Exercise For Session 3

1. Find the adjoint of the matrix $A = \begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ 1 & -2 & -2 \end{bmatrix}$ and hence show that $A(\text{adj } A) = |A| I_3$.

A. A

B. A^T

C. $3A$

D. $3A^T$

Answer: D



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2. If A is a 3×3 matrix and B is its adjoint matrix the determinant of B is 64 then determinant of A is

A. 64

B. ± 64

C. ± 8

D. 18

Answer: C



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3. For any 2×2 matrix, if $A (adj A) = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$, then $|A|$ is equal to

(a) 20 (b) 100 (c) 10 (d) 0

A. 0

B. 10

C. 20

D. 100

Answer: B



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4. If A is a singular matrix, then $\text{adj } A$ is a. singular b. non singular c. symmetric d. not defined

A. singular

B. non-singular

C. symmetric

D. not defined

Answer: D

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5. If $A = \begin{bmatrix} 1 & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$, then $\det(\text{adj}(\text{adj}A))$ is

A. 14^4

B. 14^3

C. 14^2

D. 14

Answer: A

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

A. k^{n-1}

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

C. k^n)

D. k

Answer: B

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7. With $1, \omega, \omega^2$ as cube roots of unity, inverse of which of the following matrices exists?

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

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

C. $\begin{bmatrix} \omega & \omega^2 \\ \omega^2 & 1 \end{bmatrix}$

D. None of these

Answer: D

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8. If the matrix A is such that $A \begin{bmatrix} -1 & 2 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} -4 & 1 \\ 7 & 7 \end{bmatrix}$, then A is equal to

A. (a) $\begin{bmatrix} 1 & 1 \\ 2 & -3 \end{bmatrix}$

B. (b) $\begin{bmatrix} 1 & 1 \\ -2 & 3 \end{bmatrix}$

C. (c) $\begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$

D. (d) $\begin{bmatrix} -1 & 1 \\ 2 & 3 \end{bmatrix}$

Answer: C

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9. If $A = \begin{bmatrix} \cos x & \sin x \\ -\sin x & \cos x \end{bmatrix}$ then find $|A|$

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10. The element in the first row and third column of the inverse of the

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

A. -2

B. 0

C. 1

D. None of these

Answer: D

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11. If $A = \begin{bmatrix} 0 & 1 & -1 \\ 2 & 1 & 3 \\ 3 & 2 & 1 \end{bmatrix}$ then $(A(\text{adj}A)A^{-1})A =$

A. $\begin{bmatrix} -6 & 0 & 0 \\ 0 & -6 & 0 \\ 0 & 0 & -6 \end{bmatrix}$

B. $\begin{bmatrix} 0 & \frac{1}{6} & -\frac{1}{6} \\ \frac{1}{3} & \frac{1}{6} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{6} \end{bmatrix}$

C. $\begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$

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

Answer: C



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12. A is an involutory matrix given by $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$, then the

inverse of $A/2$ will be

A. $2A$

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

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

D. A^2

Answer: A



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13. If A satisfies the equation $x^3 - 5x^2 + 4x + \lambda = 0$, then A^{-1} exists if

(a) $\lambda \neq 1$ (b) $\lambda \neq 2$ (c) $\lambda \neq -1$ (d) $\lambda \neq 0$

A. $\lambda \neq 1$

B. $\lambda \neq 2$

C. $\lambda \neq -1$

D. $\lambda \neq 0$

Answer: D



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14. A square non-singular matrix A satisfies

$A^2 - A + 2I = 0$, then $A^{-1} =$

A. $I - A$

B. $(I - A)I_2$

C. $I + A$

D. $(I+I)I$

Answer: B



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

B. $nA - I$

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

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

Answer: A



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16. If $X = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, the value of X^n is equal to

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

B. $\begin{bmatrix} 2n + n & 5 - n \\ n & -n \end{bmatrix}$

C. $\begin{bmatrix} 3^n & (-4)^n \\ 1^n & (-1)^n \end{bmatrix}$

D. None of these

Answer: D



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Exercise For Session 4

1. If the system of equations $ax + y = 1$, $x + 2y = 3$, $2x + 3y = 5$ are consistent, then a is given by

A. 0

B. 1

C. 2

D. None of these

Answer: A



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2. The system of linear equations $x + y + z = 2$, $2x + y - z = 3$, $3x + 2y + kz = 4$ has a unique solution if (A) $k \neq 0$ (B) $-1 < k < 1$ (C) $-2 < k < 2$ (D) $k = 0$

A. $\lambda \neq 0$

B. $-1 < \lambda < 1$

C. $\lambda = 0$

D. $-2 < \lambda < 2$

Answer: A



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3. The value of a for which system of equations ,
 $a^3x + (a + 1)^3y + (a + 2)^3z = 0$, $ax + (a + 1)y + (a + 2)z = 0$, $x + y + z = 0$
has a non-zero solution is:

A. 2

B. 1

C. 0

D. -1

Answer: D



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4. Let a, b, c be the real numbers. The following system of equations in $x, y, and z$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{a^2} = 1, \frac{x^2}{a^2} - \frac{y^2}{b^2} + \frac{z^2}{a^2} = 1, -\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{a^2} = 1$$
 has

(a). no solution (b). unique solution (c). infinitely many solutions (d).

finitely many solutions

A. (a) 6

B. (b) 7

C. (c) 8

D. (d) 9

Answer: D



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5. the matrix $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ is the matrix reflection in the line

A. $x=1$

B. $x+y=1$

C. $y=1$

D. $x=y$

Answer: D



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6. Let A be the the square matrix of order 3 and deteminant of A is 5 then find the value of determinant of $\text{adj}(A)$

A. 71

B. 51

C. 31

D. 25

Answer: D



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7. If $A = \begin{bmatrix} -2 & 3 \\ -1 & 1 \end{bmatrix}$ then A^3 is equal to

A. 2A

B. A

C. 2I.

D. I

Answer: D



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8. If $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ and the sum of eigen values of A is m and a product of eigen values of A is n, then m+n is equal to

