



MATHS

BOOKS - CENGAGE

MATRICES

Solved Examples And Exercises

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

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2. If nth-order square matrix A is a orthogonal, then |adj (adj A)| is

3. If P is an orthogonal matrix and $Q = PAP^{T}andx = P^{T}Q^{1000}P$ then x^{-1} is ,

where A is involutary matrix. A b. I c. A^{1000} d. none of these



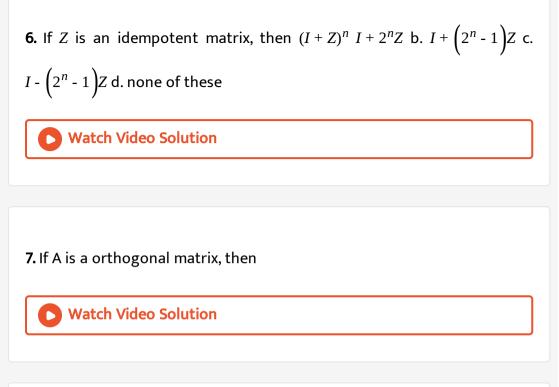
4. If A is a nilpotent matrix of index 2, then for any positive integer $n, A(I + A)^n$ is equal to A^{-1} b. $A c. A^n d. I_n$

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5. If AandB are two matrices such that AB = BandBA = A, then

$$(A^5 - B^5)^3 = A - B$$
 b. $(A^5 - B^5)^3 = A^3 - B^3$ c. $A - B$ is idempotent d. none

of these



8. If $A^2 = 1$, then the value of det(A - I) is (where A has order 3) 1 b. -1 c. 0

d. cannot say anything

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9. Let A be an nth-order square matrix and B be its adjoint, then $|AB + KI_n|$ is (where K is a scalar quantity)

10.
$$A = \begin{bmatrix} a & 1 & 0 \\ 1 & b & d \\ 1 & b & c \end{bmatrix}, B = \begin{bmatrix} a & 1 & 1 \\ 0 & d & c \\ f & g & h \end{bmatrix}, U = \begin{bmatrix} f \\ g \\ h \end{bmatrix}, V = \begin{bmatrix} a^2 \\ 0 \\ 0 \end{bmatrix}$$
 If there is a

vector matrix X, such that AX = U has infinitely many solutions, then prove that BX = V cannot have a unique solution. If $afd \neq 0$. Then, prove that BX = V has no solution.

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11. If M is a 3×3 matrix, where det M = 1 and $MM^T = I$, where 'I' is an

identity matrix, then prove that det. (M - I) = 0.

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

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

which

$$A = \begin{bmatrix} l^2 - 3 & p & 0 \\ 0 & m^2 - 8 & q \\ r & 0 & n^2 - 15 \end{bmatrix}$$
 be a nonsingular idempotent matrix. Then

the sum of all the elements of the set S is ______.

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14. Given a matrix
$$A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$$
, where a, b, c are real positive numbers.

If abc = 1 and $A^T A = I$, then find the value of $a^3 + b^2 + c^3$.

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

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16. Let
$$A = \begin{bmatrix} 3x^2 \\ 1 \\ 6x \end{bmatrix}$$
, $B = [a, b, c]$ and $C = \begin{bmatrix} (x+2)^2 & 5x^2 & 2x \\ 5x^2 & 2x & (x+2)^2 \\ 2x & (x+2)^2 & 5x^2 \end{bmatrix}$ be

three given matrices, where $a, b, candx \in R$ Given that tr(AB)=tr(C). If $f(x) = ax^2 + bx + c$, then the value of f(1) is _____.

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17. 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 $|9\alpha|$ is equal to _____.

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

then the value of λ is

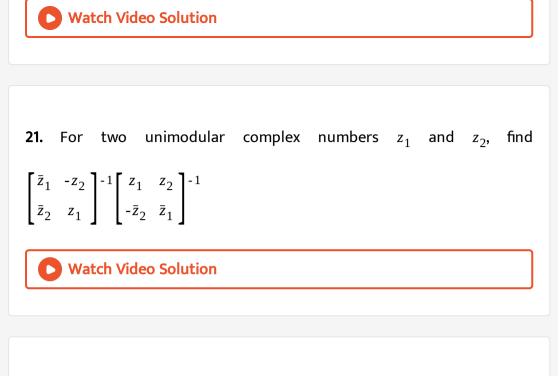
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19. Let A be the set of all 3×3 skew-symmetric matrices whose entries are either -1, 0, or 1. If there are exactly three 0's, three 1's, and three (-1)'s, then the number of such matrices is ______.



20. If $A = [0121233a1]andA_1 = [1/212/12/ - 43c5/2 - 3/21/2]$, then the

values of *a* anti *c* are equal to 1, 1 b. 1, - 1 c. 1, 2 d. -1, 1



22. If A and B are two nonsingular matrices of the same order such that

 $B^r = I$, for some positive integer r > 1, then $A^{-1}B^{r-1}A - A^{-1}B^{-1}A =$

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23. If A is non-diagonal involuntary matrix, then A = I = O b. A + I = O c.

A = I is nonzero singular d. none of these

24. If A and B are squares matrices such that $A^{2006} = O$ and AB = A + B,

then det (B) equals



25. If matrix A is given by $A = \begin{bmatrix} 6 & 11 \\ 2 & 4 \end{bmatrix}$, then the determinant of $A^{2005} - 6A^{2004}$ is

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

27. If *AandB* are two non-singular matrices such that AB = C, then |B| is

equal to
$$\frac{|C|}{|A|}$$
 b. $\frac{|A|}{|C|}$ c. $|C|$ d. none of these

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

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

these

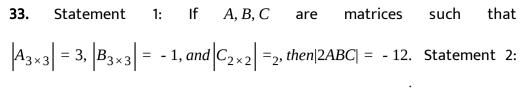
30. Statement 1: $A = [404222121]B^{-1} = [133143134]$. Then $(AB)^{-1}$ does not exist. Statement 2: Since |A| = 0, $(AB)^{-1} = B^{-1}A^{-1}$ is meaning-less.

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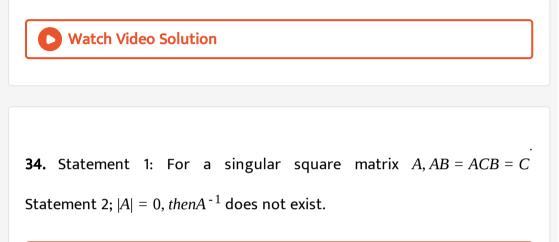
31. Statement 1: if a, b, c, d are real numbers and $A = [abcd]andA^3 = O$, $thenA^2 = O$ Statement 2: For matrix A = [abcd] we have $A^2 = (a + d)A + (ad - bc)I = O$

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



For matrices A, B, C of the same order, |ABC| = A = |A||B||C|



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35. Statement 1: The inverse of singular matrix $A = \left(\begin{bmatrix} a_{ij} \end{bmatrix} \right)_{n \times n}, where a_{ij} = 0, i \ge jisB = ([aij - 1])_{n \times n}$ Statement 2: The

inverse of singular square matrix does not exist.