A. 10

B. 12

C. 14

D. 16

Answer: B



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9. If $A = \begin{bmatrix} 1 & 2 \\ -1 & 4 \end{bmatrix}$ and θ be the angle between the two non-zero column vectors X such that $AX = \lambda X$ for some scalar λ , then $9 \sec^2 \theta$ is equal to

A. 13

B. 12

C. 11

D. 10

Answer: D



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1. If $A^5 = O$ such that $A^n \neq I$ for $1 \leq n \leq 4$, then $(I - A)^{-1}$ is equal to

A. A^4

B. A^3

C. $I + A$

D. None of these

Answer: D



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2. Let $A = \begin{bmatrix} a & b & c \\ p & q & r \\ x & y & z \end{bmatrix}$ and suppose then $\det(A) = 2$, then $\det(B)$ equals,

where $B = \begin{bmatrix} 4x & 2a & -p \\ 4y & 2b & -q \\ 4z & 2c & -r \end{bmatrix}$

A. -2

B. -8

C. -16

D. 8

Answer: C



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3. If A is any square matrix such that $A = \begin{bmatrix} 2 & 3 \\ 5 & 8 \end{bmatrix}$ then find $A + I$



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4. Let $a = \lim_{x \rightarrow 1} \left(\frac{x}{\ln x} - \frac{1}{x \ln x} \right)$, $b = \lim_{x \rightarrow 0} \left(\frac{x^3 - 16x}{4x + x^2} \right)$,

$c = \lim_{x \rightarrow 1} \left(\frac{\ln(1 + \sin x)}{x} \right)$ &

$d = \lim_{x \rightarrow -1} \frac{(x + 1)^3}{[\sin(x + 1) - (x + 1)]}$

Then $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is

A. idempotent

B. involutory

C. non-singular

D. nilpotent

Answer: D



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5. Let $A = \begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$ If θ is the angle between the two non-zero column vectors X such that $AX = \lambda X$ for some scalar λ then $\tan \theta$ is equal to

A. 3

B. 5

C. 7

D. 9

Answer: C



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6. If a square matrix A is involutory, then A^{2n+1} is equal to:

A. (a) I

B. (b) A

C. (c) A^2

D. (d) $(2n + 1)A$

Answer: B



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7. If $A = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix}$, then $\lim_{n \rightarrow \infty} \frac{A^n}{n}$ is (where $\theta \in R$)

A. a zero matrix

B. an identity matrix

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

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

Answer: A



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8. The rank of the matrix $\begin{bmatrix} -1 & 2 & 5 \\ 2 & -4 & a - 4 \\ 1 & -2 & a + 1 \end{bmatrix}$ is (where $a = -6$)

A. 1

B. 2

C. 3

D. 4

Answer: A



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9. A is an involutory matrix given by $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$, then the inverse of $A/2$ will be

A. $2A$

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

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

D. A^2

Answer: A



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

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

B. $(|A| + k)^n$

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

D. $(|A| + k)^{n+1}$

Answer: B



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11. If A and B are two square matrices such that $B = -A^{-1}BA$, then $(A + B)^2$ is equal to

A. O

B. $A^2 + B^2$

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

D. $A + B$

Answer: B



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

A. skew- symmetric matrix

B. singular

C. symmetric

D. Both B & C

Answer: D



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13. Let A be a $n \times n$ matrix such that $A^n = \alpha A$, where α is a real number different from 1 and -1. The matrix $A + I_n$ is

A. singular

B. invertible

C. scalar matrix

D. None of these

Answer: B

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14. If $A = \begin{bmatrix} \frac{-1+i\sqrt{3}}{2i} & \frac{-1-i\sqrt{3}}{2i} \\ \frac{1+i\sqrt{3}}{2i} & \frac{1-i\sqrt{3}}{2i} \end{bmatrix}$, $i = \sqrt{-1}$ and $f(x) = x^2 + 2$,

then $f(A)$ equals to

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

B. $\left(\frac{3-i\sqrt{3}}{2}\right) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

C. $\left(\frac{5-i\sqrt{3}}{2}\right) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

D. $(2+i\sqrt{3}) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Answer: D

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15. The number of 2×2 matrices X satisfying the matrix equation

$X^2 = I$ (I is 2×2 unit matrix) is 1 (b) 2 (c) 3 (d) infinite

A. 0

B. 1

C. 2

D. more than 3

Answer: D



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

A. -1

B. 0

C. 1

D. None of these

Answer: B



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17. If $P = \begin{bmatrix} \cos \frac{\pi}{6} & \sin \frac{\pi}{6} \\ -\sin \frac{\pi}{6} & \cos \frac{\pi}{6} \end{bmatrix}$, $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ then $P^{-1}AP = A'$



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18. 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, F are real numbers. The absolute

value of the difference of these two solutions, is

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

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

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

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

Answer: D



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19. If $f(\theta) = \begin{bmatrix} \cos^2 \theta & \cos \theta \sin \theta & -\sin \theta \\ \cos \theta \sin \theta & \sin^2 \theta & \cos \theta \\ \sin \theta & -\cos \theta & 0 \end{bmatrix}$, then $f(\pi/7)$ is

- A. symmetric
- B. skew-symmetric
- C. singular
- D. non-singular

Answer: D



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20. In a square matrix A of order 3 the elements a_{ij} 's are the sum of the roots of the equation $x^2 - (a + b)x + ab = 0$,

$a_{I,i+1}$'s are the product of the roots, $a_{I,i-1}$'s are all unity

and the rest of the elements are all zero. The value of the det (A) is equal to



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21. 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. 0 d. $-I$

A. I

B. $2I$

C. 0

D. $-I$

Answer: C



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22. 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

$A^T C^n A$, $n \in I^+$ equals to

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

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

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

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

Answer: D



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23. If A is a square matrix of order 3 such that $|A| = 2$, then

$|(\text{adj} A^{-1})^{-1}|$ is

A. 1

B. 2

C. 4

D. 8

Answer: C



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24. If A and B are different matrices satisfying $A^3 = B^3$ and $A^2B = B^2A$, then

A. $\det(A^2 + B^2)$ must be zero

B. $\det(A - B)$ must be zero

C. $\det(A^2 + B^2)$ as well as $\det(A - B)$ must be zero

D. atleast one of $\det(A^2 + B^2)$ or $\det(A - B)$ must be zero

Answer: D



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25. Show that A is a symmetric matrix if $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

- A. a symmetric matrix
- B. a skew-symmetric matrix
- C. an identity matrix
- D. None of these

Answer: B

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26. If $A = \begin{bmatrix} a & b & c \\ x & y & z \\ p & q & r \end{bmatrix}$, $B = \begin{bmatrix} q & -b & y \\ -p & a & -x \\ r & -c & z \end{bmatrix}$ and if A is

invertible, then which of the following is not true?

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

D. A is invertible \Leftrightarrow B is invertible

Answer: A

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

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

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

A. 4

B. 9

C. 12

D. 6

Answer: D



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

A. 0

B. I

C. $2I$

D. $6I$

Answer: B

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

A. $a = 1, b = -1$

B. $a = 2, b = -\frac{1}{2}$

C. $a = -1, b = 1$

D. $a = \frac{1}{2}, b = \frac{1}{2}$

Answer: A



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30. Given the matrix $A = \begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}$. If

$xyz = 60$ and $8x + 4y + 3z = 20$, then $A(adjA)$ is equal to

A. $64I$

B. $88I$

C. $68I$

D. $34I$

Answer: C



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Exercise More Than One Correct Option Type Questions

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

A. $A^3 = 9A$

B. $A^3 = 27A$

C. $A + A = A^2$

D. A^{-1} does not exist

Answer: A:D

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2. A square matrix A with elements from the set of real numbers is said to be orthogonal if $A' = A^{-1}$. If A is an orthogonal matrix, then

A. (a) A' is orthogonal

B. (b) A^{-1} is orthogonal

C. (c) $\text{adj}A = A'$

D. (d) $|A^{-1}| = 1$

Answer: A::B::D

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3. Let $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$, then

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

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

C. A^3 is not invertible

D. A^2 is invertible

Answer: A::B::D

4. D is a 3×3 diagonal matrix. Which of the following statements are not true?

A. $D^T = D$

B. $AD = DA$ for every matrix A of order 3×3

C. D^{-1} if exists is a scalar matrix

D. None of the above

Answer: B::C

5. If the rank of the matrix $\begin{bmatrix} -1 & 2 & 5 \\ 2 & -4 & a - 4 \\ 1 & -2 & a + 1 \end{bmatrix}$ is 1 then the value of a is

(A) -1 (B) 2 (C) -6 (D) 4

A. 2 , if $a = -6$

B. 2, if $a = 1$

C. 1, if $a = 2$

D. 1, if $a = -6$

Answer: B::D

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

A. $\text{adj}(\text{adj}A) = A$

B. $|\text{adj}(\text{adj}(A))| = 1$

C. $|\text{adj}(A)| = 1$

D. None of these

Answer: A::B::C

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

A. $A^2 = A$

B. $A^2 = I$

C. $AB = O$

D. $BA = O$

Answer: A::C::D



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8. If A is a non-singular matrix then

A. A^{-1} is a non-singular matrix, then

B. A^{-1} is skew-symmetric if A is symmetric

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

$$D. |A^{-1}| = |A|^{-1}$$

Answer: A::D



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9. Let A and B are two matrices such that $AB = BA$, then

for every $n \in \mathbb{N}$

A. $A^n B = B A^n$

B. $(AB)^n = A^n B^n$

C. $(A + B)^n = {}^n C_0 A^n + {}^n C_1 A^{n-1} B + \dots + {}^n C_n B^n$

D. $A^{2n} - B^{2n} = (A^n - B^n)(A^n + B^n)$

Answer: A::C::D



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10. If A and B are 3×3 matrices and $|A| \neq 0$, which of the following are true?

A. $|AB| = 0 \Rightarrow |B| = 0$

B. $|AB| = 0 \Rightarrow B = 0$

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

D. $|A + A| = 2|A|$

Answer: A::C



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11. If A is a matrix of order $m \times m$ such that

$$A^2 + A + 2I = O, \text{ then}$$

A. A is non-singular

B. A is symmetric

C. $|A| \neq 0$

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

Answer: A::C::D



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12. If $A^2 - 3A + 2I = 0$, then A is equal to

A. I

B. $2I$

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

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

Answer: A::B::C::D



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13. If A and B are two matrices such that their product AB is a null matrix, then

- A. $\det A \neq 0 \Rightarrow B$ must be a null matrix
- B. $\det B \neq 0 \Rightarrow A$ must be a null matrix
- C. atleast one of the two matrices must be singular
- D. if neither $\det A$ nor $\det B$ is zero, then the given statement is not possible

Answer: C::D



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14. If D_1 and D_2 are two 3×3 diagonal matrices where none of the diagonal elements is zero, then

- A. $D_1 D_2$ is a diagonal matrix
- B. $D_1 D_2 = D_2 D_1$

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

D. None of the above

Answer: A::B::C



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15. Let, $C_k = {}^n C_k$ for $0 \leq k \leq n$ and $A_k = \begin{bmatrix} C_{k-1}^2 & 0 \\ 0 & C_k^2 \end{bmatrix}$ for $k \geq 1$ and

$A_1 + A_2 + A_3 + \dots + A_n = \begin{bmatrix} k_1 & 0 \\ 0 & k_2 \end{bmatrix}$, then

A. $k_1 = k_2$

B. $k_1 + k_2 = {}^{2n} C_{2n} + 1$

C. $k_1 = {}^{2n} C_n - 1$

D. $k_2 = {}^{2n} C_{n+1}$

Answer: A, C



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Exercise Passage Based Questions

1. Suppose A and B be two non-singular matrices such that

$$AB = BA^m, B^n = I \text{ and } A^p = I, \text{ where } I \text{ is an identity matrix.}$$

If $m = 2$ and $n = 5$ then p equals to

A. 30

B. 31

C. 33

D. 81

Answer: B

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2. Suppose A and B be two non-singular matrices such that

$$AB = BA^m, B^n = I \text{ and } A^p = I, \text{ where } I \text{ is an identity matrix.}$$

The relation between m, n and p, is

A. $p = mn^2$

B. $p = m^n - 1$

C. $p = n^m - 1$

D. $p = m^{n-1}$

Answer: B



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3. Suppose A and B be two non-singular matrices such that

$AB = BA^m$, $B^n = I$ and $A^p = I$, where I is an identity matrix.