Statement 1: The determinant of a 36. matrix $A = \left(\left[a_{ij} \right] \right)_{5 \times 5}$ where $a_{ij} + a_{ji} = 0$ for all *iandj* is zero. Statement 2: The determinant of a skew-symmetric matrix of odd order is zero

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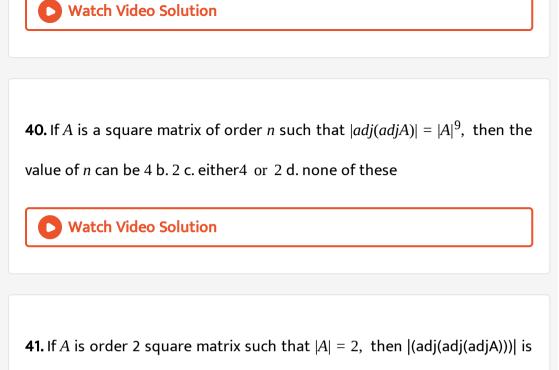
37. If
$$A = [1221]andf(x) = \frac{1+x}{1-x}$$
, then $f(A)$ is $[1111]$ b. $[2222]$ c. $1 - 1 - 1$ d.

none of these

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38. If
$$\begin{bmatrix} 1/25 & 0 \\ x & 1/25 \end{bmatrix} = \left(\begin{bmatrix} 5 & 0 \\ -a & 5 \end{bmatrix}^{-1} \right)^2$$
, then the value of x is

39.
$$A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$$
, show that $A^T A^{-1} = \begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$



512 b. 256 c. 64 d. none of these

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42. If $A^3 = O$, then $I + A + A^2$ equals a. I - A b. $(I + A^1)^{-1}$ c. $(I - A)^{-1}$ d. none

of these

43. Prove that sin² A cos² B+cos² A sin² B+cos² A cos² B+sin² A

sin^2 B=1



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

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

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

46. Let AdnB be 3×3 matrices of ral numbers, where A is symmetric, B is

skew-symmetric , and (A + B)(A - B) = (A - B)(A + B) If

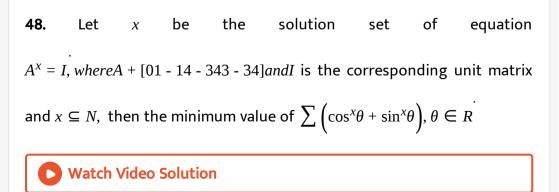
 $(AB)^{t} = (-1)^{k}AB$, where $(AB)^{t}$ is the transpose of the mattix AB, then find

the possible values of k



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

the value of 1/f(a) is _____.



49. If
$$A = \begin{bmatrix} \alpha & 0 \\ 1 & 1 \end{bmatrix}$$
 and $B = \begin{bmatrix} 1 & 0 \\ 5 & 1 \end{bmatrix}$ find the values of α for which $A^2 = B$.



50. Let *a* and *b* be two real numbers such that a > 1, b > 1. If $A = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$,

then $\lim n \to \infty A^{-n}$ is

a. unit matrix

b. null matrix

c. 2l

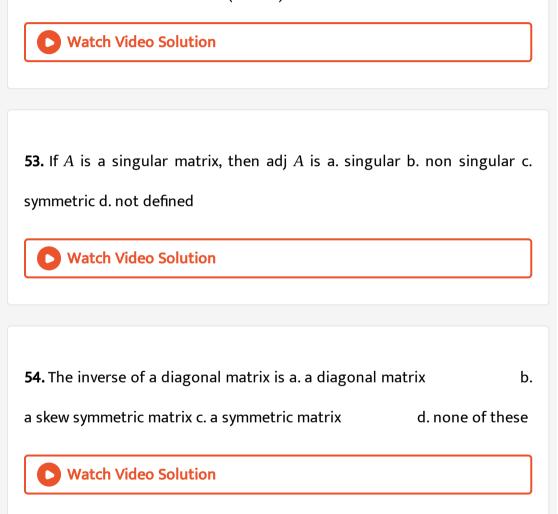
d. none of these

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

52. If A and B are square matrices of the same order and A is nonsingular,

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then for a positive integer n, (A^{-1}BA)^n is equal to
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55. If *P* is non-singular matrix, then value of $adj(P^{-1})$ in terms of *P* is (A) $\frac{P}{|P|}$ (B) P|P| (C) *P* (D) none of these

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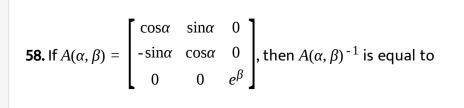
56. If adj
$$B = A$$
, $|P| = |Q| = 1$, then adj $(Q^{-1}BP^{-1})$ is

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

OI b. 2I c. 6I d. I







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

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60. A = [1tanx - tanx1]andf(x) is defined as $f(x) = detA^{T}A^{-1}$ en the value of

$$(f(f(f(f(f(x))))) \text{ is } (n \ge 2) _____.$$

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61. The equation
$$\begin{bmatrix} 1 & 2 & 2 \\ 1 & 3 & 4 \\ 3 & 4 & k \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$
 has a solution for (x, y, z) besides (0, 0,

0). Then the value of k is _____ .

62. If D_1 and D_2 are two 3×3 diagonal matrices, then which of the

following is/are true ?



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

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



65. 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

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66. Let A = a ij be a matrix of order 3, where
$$a_{ij} = \begin{cases} x & \text{if } i = j, x \in R \\ 1 & \text{if } |i - j| = 1 \\ 0 & \text{otherwise} \end{cases}$$

then which of the following hold (s) good :

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

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

$$BAB = B$$

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

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70. If
$$F(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$$
 and $G(y) = \begin{bmatrix} \cos y & 0 & \sin y \\ 0 & 1 & 0 \\ -\sin y & 0 & \cos y \end{bmatrix}$, then

 $[F(x)G(y)]^{-1}$ is equal to

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

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72. If A is a 3×3 skew-symmetric matrix, then trace of A is equal to -1 b. 1

c. |A| d. none of these

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73. If *AandB* are symmetric matrices of the same order and

X = AB + BAandY = AB - BA, then $(XY)^T$ is equal to XY b. YX c. - YX d. none

of these

74. The number of solutions of the matrix equation

$$X^2 = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$$
is

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

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76. 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

$$B = \begin{bmatrix} 0 & 2k - 1 & \sqrt{k} \\ 1 - 2k & 0 & 2 \\ -\sqrt{k} & -2\sqrt{k} & 0 \end{bmatrix}$$
. If det (adj A) + det (adj B) = 10⁶, then [k] is

equal to _____ .