Which of the following ordered triplet (m, n, p) is false?

A. $(3, 2, 80)$

B. $(6, 3, 215)$

C. $(8, 3, 510)$

D. $(2, 8, 255)$

Answer: C

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4. Let $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ is an orthogonal matrix and $abc = \lambda (< 0)$.

The value $a^2b^2 + b^2c^2 + c^2a^2$, is

A. 2λ

B. -2λ

C. λ^2

D. $-\lambda$

Answer: B

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5. Let $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ then find tranpose of A matrix



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6. Let $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ is an orthogonal matrix and $abc = \lambda (< 0)$.

The equation whose roots are a, b, c , is

A. $x^3 - 2x^2 + \lambda = 0$

B. $x^3 - \lambda x^2 + \lambda x + \lambda = 0$

C. $x^3 - 2x^2 + 2\lambda x + \lambda = 0$

D. $x^3 \pm x^2 - \lambda = 0$

Answer: D



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7. Let $A = [a_{ij}]_{3 \times 3}$. If tr is arithmetic mean of elements of r th row and

$a_{ij} + a_{jk} + a_{ki} = 0$ holds for all $1 \leq i, j, k \leq 3$. $\sum_{1 \leq i} \sum_{j \leq 3} a_{ij}$ is not

equal to

A. $t_1 + t_2 + t_3$

B. zero

C. $(\det(A))^2$

D. $t_1 t_2 t_3$

Answer: D

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8. Let $A = [a_{ij}]_{3 \times 3}$. If tr is arithmetic mean of elements of r th row

and $a_{ij} + a_{jk} + a_{ki} = 0$ holds for all $1 \leq i, j, k \leq 3$.

Matrix A is

A. non-singular

B. symmetric

C. skew-symmetric

D. neither symmetric nor skew-symmetric

Answer: C

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9. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ be a square matrix and C_1, C_2, C_3 be three

columns

matrices

satisfying

$AC_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, $AC_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$ and $AC_3 = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$ of matrix B. If the matrix

$$C = \frac{1}{3}(A \cdot B).$$

The value of $\det(B^{-1})$, is

A. 2

B. $\frac{1}{2}$

C. 3

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

Answer: D

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10. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ be a square matrix and C_1, C_2, C_3 be three

column

matrices

satisfying

$AC_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, $AC_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$ and $AC_3 = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$ of matrix B. If the matrix $C = \frac{1}{3}(A \cdot B)$.

The ratio of the trace of the matrix B to the matrix C, is

A. $-\frac{9}{5}$

B. $-\frac{5}{9}$

C. $-\frac{2}{3}$

D. $-\frac{3}{2}$

Answer: A



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11. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ be a square matrix and C_1, C_2, C_3 be three

column

matrices

satisfying

$AC_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, $AC_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$ and $AC_3 = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$ of matrix B. If the matrix

$C = \frac{1}{3}(A \cdot B)$. find $\sin^{-1}(\det A) + \tan^{-1}(9 \det C)$

A. $\frac{\pi}{4}$

B. $\frac{\pi}{2}$

C. $\frac{3\pi}{4}$

D. π

Answer: C



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12. 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

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

$$(iii) C^T AC = A$$

A. $A + B$

B. $A - B$

C. A

D. B

Answer: A



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13. 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

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

$$(iii) C^T AC = A$$

A. $A + B$

B. $A - B$

C. A

D. B

Answer:



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14. 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) $C^TAC = A$

A. $A + B$

B. $A - B$

C. A

D. B

Answer: C



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15. Let A be a square matrix of order 3 satisfies the matrix equation

$$A^3 - 6A^2 + 7A - 8I = O \text{ and } B = A - 2I. \text{ Also, } \det A = 8.$$

The value of $\det(\text{adj}(I - 2A^{-1}))$ is equal to

A. $\frac{25}{16}$

B. $\frac{125}{64}$

C. $\frac{64}{125}$

D. $\frac{16}{25}$

Answer: A

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16. Let A be a square matrix of order 3 satisfies the relation

$$A^3 - 6A^2 + 7A - 8I = O \text{ and } B = A - 2I. \text{ Also, } \det. A = 8, \text{ then}$$

A. 7

B. 9

C. 29

D. 41

Answer: A

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Exercise Single Integer Answer Type Questions

1. Let A, B, C, D be (not necessarily) real matrices such that $A^T = BCD, B^T = CDA, C^T = DAB$ and $D^T = ABC$ for the matrix $S = ABCD$ the least value of k such that $S^k = S$ is

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2. $A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$ and $f(x)$ is defined as $f(x) = \det. (A^T A^{-1})$
 then the value of $\underbrace{f(f(f(f(\dots\dots\dots f(x))))))}_{n \text{ times}}$ is ($n \geq 2$) _____ .

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3. If the matrix $A = \begin{bmatrix} \lambda_1^2 & \lambda_1 \lambda_2 & \lambda_1 \lambda_3 \\ \lambda_2 \lambda_1 & \lambda_2^2 & \lambda_2 \lambda_3 \\ \lambda_3 \lambda_1 & \lambda_3 \lambda_2 & \lambda_3^2 \end{bmatrix}$ is idempotent,
 the value of $\lambda_1^2 + \lambda_2^2 + \lambda_3^2$ is

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4. Let A be a 3×3 matrix given by $A = [a_{ij}]$. If for every
 column vector X , $X^T A X = 0$ and $a_{23} = -1008$, the sum
 of the digits of a_{32} is

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5. If $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$ find the transpose of A matrix

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6. If A is an idempotent matrix and I is an identity matrix of the Same order, then the value of n, such that $(A + I)^n = I + 127A$ is

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7. Suppose $a, b, c, \in R$ and $abc = 1$, if $A = \begin{bmatrix} 3a & b & c \\ b & 3c & a \\ c & a & 3b \end{bmatrix}$ is such that $A^T A = 4^{1/3} I$ and $|A| > 0$, the value of $a^3 + b^3 + c^3$ is

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8. If $A = \begin{bmatrix} 0 & 1 \\ 3 & 0 \end{bmatrix}$ and $(A^8 + A^6 + A^4 + A^2 + I)V = \begin{bmatrix} 0 \\ 11 \end{bmatrix}$,

where V is a vertical vector and I is the 2×2 identity

matrix and if λ is sum of all elements of vertical vector

V , the value of 11λ is

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9. Let the matrix A and B defined as $A = \begin{vmatrix} 3 & 2 \\ 2 & 1 \end{vmatrix}$ and $B = \begin{vmatrix} 3 & 1 \\ 7 & 3 \end{vmatrix}$ Then the value of $|\det(2A^9 B^{-1})| =$

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10. Let $A = \begin{bmatrix} 0 & \alpha \\ 0 & 0 \end{bmatrix}$ and $(A + I)^{70} - 70A = \begin{bmatrix} a - 1 & b - 1 \\ c - 1 & d - 1 \end{bmatrix}$, the value of $a + b + c + d$ is

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Matrices Exercise 5 Matching Type Questions

1. Find $A + B$ if $A = \begin{bmatrix} 2 & 5 \\ 3 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} 7 & 9 \\ 6 & 5 \end{bmatrix}$



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2. Find $|\text{adj}(a)|$ if $|A|=7$ and A is a square matrix of order 3



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3. If A is a square matrix of order 2 and $|A| = 8$ then find the value of $|\text{adj}(A)|$



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Column I		Column II	
(A)	If C is skew-symmetric matrix of order n and X is $n \times 1$ column matrix, then $X^T C X$ is	(p)	invertible
(B)	If A is skew - symmetric, then $I - A$ is, where I is an identity matrix of order A .	(q)	singular
(C)	If $S = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ and $A = \begin{bmatrix} b+c & c-a & b-a \\ c-b & c+a & a-b \\ b-c & a-c & a+b \end{bmatrix}$ $(a, b, c \neq 0)$, then SAS^{-1} is	(r)	symmetric
(D)	If A, B, C are the angles of a triangle, then the matrix $A = \begin{bmatrix} \sin 2A & \sin C & \sin B \\ \sin C & \sin 2B & \sin A \\ \sin B & \sin A & \sin 2C \end{bmatrix}$ is	(s)	non-singular
		(t)	non-invertible

4.



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Exercise Statement I And II Type Questions

1. (Statement-1 Assertion and Statement-2 (Reason))

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement - 1 If matrix $A = [a_{ij}]_{3 \times 3}$, $B = [b_{ij}]_{3 \times 3}$, where $a_{ij} + a_{ji} = 0$ and $b_{ij} - b_{ji} = 0$ then $A^4 B^5$ is non-singular matrix.

Statement-2 If A is non-singular matrix, then $|A| \neq 0$.

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 not 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: D



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2. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement-1 if A and B are two square matrices of order

$n \times n$ which satisfy $AB = A$ and $BA = B$, then

$$(A + B)^7 = 2^6(A + B)$$

Statement- 2 A and B are unit matrices.

A. Statement-1 is true, Statement -2 is true, Statement-1

is a correct explanation for Statement-2

B. Statement-1 is true, Statement-2 is true, Sttatement - 2

is not a correct explanation for Statement-2

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

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

Answer: C



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3. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement-1 For a singular matrix A , if $AB = AC \Rightarrow B = C$

Statement-2 If $|A| = 0$, then A^{-1} does not exist.

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 not 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: D



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4. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement - 1 If A is skew-symmetric matrix of order 3, then its determinant should be zero.

Statement - 2 If A is square matrix,

$$\det(A) = \det(A') = \det(-A')$$

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 not 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: C



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5. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Let A be a skew-symmetric matrix, $B = (I - A)(I + A)^{-1}$

and X and Y be column vectors conformable for multiplication with B .

Statement-1 $(BX)^T (BY) = X^T Y$

Statement- 2 If A is skew-symmetric, then $(I+A)$ is non-singular.

A. Statement- is true, Statement -2 is true, Statement-2

is a correct explanation for Statement-5

B. Statement-1 is true, Statement-2 is true, Sttatement - 2

is not a correct explanation for Stamentent-5

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

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

Answer: A

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6. Let A 2×2 matrix A has determinant Find $|\text{adj}(A)|$ if determinant of A is

9

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7. If $A = \begin{bmatrix} 1 & -1 & -1 \\ 1 & -1 & 0 \\ 1 & 0 & -1 \end{bmatrix}$ then find transpose of A

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8. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement - 1 $A = [a_{ij}]$ be a matrix of order 3×3 where $a_{ij} = \frac{i - j}{i + 2j}$ cannot be expressed as a sum of symmetric and skew-symmetric matrix.

Statement-2 Matrix $A = [a_{ij}]_{n \times n}$, $a_{ij} = \frac{i - j}{i + 2j}$ is neither symmetric nor skew-symmetric.

- 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 not 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: D



9. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement- 1 If A, B, C are matrices such that

$$|A_{3 \times 3}| = 3, |B_{3 \times 3}| = -1 \text{ and } |C_{2 \times 2}| = 2, |2ABC| = -12.$$

Statement - 2 For matrices A, B, C of the same order

$$|ABC| = |A||B||C|.$$

A. Statement- is true, Statement -2 is true, Statement-2

is a correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is true, Sttatement - 2

is not a correct explanation for Stamentent-1

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

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

Answer: D



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10. Statement-1 (Assertion and Statement- 2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice as given below.

Statement-1 The determinant fo a matrix $A = [a_{ij}]_{n \times n}$,

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.