[Note : adj M denotes the adjoint of a square matrix M and [k] denotes the largest integer less than or equal to k.] 77. 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. The which of the

following matrices is (are) skew symmetric ?

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78. If B is an idempotent matrix, and A = I - B, then

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

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

80. If
$$A_1 = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$
, $A_2 = \begin{bmatrix} 0 & 0 & 0 & i \\ 0 & 0 & -i & 0 \\ -i & 0 & 0 & 0 \end{bmatrix}$, then $A_i A_k + A_k A_i$ is equal to
a. 2*I* if $i = k$
b. *O* if $i \neq k$
c. 2*I* if $i \neq k$
d. *O* always



81. If A is an invertible matrix, then (adj. A)⁻¹ is equal to

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82. If
$$A = (a_{ij})_{n \times n}$$
 and f is a function, we define

$$f(A) = \left(f(a_{ij})\right)_{n \times n} \operatorname{Let} A = \begin{pmatrix} \pi/2 - \theta & \theta \\ -\theta & \pi/2 - \theta \end{pmatrix}.$$
 Then

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83. If A, B, and C are three square matrices of the same order, then

 $AB = AC \Rightarrow B = C$. Then



84. If
$$\alpha, \beta, \gamma$$
 are three real numbers and

$$A = \begin{bmatrix} 1 & \cos(\alpha - \beta) & \cos(\alpha - \gamma) \\ \cos(\beta - \alpha) & 1 & \cos(\beta - \gamma) \\ \cos(\gamma - \alpha) & \cos(\gamma - \beta) & 1 \end{bmatrix}$$

then which of following is/are true ?

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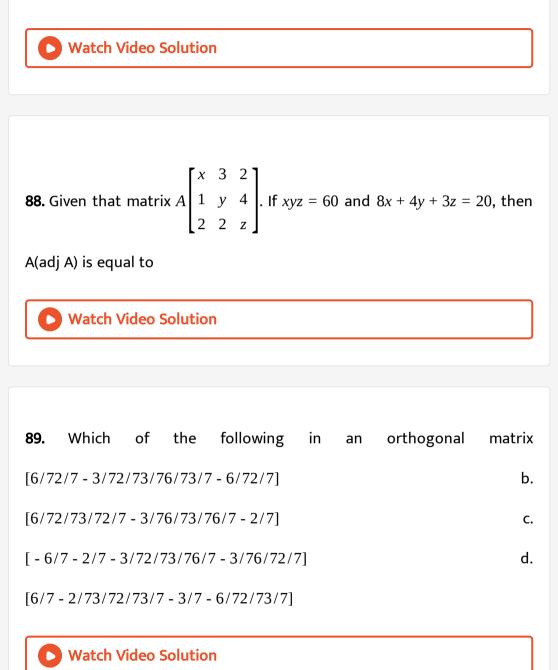
85. If A and B are square matrices of the same order and A is nonsingular,

then for a positive integer n, $(A^{-1}BA)^n$ is equal to

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

87. If A, B, A + I, A + B are idempotent matrices, then AB is equal to



90. If $k \in R_0$, then det $\{ \operatorname{adj}(kI_n) \}$ is equal to



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

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

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92. Let
$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 0 & 5 \\ 0 & 2 & 1 \end{bmatrix}$$
 and $B = \begin{bmatrix} 0 \\ -3 \\ 1 \end{bmatrix}$. Which of the following is true ?

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93.
$$A = \begin{bmatrix} 0 & 1 \\ 3 & 0 \end{bmatrix}$$
 and $A^8 + A^6 + A^4 + A^2 + IV = \begin{bmatrix} 0 \\ 11 \end{bmatrix}$ (where *I* is the 2 × 2

idensity matrix), then the product of all elements of matrix V is _____.

94. Show that every square matrix A can be uniquely expressed as

P + iQ, where PandQ are Hermitian matrices.

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95. If
$$A = [a_{ij}]_{n \times n}$$
 is such that $a_{ij} = \bar{a}_{ji} \forall I, j$ and $A^2 = O$, then prove that

matrix A is null matrix. Here, \bar{a}_{ii} denotes the conjugate a_{ii} .



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

97. If $A = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix}$, then prove that $A^2 + 3A + 2I = O$. Further, find

matrices B and C of order 2 with integer elements if $A = B^3 + C^3$.

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98. If D =diag.
$$[d_1, d_2, ..., d_n]$$
, then prove that $f(D) = diag$. $[f(d_1), f(d_2), ..., f(d_n)]$, where $f(x)$ is a polynominal with scalar coefficieents.

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99. Find the possible square roots of the two-rowed unit matrix I.



100. Let M be a 3×3 matrix satisfying

$$M\begin{bmatrix}0\\1\\0\end{bmatrix} = \begin{bmatrix}-1\\2\\3\end{bmatrix}, M\begin{bmatrix}1\\-1\\0\end{bmatrix} = \begin{bmatrix}1\\1\\-1\end{bmatrix}, \text{ and } M\begin{bmatrix}1\\1\\1\end{bmatrix} = \begin{bmatrix}0\\0\\12\end{bmatrix}$$

Then the sum of the diagonal entries of M is ____.

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

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102. 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

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

values of a and b are

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104. Let *AandB* be two nonsinular square matrices, $A^T andB^T$ are the transpose matrices of *AandB*, respectively, then which of the following are correct? B^TAB is symmetric matrix if *A* is symmetric B^TAB is symmetric matrix if *B* is symmetric B^TAB is symmetric matrix for every matrix $A B^TAB$ is skew-symmetric matrix if *A* is skew-symmetric

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

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

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107. If the square of the matrix $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is the unit matrix of order 2, then

 α , β and γ should satisfy the relation.

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108. If
$$A = [a_{ij}]_{4 \times 4}$$
, such that $a_{ij} = \begin{cases} 2, & \text{when } i = j \\ 0, & \text{when } i \neq j \end{cases}$, then

 $\left\{\frac{\det (\operatorname{adj} (\operatorname{adj} A))}{7}\right\}$ is (where $\{\cdot\}$ represents fractional part function)

109. Statement 1: Let A, B be two square matrices of the same order such that AB = BA, $A^m = O$, $ndB^n = O$ for some positive integers m, n, then there exists a positive integer r such that $(A + B)^r = O$ Statement 2: If $AB = BAthen(A + B)^r$ can be expanded as binomial expansion.