A. Statement- is true, Statement -2 is true, Statement-2

is a correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is true, Sttatement - 2

is not 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: A

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Exercise Subjective Type Questions

1. 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.

A.

B.

C.

D.

Answer:

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2. If M is a 3×3 matrix, where $\det M = 1$ and $MM^T = I$, where I is an identity matrix, prove that $\det (M - I) = 0$.

A.

B.

C.

D.

Answer:



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3. 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 $BA^4B = A^{-1}$

A.

B.

C.

D.

Answer: $\alpha = \frac{2\pi}{3}$



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A.

B.

C.

D.

Answer:
$$\begin{bmatrix} \cos \theta \cos \phi \cos(\theta-\phi) & \cos \theta \sin \phi \cos(\theta-\phi) \\ \sin \theta \cos \phi \cos(\theta-\phi) & \sin \theta \sin \phi \cos(\theta-\phi) \end{bmatrix}$$



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5. If $A = \begin{bmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{bmatrix}$ then Find $A + I$

A.

B.

C.

D.

Answer:



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6. A finance company has offices located in every division, every district and every taluka in a certain state in India.

Assume that there are five divisions, thirty districts and 200 talukas in the state. Each office has one head clerk, one cashier, one clerk and one peon. A divisional office has, in addition, one office superintendent, two clerks, one typist and one peon. A district office, has in

addition, one clerk and one peon. The basic monthly

salaries are as follows :

Office superintendent Rs 500, Head clerk Rs 200, cashier Rs 175, clerks and typist

Rs 150 and peon Rs 100. Using matrix notation find

The total number of posts of each kind in all the offices taken together,

A.

B.

C.

D.

Answer: Number of posts in all the offices taken together are 5 office superintendents; 235 had clerks; 235 cashiers; 275 clerks; 5 typisit and 270



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7. A finance company has offices located in every division, every district and every taluka in a certain state in India.

Assume that there are five divisions, thirty districts and 200 talukas in the state. Each office has one head clerk, one cashier, one clerk and one peon. A divisional office has, in addition, one office superintendent, two clerks, one typist and one peon. A district office, has in addition, one clerk and one peon. The basic monthly salaries are as follows :

Office superintendent Rs 500, Head clerk Rs 200, cashier Rs 175, clerks and typist

Rs 150 and peon Rs 100. Using matrix notation find

the total basic monthly salary bill of each kind of office

A.

B.

C.

D.

Answer: Total basic monthly salary bill of each division of district and taluka offices an Rs 1675, Rs 675 and Rs 625, respectively.



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8. A finance company has offices located in every division, every district and every taluka in a certain state in India.

Assume that there are five divisions, thirty districts and 200 talukas in the state. Each office has one head clerk, one cashier, one clerk and one peon. A divisional office has, in addition, one office superintendent, two clerks, one typist and one peon. A district office, has in addition, one clerk and one peon. The basic monthly salaries are as follows :

Office superintendent Rs 500, Head clerk Rs 200, cashier Rs 175, clerks and typist

Rs 150 and peon Rs 100. Using matrix notation find

the total basic monthly salary bill of all the offices taken together.

A.

B.

C.

D.

Answer: Total basic monthly salary bill of all the offices taken together is Rs 159625.



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9. In a development plan of a city, a contractor has taken a contract to construct certain houses for which he needs building materials like stones, sand etc. There are three firms A, B, C that can supply him these materials. At one time these firms A, B, C supplied him 40, 35 and 25 truck loads of stones and 10, 5 and 8 truck load of sand respectively. If the cost of one truckload of stone and sand are Rs 1200 and 500 respectively, then find the total amount paid by the contractor to each of these firms A, B, C separately.

A.

B.

C.

D.

Answer: Rs 53000; Rs 44500; Rs 34000 , respectively



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10. Show that the matrix $A = \begin{bmatrix} 1 & a & \alpha & a\alpha \\ 1 & b & \beta & b\beta \\ 1 & c & \gamma & c\gamma \end{bmatrix}$ is of rank 3

provided no two of a, b, c are equal and no two of α, β, γ are equal.

A.

B.

C.

D.

Answer:



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11. By the method of matrix inversion, solve the system.

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

A.

B.

C.

D.

Answer: $x = -1, u = -1, y = 3, v = 2, z = 5, w = 1$



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12. If $x_1 = 3y_1 + 2y_2 - y_3$, $y_1 = z_1 - z_2 + z_3$

$$x_2 = -y_1 + 4y_2 + 5y_3, y_2 = z_2 + 3z_3$$

$$x_3 = y_1 - y_2 + 3y_3, y_3 = 2z_1 + z_2$$

express x_1, x_2, x_3 in terms of z_1, z_2, z_3 .

A.

B.

C.

D.

Answer:

$$x_1 = z_1 - 2z_2 + 9z_3, x_2 = 9z_1 + 10z_2 + 11z_3, x_3 = 7z_1 + z_2 - 2z_3$$



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13. For what values of k the set of equations

$$2x - 3y + 6z - 5t = 3, y - 4z + t = 1,$$

$4x - 5y + 8z - 9t = k$ has infinite solution and no solution.

A.

B.

C.

D.

Answer: $(i)k \neq 7(ii)k = 7$



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14. $A = \begin{bmatrix} a & 1 & 0 \\ 1 & b & d \\ 1 & b & c \end{bmatrix}$ then find the value of $|A|$

A.

B.

C.

D.

Answer:

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Exercise Questions Asked In Previous 13 Years Exam

1.

Let

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

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

A. $(6, 11)$

B. $(6, -11)$

C. $(-6, 11)$

D. $(-6, -11)$

Answer: C

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A. $\begin{bmatrix} 1 & 2005 \\ 0 & 1 \end{bmatrix}$

B. $\begin{bmatrix} \sqrt{3}/1 & 2005 \\ 1 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 2005 \\ \sqrt{3}/2 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 1 & \sqrt{3}/2 \\ 0 & 2005 \end{bmatrix}$

Answer: A



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3. If $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ then which one of the following

holds for all $n \geq 1$ by the principle of mathematica induction? (A)

$A^n = 2^{n-1}A + (n-1)I$ (B) $A^n = nA + (n-1)I$ (C)

$A^n = 2^{n-1}A - (n-1)I$ (D) $A^n = nA - (n-1)AI$

A. $A^n = nA + (n-1)I$

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

C. $A^n = nA - (n - 1)I$

D.