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110. If the matrices, A, B and (A + B) are non-singular, then prove that

$$\left[A(A+B)^{-1}B\right]^{-1} = B^{-1} + A^{-1}.$$

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111. The number of diagonal matrix, A or ordern which $A^3 = A$ is

112. A is a 2×2 matrix such that

$$A\begin{bmatrix}1\\-1\end{bmatrix} = \begin{bmatrix}-1\\2\end{bmatrix} \text{ and } A^2\begin{bmatrix}1\\-1\end{bmatrix} = \begin{bmatrix}1\\0\end{bmatrix}.$$

The sum of the elements of A is

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113. If
$$A = \begin{bmatrix} a & b \\ 0 & a \end{bmatrix}$$
 is nth root of I_2 , then choose the correct statements :

- (i) if n is odd, a=1, b=0
- (ii) if n is odd, a=-1, b=0
- (iii) if n is even, a=1, b=0
- (iv) if n is even, a=-1, b=0

114. Let $\omega \neq 1$ be cube root of unity and S be the set of all non-singular

matrices of the form
$$\begin{bmatrix} 1 & a & b \\ \omega & 1 & c \\ \omega^2 & \theta & 1 \end{bmatrix}$$
, where each of *a*, *b*, and *c* is either ω

or ω^2 . Then the number of distinct matrices in the set *S* is (a) 2 (b) 6 (c) 4

(d) 8

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115. The number of 3×3 matrices a whose entries are either 0 or 1 and for

which the system
$$A\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$
 has exactly two distinct solutions is

116. *A* is an involuntary matrix given by $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$, then the inverse of $\frac{A}{2}$ will be a. 2*A* b. $\frac{A^{-1}}{2}$ c. $\frac{A}{2}$ d. A^{2} Watch Video Solution

117. If A is a nonsingular matrix such that $AA^T = A^T A$ and $B = A^{-1}A^T$, then

matrix B is



118. Let MandN be two 3×3 non singular skew-symmetric matrices such

that MN = NM If P^T denote the transpose of P, then

$$M^{2}N^{2}(M^{T}N)^{-1}(MN^{-1})^{T}$$
 is equal to
a. M^{2}
b. $-N^{2}$
c. $-M^{2}$
d. MN

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119. Let ω be a complex cube root of unity with $\omega \neq 1$ and $P = \left[p_{ij}\right]$ be a

$$n \times n$$
 matrix withe $p_{ij} = \omega^{i+j}$ Then $p^2 \neq O$, when $n =$

a.57

b. 55

c. 58

d. 56

120. If
$$A = \begin{bmatrix} i & -i \\ -i & i \end{bmatrix}$$
 and $B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$, then A^8 equals

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

matrix a is

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

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123. If A is a square matrix such that $A^2 = A$, find the value of $7A - (I + A)^3$.

124. If A and B are square matrices of order n, then $A - \lambda I$ and $B - \lambda I$

commute for every scalar λ , only if



125. Matrix A such that $A^2 = 2A - I$, where I is the identity matrix, then for

 $n \ge 2, A^n$ is equal to

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126. Let
$$A = \begin{bmatrix} 0 & \alpha \\ 0 & 0 \end{bmatrix}$$
 and $(A + I)^{50}A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. Then the value of

a + *b* + *c* + *d* is



1. If e^A is defined as $e^A = I + A + \frac{A^2}{2!} + \frac{A^3}{3!} + ... = \frac{1}{2} \begin{bmatrix} f(x) & g(x) \\ g(x) & f(x) \end{bmatrix}$, where

 $A = \begin{bmatrix} x & x \\ x & x \end{bmatrix}, 0 < x < 1 \text{ and I is identity matrix, then find the functions f(x)}$

and g(x).

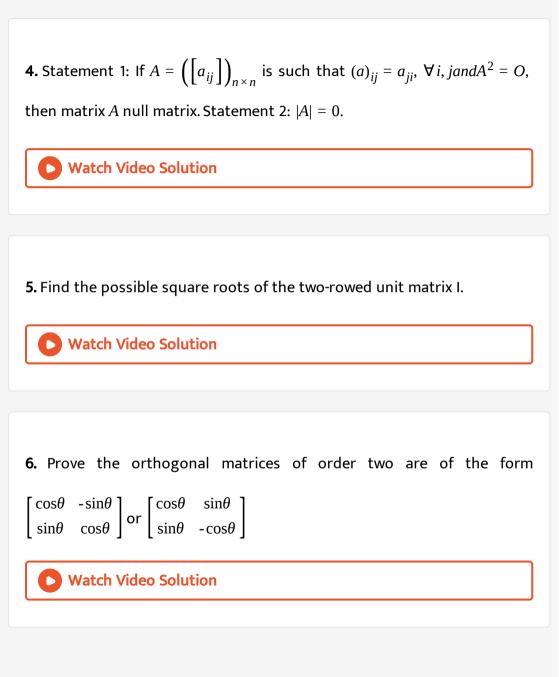
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2. Prove that matrix
$$\begin{bmatrix} \frac{b^2 - a^2}{a^2 + b^2} & \frac{-2ab}{a^2 + b^2} \\ \frac{-2ab}{a^2 + b^2} & \frac{a^2 - b^2}{a^2 + b^2} \end{bmatrix}$$
 is orthogonal.

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





7. Let
$$A = \begin{bmatrix} \tan \frac{\pi}{3} & \sec \frac{2\pi}{3} \\ \\ \cot \left(2013 \frac{\pi}{3} \right) & \cos(2012\pi) \end{bmatrix}$$
 and P be a 2 × 2 matrix such that

 $PP^{T} = I$, where I is an identity matrix of order 2. If $Q = PAP^{T}$ and $R = \left[r_{ij}\right]_{2 \times 2} = P^{T}Q^{8}P$, then find r_{11} .

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

9. If A and B are square matrices of order 3 such that det. (A) = -2 and det. (B) = 1, then det. $(A^{-1}adjB^{-1}.adj(2A^{-1}))$ is equal to



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



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

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

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12. What is the maximum number of different elements required to form

a symmetric matrix of order 12?

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

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

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

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

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

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

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

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18. If
$$A = \begin{bmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{bmatrix}$$
, and $A + A' = I$, then the value of α is

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



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

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

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

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

tr(A) - tr(B).

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

then find matrices B and C.



24. Prove that square matrix can be expressed as the sum of a symmetric

matrix and a skew-symmetric matrix.