Answer: C



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4. If $A^2 - A + I = O$, then A^{-1} is equal to

A. a^{-2}

B. $A + I$

C. $I - A$

D. $A - I$

Answer: C



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5. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ and U_1, U_2, U_3 be column matrices satisfying

$$AU_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, AU_2 = \begin{bmatrix} 2 \\ 3 \\ 6 \end{bmatrix}, AU_3 = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}.$$

If U is 3×3 matrix whose columns are U_1, U_2, U_3 , then $|U| =$

A. 3

B. -3

C. $3/2$

D. 2

Answer: A



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6. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$, and U_1, U_2 and U_3 are columns of a 3×3

matrix U . If column matrices U_1, U_2 and U_3 satisfy

$AU_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, $AU_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$, $AU_3 = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$ then the sum of the elements of the matrix U^{-1} is

A. -1

B. 0

C. 1

D. 3

Answer: B



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7. If $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$, U_1 , U_2 , and U_3 are column matrices

satisfying $AU_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$, $AU_2 = \begin{pmatrix} 2 \\ 3 \\ 0 \end{pmatrix}$ and $AU_3 = \begin{pmatrix} 2 \\ 3 \\ 1 \end{pmatrix}$ and

U is 3×3 matrix when columns are U_1, U_2, U_3 then

answer the following questions

The value of $(3 \ 2 \ 0) U \begin{pmatrix} 3 \\ 2 \\ 0 \end{pmatrix}$ is

A. (a) 5

B. $5/2$

C. 4

D. $3/2$

Answer: A



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8. Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$ where a, b are natural numbers, then which one of the following is correct ?

A. there cannot exist any B such that $AB = BA$

B. There exist more than one but finite number of B' s such that

$$AB = BA$$

C. there exists exactly one B such that $AB = BA$

D. there exist infinitely among B' s such that $AB = BA$

Answer: B



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9. If A and B are square matrices of size $n \times n$ such that $A^2 - B^2 = (A - B)(A + B)$, then which of the following will be always true

A. $A = B$

B. $AB = BA$

C. Either of A or B is a zero matrix

D. Either of A or B is identity matrix

Answer: B



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10. Let $A = \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix}$. If $|A^2| = 25$, then α equals to:

A. 5^2

B. 1

C. $1/5$

D. 5

Answer: C



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11. Let A and B be 3×3 matrices of real 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 matrix AB , then find the possible values of k .

A. 0

B. 1

C. 2

D. 3

Answer: B::D

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12. Let A be a square matrix all of whose entries are integers. Then which one of the following is true? (1) If $\det A = \pm 1$, then A^{-1} exists but all its entries are not necessarily integers (2) If $\det A \neq \pm 1$, then A^{-1} exists and all its entries are non-integers (3) If $\det A = \pm 1$, then A^{-1} exists and all its entries are integers (4) If $\det A = \pm 1$, then A^{-1} need not exist

A. If $\det A \neq \pm 1$, then A^{-1} exists and all its entries are non-integers

B. If $\det A = \pm 1$. then A^{-1} then A^{-1} exist and all its entries are integers

C. If $\det A = \pm 1$, then A^{-1} need not exist

D. If $\det A = \pm 1$, then A^{-1} exists but all its entries are not necessarily integers

Answer: D



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13. Let A be a 2×2 matrix with real entries. Let I be the 2×2 identity matrix. Denote by $\text{tr}(A)$, the sum of diagonal entries of A . Assume that $A^2 = I$. Statement 1: If $A \neq I$ and $A \neq -I$, then $\det A = -1$. Statement 2: If $A \neq I$ and $A \neq -I$, then $\text{tr}(A) \neq 0$. (1) Statement 1 is false, Statement (2)(3) – 2(4) is true (6) Statement 1 is true, Statement (7)(8) – 2(9) (10) is true, Statement (11)(12) – 2(13) is a correct explanation for Statement 1 (15) Statement 1 is true, Statement (16)(17) – 2(18) (19) is true; Statement (20)(21) – 2(22) is not a correct explanation for Statement 1. (24) Statement 1 is true, Statement (25)(26) – 2(27) is false.

- 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 not 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: C



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14. 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 in A is

- A. 12
- B. 6
- C. 9

D. 3

Answer: A



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15. 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. less than 4
- B. at least 4 but less than 7
- C. at least 7 but less than 10
- D. at least 10

Answer: B



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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

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

is inconsistent is

- A. 0
- B. more than 2
- C. 2
- D. 1

Answer: B



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17. Let A be a 2×2 matrix

Statement -1 $\text{adj}(\text{adj}A) = A$

Statement-2 $|\text{adj}A| = |A|$

- 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 not 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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18. The number of 3×3 matrices 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

Answer: A



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19. Let P be an odd prime number and T_p be the following set of 2×2 matrices :

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

The number of A in T_p such that $\det(A)$ is not 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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20. Let P be an odd prime number and T_P be the following set of 2×2 matrices :

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

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

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

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

C. $(p-1)^2$

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

Answer: A



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21. Let P be an odd prime number and T_P be the following set of 2×2 matrices :

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

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

A. $2P^2$

B. $p^3 - 5p$

C. $p^3 3p$

D. $P^3 = p^2$

Answer: B

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22. Let K be a positive real number and $A = \begin{bmatrix} 2k-1 & 2\sqrt{k} & 2\sqrt{k} \\ 2\sqrt{k} & 1 & -2k \\ -2\sqrt{k} & 2k & -1 \end{bmatrix}$ and

$$B = \begin{bmatrix} 0 & 2k-1 & \sqrt{k} \\ 1-2k & 0 & 2 \\ -\sqrt{k} & -2\sqrt{k} & 0 \end{bmatrix}. \text{ If } \det(\text{adj } A) + \det(\text{adj } B) = 10^6, \text{ then } [k]$$

is equal to _____ .

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

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23. 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. 5

B. 6

C. at least 7

D. less than 4

Answer: C

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24. Let a be a 2×2 matrix with non-zero entries and let $A^2 = I$, where I is a 2×2 identity matrix. Define $\text{Tr}(A)$ = sum of diagonal elements of A and $|A|$ = determinant of matrix A .

Statement 1 : $\text{Tr}(A) = 0$

Statement 2 : $|A| = 1$

- A. Statement -1 is true, Statement - 2 is true, Statement -2 is not a correct explanation for Statement-1
- B. Statement-1 is true, Statement-2 is false
- C. Statement-1 is false, Statement-2 is true
- D. Statement -1 is true, Statement-2 is true, Statement-2 is a correct explanation for Statement-1

Answer: B



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25. Let M and N be two 3×3 nonsingular skew-symmetric matrices such that $Mn = NM$. If P^T denotes the transpose of P , then $M^2N^2(M^TN)^{-1}(MN^{-1})^T$ is equal to

A. M^2

B. $-N^2$

C. $-M^2$

D. MN

Answer: C



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26. Let a , b , and c be three real numbers satisfying $[a \ b \ c]$

$$\begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix} = [0 \ 0 \ 0]$$

If the point $P(a, b, c)$ with reference to (E) lies on the plane $2x + y + z = 1$, then the value of $7a + b + c$ is

A. 0

B. 12

C. 7

D. 6

Answer: D



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27. 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 ω be a solution of $x^3 - 1 = 0$ with $Im(\omega) > 0$. If $a = 2$ with b and c

satisfying (E), then the value of $\frac{3}{\omega^a} + \frac{1}{\omega^b} + \frac{3}{\omega^c}$ is equal to

A. -2

B. 2

C. 3

D. -3

Answer: A



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28. 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 α and β 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. 3

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

D. ∞

Answer: B



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29. Let $\omega \neq 1$ be cube root of unity and S be the set of all non-singular matrices of the form $\begin{bmatrix} 1 & a & b \\ \omega & 1 & c \\ \omega^2 & \omega & 1 \end{bmatrix}$, where each of $a, b,$ and c is either 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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30. Let M be a 3×3 matrix satisfying $M \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = M \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$, and $M \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ Then the sum of the diagonal entries of M is _____.

A.

B.

C.

D.

Answer:



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31. 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 true, Statement - 2 is true, Statement -2 is not

a correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is false

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

D. Statement -1 is true, Statement-2 is true, Statement-2 is a

correct explanation for Statement-1

Answer: A



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32. Let $P = [a_{ij}]$ be a 3×3 matrix and let $Q = [b_{ij}]$, where $b_{ij} = 2^{i+j} a_{ij}$ 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}

A. 2^{11}

B. 2^{12}

C. 2^{13}

D. 2^{10}

Answer: C



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33. If P is a 3×3 matrix such that $P^T = 2P + I$, where P^T is the transpose of P and I is the 3×3 identity matrix, then there exists a

column matrix, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ such that

A. $PX = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

B. $PX = X$

C. $PX = 2X$

D. $PX = -X$

Answer: D



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34. If the adjoint of a 3×3 matrix P is $(1 \ 4 \ 4) \ (2 \ 1 \ 7) \ (1 \ 1 \ 3)$, then the possible value(s) of the determinant of P is (are) (A) -2 (B) -1 (C) 1 (D) 2

A. -2

B. -1

C. 1

D. 2

Answer: A::D



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35. 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: B



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36. Let P and Q be 3×3 matrices $P \neq Q$. If $P^3 = Q^3$ and $P^2Q = Q^2P$, then determinant of $(P^2 + Q^2)$ is equal to :

A. 0

B. -1

C. -2

D. 1

Answer: A



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37. IF $P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is the adjoint of 3×3 matrix A and $|A| = 4$, then

α is equal to :

A. 11

B. 5

C. 0

D. 4

Answer: A



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38. For 3×3 matrices M and N , which of the following statement (s) is (are) NOT correct ?

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

Statement - II : $M N - N M$ is skew-symmetric for all symmetric matrices

M and N .

Statement - III : MN is symmetric for all symmetric matrices M and N .

Statement - IV : $(adj M)(adj N) = adj(MN)$ 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 skew-symmetric 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 invertible matrices M and N

Answer: C::D



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

A. 55

B. 56

C. 57

D. 58

Answer: A::B::D[Watch Video Solution](#)

40. If A is an 3×3 non-singular matrix such that $AA^T = A^T A$ and $B = A^{-1}A^T$, then BB^T equals

A. B^{-1} B. (B^{-1}) C. $I + B$ D. I

Answer: D



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41. Let M be a 2×2 symmetric matrix with integer entries.

Then, M is invertible, if

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 first 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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42. 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

A. determinant of $(M^2 + MN^2)$ is 0

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

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

D. for a 3×3 matrix U if $(M^2 + MN^2)U$ equals the zero matrix, then U is the zero matrix

Answer: A:B



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43. If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is a matrix satisfying the equation $AA^T = 9I$,

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: B



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44. Let X and Y 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. $Y^3Z^4 - Z^4Y^3$

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

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

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

Answer: C::D



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45. 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. 13

C. 4

D. -1

Answer: A



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

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

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

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

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

Answer: B::C



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47. Let $z = \frac{-1 + \sqrt{3}i}{2}$, where $i = \sqrt{-1}$, and $r, s \in \{1, 2, 3\}$. Let $P = \begin{bmatrix} (-z)^r & z^{2s} \\ z^{2s} & z^r \end{bmatrix}$ and I be the identity matrix of order 2. Then the total number of ordered pairs (r, s) for which $P^2 = -I$ is _____.

A. $\frac{1}{2}|a - b|$

B. $\frac{1}{2}|a + b|$

C. $|a - b|$

D. $|a + b|$

Answer: A



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

A. 52

B. 103

C. 201

D. 205

Answer: B



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49. If $A = \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$, then $\text{adj}(3A^2 + 12A)$ is equal to

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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