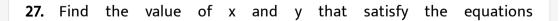
25. Matrix A ha s m rows and n+ 5 columns; matrix B has m rows and 11 - *n* columns. If both AB and BA exist, then (A) AB and BA are square matrix (B) AB and BA are of order 8×8 and 3×13 , respectively (C) AB = BA (D) None of these



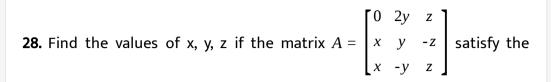
26. If
$$A = \begin{bmatrix} 2 & 3 & -1 \\ 1 & 4 & 2 \end{bmatrix}$$
 and $B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \\ 2 & 1 \end{bmatrix}$ then AB and BA are defined and

equal.

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$$\begin{bmatrix} 3 & -2 \\ 3 & 0 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} y & y \\ x & x \end{bmatrix} = \begin{bmatrix} 3 & 3 \\ 3y & 3y \\ 10 & 10 \end{bmatrix}$$



equation A'A = I.

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

 $A^n = [\cos n\theta \sin n\theta - \sin n\theta \cos n\theta], n \in N.$

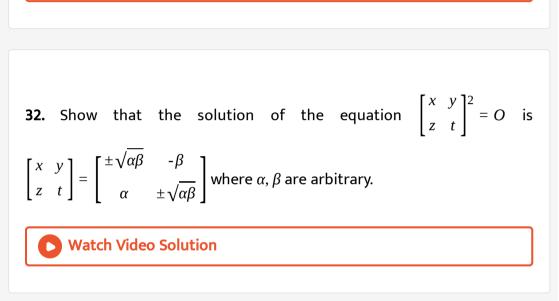
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30. If
$$A = \begin{pmatrix} p & q \\ 0 & 1 \end{pmatrix}$$
, then show that $A^8 = \begin{pmatrix} p^8 & q \begin{pmatrix} p^8 - 1 \\ p - 1 \end{pmatrix} \\ 0 & 1 \end{pmatrix}$

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

divisible by 13.

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



34. If A, B are square materices of same order and B is a skewsymmetric

matrix, show that $A^{T}BA$ is skew-symmetric.



35. If a and B are square matrices of same order such that AB + BA = O,

then prove that $A^3 - B^3 = (A + B)(A^2 - AB - B^2)$.

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

k - 40 should be

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37. Let A, B, C, D be (not necessarily square) real matrices such that $A^T = BCD$: $B^T = CDA$; $C^T = DAB$ and $D^T = ABC$. For the matrix

S = ABCD, consider the two statements. I. $S^3 = S$ II. $S^2 = S^4$ (A) II is true but not I (B) I is true but not II (C) both I and II are true (D) both I and II are false



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

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39. If A = [-110 - 2], then prove that $A^2 + 3A + 2I = O$ Hence, find *BandC*

matrices of order 2 with integer elements, if $A = B^3 + C^3$

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



41. If A is a nonsingular matrix satisfying AB - BA = A, then prove that det.

 $(B + I) = \det, (B - I).$

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

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43. Given a matrix A = [abcbcacab], wherea, b, c are real positive numbers

 $abc = 1 and A^T A = I$, then find the value of $a^3 + b^3 + c^3$.

44. If M is a 3×3 matrix, where det M = 1 and $MM^T = 1$, where I is an

identity matrix, prove theat det (M - I) = 0.



45. Consider point P(x, y) in first quadrant. Its reflection about x-axis is

$$Q(x_1, y_1)$$
. So, $x_1 = x$ and $y(1) = -y$.

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

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

 $\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$ Here, matrix $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ is the matrix of reflection about x-axis. Then find the

matrix of

(i) reflection about y-axis

(ii) reflection about the line y = x

(iii) reflection about origin

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

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

matrix 3) involutary 4) orthogonal matrix

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

48. The matrix A = [-5 - 8035012 -] is a. idempotent matrix b. involutory

matrix c. nilpotent matrix d. none of these



49. If
$$abc = p$$
 and $A = \begin{bmatrix} a & b & c \\ c & a & b \\ b & c & a \end{bmatrix}$, prove that A is orthogonal if and only if

a, b, c are the roots of the equation $x^3 \pm x^2 - p = 0$.

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50. Let A be an orthogonal matrix, and B is a matrix such that AB = BA,

then show that $AB^T = B^T A$.



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

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

matrix $S^T P^{10} S$.

53. If A is a square matrix such that
$$A(adjA) = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$
, then
$$= \frac{|adj(adjA)|}{2|adjA|}$$
 is equal to
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54. Let A be a square matrix of order 3 such that

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

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

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

then α is :

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

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

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

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

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57. Given the matrices a and B as $A = \begin{bmatrix} 1 & -1 \\ 4 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ 2 & -2 \end{bmatrix}$. The two

matrices X and Y are such that XA = B and AY = B, then find the matrix 3(X + Y)

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

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59. Let p be a non singular matrix, and $I + P + p^2 + ... + p^n = 0$, then find

 p^{-1} .

60. If A and B are square matrices of same order such that AB = O and

 $B \neq O$, then prove that |A| = 0.

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61. If A is a symmetric matrix, B is a skew-symmetric matrix, A + B is nonsingular and $C = (A + B)^{-1}(A - B)$, then prove that (i) $C^{T}(A + B)C = A + B$ (ii) $C^{T}(A - B)C = A - B$ (iii) $C^{T}AC = A$

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62. If the matrices, A, B and (A + B) are non-singular, then prove that

$$\left[A(A+B)^{-1}B\right]^{-1} = B^{-1} + A^{-1}.$$

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



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

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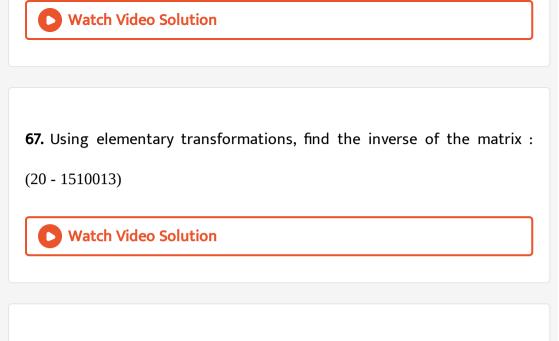
65. If A is a matrix of order n such that $A^{T}A = I$ and X is any matric such

that $X = (A + I)^{-1}(A - I)$, then show that X is skew symmetric matrix.



66. Show that two matrices

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



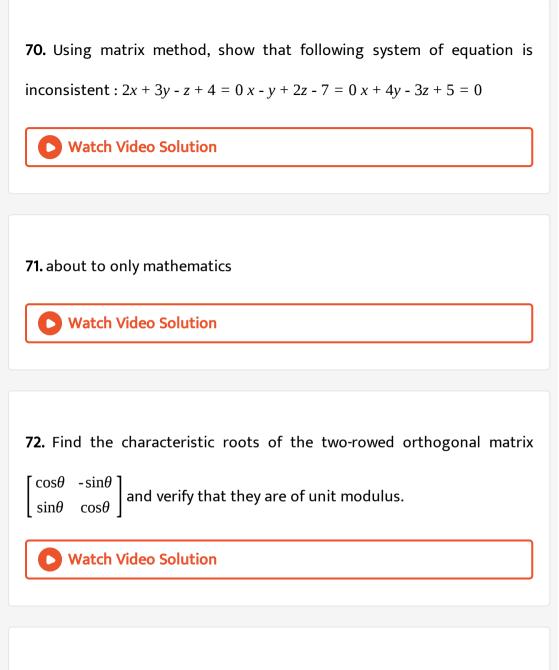
68. Let a be a 3×3 matric such that

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

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69. Using matrix method, solve the following system of equations:

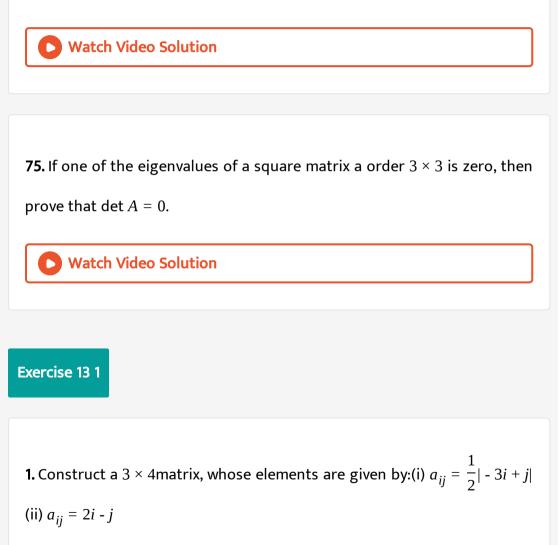
x + 2y + z = 7, x + 3z = 11, 2x - 3y = 1

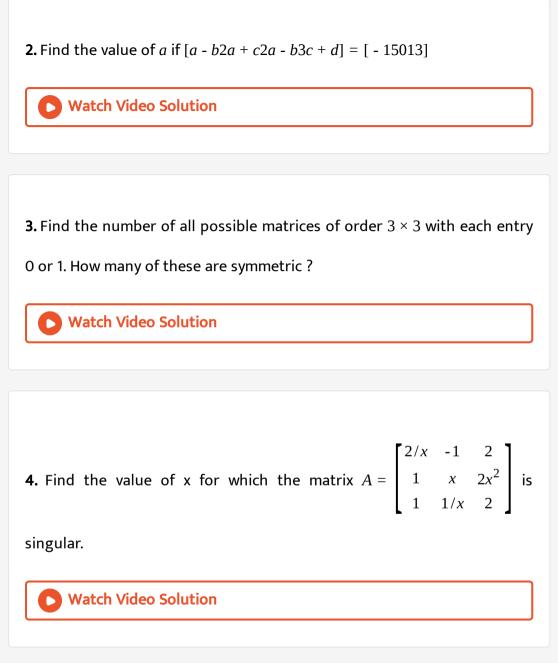


73. Show that if $\lambda_1, \lambda_2, \dots, lamnda_n$ are *n* eigenvalues of a square matrix a

of order n, then the eigenvalues of the matric A^2 are $\lambda_1^2, \lambda_2^2, ..., \lambda_n^2$.

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





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

det. A.

Exercise 13 2

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

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

3A + 5B + 2C is a null matrix.

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3. Solve the following equations for X and Y :

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

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

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5. If $A = \begin{bmatrix} 3 & -2 \\ 4 & -1 \end{bmatrix}$, then find all the possible values of λ such that the

matrix (A - λI) is singular.

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

is skew-symmetric matrix, then find matrices B and C.

Exercise 13 3

1. Consider the matrices

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

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

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

 $D. A^T A B B^T C$

Answer: B

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

that a is unit matrix.

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

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

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

integer.

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



7. For what values of
$$x$$
: $\begin{bmatrix} 1 & 2 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 0 \\ 2 & 0 & 1 \\ 1 & 0 & 2 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ x \end{bmatrix} = O?$

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

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

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

symmetric, then find AB.

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1. If A and B are matrices of the same order, then $AB^T - BA^T$ is a/an

(a) skew-symmetric matrix

- (b) null matrix
- (c) unit matrix
- (d) symmetric matrix

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2. If A and B are square matrices such that AB = BA then prove that

$$A^3 - B^3 = (A - B)(A^2 + AB + B^2).$$

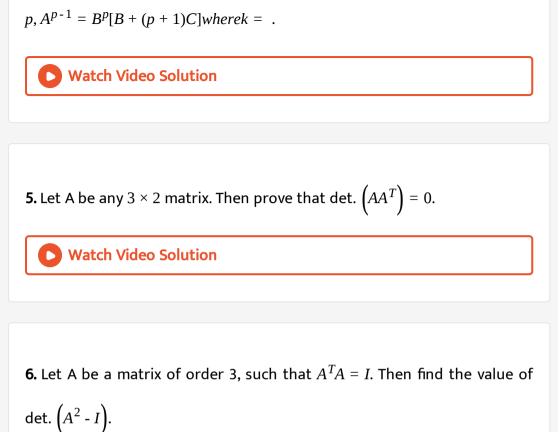
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3. If A is a square matrix such that $A^2 = I$, then

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



4. If B, C are square matrices of order nand if $A = B + C, BC = CB, C^2 = O$, then for any positive integer



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

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

coefficient.

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9. Point P(x, y) is rotated by an angle θ in anticlockwise direction. The new

position of point P is
$$Q(x_1, y_1)$$
. If $\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = A \begin{bmatrix} x \\ y \end{bmatrix}$, then find matrix A.

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10. How many different diagonal matrices of order n can be formed which

are involuntary?



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

A. 2ⁿ B. 2ⁿ - 1 C. 2ⁿ⁻¹

D. n

Answer: A

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

matrices.

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Exercise 13 5

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

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

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

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3. If
$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$
 show that $A^{-1} = \frac{1}{2} \left(A^2 = 3I \right)$

4. For the matrix A = [3175], find x and y so that $A^2 + xI = yA$



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



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

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

equation AX = B.

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8. If A is a 2 × 2 matrix such that
$$A^2 - 4A + 3I = 0$$
, then prove that
 $(A + 3I)^{-1} = \frac{7}{24}I - \frac{1}{24}A.$

9. For two unimobular complex numbers
$$z_1$$
 and z_2 , find

$$\begin{bmatrix} \bar{z}_1 & -z_2 \\ \bar{z}_2 & z_1 \end{bmatrix}^{-1} \begin{bmatrix} z_1 & z_2 \\ -\bar{z}_2 & \bar{z}_1 \end{bmatrix}^{-1}$$
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10. Prove that inverse of a skew-symmetric matrix (if it exists) is skew-

symmetric.

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

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

an identity matrix of same order as of A)

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

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

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

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

roots.

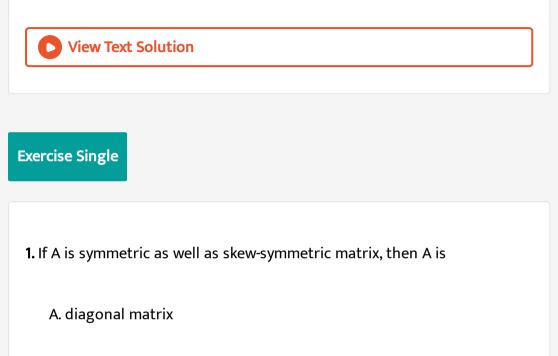
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16. Show that the characteristics roots of an idempotent matris are either

0 or 1

17. If α is a characteristic root of a nonsin-gular matrix, then prove that

 $|A|\alpha|$ is a characteristic root of adj A.



B. null matrix

C. triangular materix

D. none of these

Answer: B

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

A. 0

B. 1

C. 3

D. none of these

Answer: D

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3. If A_1, A_2, A_{2n-1} are skew-symmetric matrices of same order, then

 $B = \sum_{r=1}^{n} (2r - 1) \left(A^{2r - 1} \right)^{2r - 1}$ will be symmetric skew-symmetric neither

symmetric nor skew-symmetric data not adequate

A. symmetric

B. skew-symmetric

C. neither symmetric nor skew-symmetric

D. data not adequate

Answer: B

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

(i) $y = 0$,	(p) rational roots	
(ii) $y = -1$	(q) irrational roots	
	(r) integral roots	

 $A. \frac{(i)}{(p)} \quad (ii) \\ (p) \quad (r) \\ B. \frac{(i)}{(q)} \quad (p) \\ C. \frac{(i)}{(p)} \quad (q) \\ (q) \\$

D. $\frac{(i)}{(r)}$ (ii) (ii) (ii) (p)

Answer: C



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

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

Answer: D



A. 1

B. 0

C. 2^{*n*}

D. 3^{*n*}

Answer: D



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

A. - 1 B. O C. 2 D. 5

Answer: D

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

$$\begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix} \begin{bmatrix} \cos^2\phi & \cos\phi\sin\phi \\ \cos\phi\sin\phi & \sin^2\phi \end{bmatrix} = 0$$
A. $2n\pi$, $\in Z$
B. $n\frac{\pi}{2}, n \in Z$

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

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

Answer: C

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

A. i, ii, iii

B. ii, iii, iv

C. i, ii, iii, iv

D. i, iii, iv

Answer: D

10. If the square of the matrix $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is the unit matrix of order 2, then

 α , β and γ should satisfy the relation.

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

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

Answer: B

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

-64B

A. 4B

B. 128B

С. - 128 В

D.-64B

Answer: B

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

A. 0

B. 1

C. 2

D. - 3

Answer: B

13. For each real x, -1 < x < 1. Let A(x) be the matrix $(1 - x)^{-1} \begin{bmatrix} 1 & -x \\ -x & 1 \end{bmatrix}$

and
$$z = \frac{x + y}{1 + xy}$$
. Then
A. $A(z) = A(x)A(y)$
B. $A(z) = A(x) - A(y)$
C. $A(z) = A(x) + A(y)$
D. $A(z) = A(x)[A(y)]^{-1}$

Answer: A

14. If
$$A = \begin{bmatrix} 0 & -\tan\frac{\alpha}{2} \\ \tan\frac{\alpha}{2} & 0 \end{bmatrix}$$
 and I is the identity matrix of order 2, show that
 $I + A = (I - A) \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$

A. -*I* + *A*

В. І - А

C. -*I* - *A*

D. none of these

Answer: B

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15. The number of solutions of the matrix equation $X^2 = [1123]$ is a. more

than2 b. 2 c. 0 d. 1

A. more then 2

B. 2

C. 0

D. 1

Answer: A

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

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

A. a + d = 0

B. k = -|A|

C. k = |A|

D. none of these

Answer: C

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

$$c = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix},$$

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

A. 6

B. 9

C. 12

D. none of these

Answer: A

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

of *k*, is

A. 3

B. 6

C. 7

D. 14

Answer: C



19. If A and B are square matrices of order *n*, then prove that *AandB* will

commute iff A - $\lambda IandB$ - λI commute for every scalar λ

A.AB = BA

B.AB + BA = O

C.A = -B

D. none of these

Answer: A



20. Matrix A such that $A^2 = 2A - I$, where I is the identity matrix, the for

 $n \ge 2$. A^n is equal to $2^{n-1}A - (n-1)l$ b. $2^{n-1}A - I$ c. nA - (n-1)l d. nA - I

Answer: C

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

Answer: A

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

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

A. $I + 2^{n}Z$

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

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

D. none of these

Answer: B

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23. if *AandB* are squares matrices such that $A^{2006} = OandAB = A + B$, thendet(B) equals 0 b. 1 c. -1 d. none of these

B. 1

C. - 1

D. none of these

Answer: A

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24. If matrix A is given by
$$A = \begin{bmatrix} 6 & 11 \\ 2 & 4 \end{bmatrix}$$
 then determinant of $A^{2005} - 6A^{2004}$

is

A. 2²⁰⁰⁶

B. (- 11)2²⁰⁰⁵

C. - 2²⁰⁰⁵.7

D. (-9)2²⁰⁰⁴

Answer: B

25. If A is a non-diagonal involutory matrix, then

A.A - I = O

 $\mathsf{B}.A + I = O$

C. A - I is nonzero singular

D. none of these

Answer: C

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26. If A and B are two nonzero square matrices of the same order such

that the product AB = O, then

A. both A and B must be singular

B. exactly one of them must be singular

C. both of them are nonsingular

D. none of these

Answer: A

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

A. XY

B. *YX*

C. - *YX*

D. none of these

Answer: C

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

A. BA

В.-ВА

C. I

D. *O*

Answer: B

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29. If
$$A = \begin{bmatrix} 0 & x \\ y & 0 \end{bmatrix}$$
 and $A^3 + A = O$ then sum of possible values of xy is
A. 0
B. -1

C. 1

Answer: B



30. Which of the following is an orthogonal matrix ?

A.	6/7	2/7	-3/7
	2/7	3/7	6/7
	3/7	-6/7	2/7
B.	6/7	2/7	3/7
	2/7	-3/7	6/7
	3/7	6/7	-2/7
C.	-6/7	-2/7	-3/7
	2/7	3/7	6/7
	-3/7	6/7	2/7
D.	6/7	-2/7	3/7
	2/7	2/7	-3/7
	-6/7	2/7	3/7

Answer: A



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

A. a symmetric matrix

B. a skew-symmetric matrix

C. an orthogonal matrix

D. an invertible matrix

Answer: B

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

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

A. idempotent

B. orthogonal

C. involuntary

D. none of these

Answer: A

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

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

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

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

D. none of these

Answer: B



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

of the following is not true ?

A. |A| = |B|

B. |A| = -|B|

C. |adj A| = |adj B|

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

Answer: A

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

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

Answer: A

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36. If
$$A = \begin{bmatrix} a+ib & c+id \\ -c+id & a-ib \end{bmatrix}$$
 and $a^2 + b^2 + c^2 + d^2 = 1$, then A^{-1} is equal to
A. $\begin{bmatrix} a-ib & -c-id \\ c-id & a+ib \end{bmatrix}$
B. $\begin{bmatrix} a+ib & -c+id \\ -c+id & a-ib \end{bmatrix}$
C. $\begin{bmatrix} a-ib & -c-id \\ -c-id & a+ib \end{bmatrix}$

D. none of these

Answer: A

37. Id $[1/250x1/25] = [50 - a5]^{-2}$, then the value of x is a/125 b. 2a/125 c.

2a/25 d. none of these

A. *a*/125

B. 2*a*/125

C. 2*a*/25

D. none of these

Answer: B

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

$$\mathbf{B} \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}$$
$$\mathbf{C} \begin{bmatrix} -1 & -1 \\ -1 & -1 \end{bmatrix}$$

D. none of these

Answer: C

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

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

where A, B, C, D, E and F are real numbers. The absolute value of the

difference of these two solutions, is

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

B. $\frac{19}{3}$
C. $\frac{1}{3}$

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

Answer: B



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

A. $A^2 + B^2$

B. *O*

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

D.A + B

Answer: A

41.
$$A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$$
, show that $A^T A^{-1} = \begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$.
A. $\begin{bmatrix} -\cos 2x & \sin 2x \\ -\sin 2x & \cos 2x \end{bmatrix}$
B. $\begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$
C. $\begin{bmatrix} \cos 2x & \cos 2x \\ \cos 2x & \sin 2x \end{bmatrix}$
D. none of these

Answer: B

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42. If A is order 3 square matrix such that |A| = 2, then |adj (adj (adj A))| is

A. 512

B. 256

C. 64

D. none of these

Answer: B

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43. If
$$A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & a & 1 \end{bmatrix}$$
 and $A^{-10} = \begin{bmatrix} 1/2 & 1/2 & 1/2 \\ -4 & 3 & c \\ 5/2 & -3/2 & 1/2 \end{bmatrix}$, then the values of a

and c are equal to

A. 1, 1

B. 1, -1

C. 1, 2

D.-1, 1

Answer: B

44. If nth-order square matrix A is a orthogonal, then |adj (adj A)| is

A. always -1 if n is even

B. always 1 if n is odd

C. always 1

D. none of these

Answer: B

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45. Let *a* and *b* be two real numbers such that a > 1, b > 1. If $A = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$,

then $\lim n \to \infty A^{-n}$ is

a. unit matrix

b. null matrix

c. 2*l*

d. none of these

A. unit matrix

B. null matrix

C. 2I

D. none of these

Answer: B

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

A. 1/7

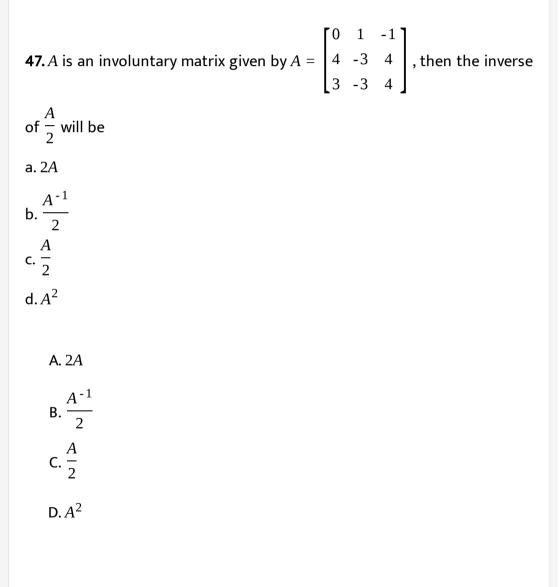
B.2/7

C. 3/7

D. none of these

Answer: A





Answer: A

48. If A is a nonsingular matrix such that $AA^T = A^T A$ and $B = A^{-1}A^T$, then

matrix B is

A. involuntary

B. orthogonal

C. idempotent

D. none of these

Answer: B

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49. If *P* is an orthogonal matrix and $Q = PAP^{T}andx = P^{T}A$ b. *I* c. A^{1000} d.

none of these

В.*І*

 $C.A^{1000}$

D. none of these

Answer: B

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50. If AandB are two non-singular matrices of the same order such that

 $B^r = I$, for some positive integer r > 1, then $A^{-1}B^{r-1}A = A^{-1}B^{-1}A = I$ b. 2I

c. *O* d. -I

A. I

B. 2*I*

C. *O*

D. -*I*

Answer: C



51. If adjB = A, |P| = |Q| = 1, then $adj(Q^{-1}BP^{-1})$ is PQ b. QAP c. PAQ d. PA¹Q

A. PQ

B. QAP

C. PAQ

D. $PA^{-1}Q$

Answer: C

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

OI b. 2*I* c. 6*I* d. *I*

A. 0

В.*І*

C. 2*I*

D. 6I

Answer: B

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

A. $I + A + A^2$

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

C. $I - A - A^2$

D. none of these

Answer: B

54. if
$$\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$
, then $A = ?$
A. $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$
B. $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$
C. $\begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$
D. $-\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

Answer: A

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55. If $A^2 - A + I = 0$, then the inverse of A is: (A) A + I (B) A (C) A - I (D) I - A

A. A⁻²

B.A + I

C. I - A

D. A - I

Answer: C

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56. If
$$F(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$$
 and $G(y) = \begin{bmatrix} \cos y & 0 & \sin y \\ 0 & 1 & 0 \\ -\sin y & 0 & \cos y \end{bmatrix}$, then

 $[F(x)G(y)]^{-1}$ is equal to

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

Answer: B

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

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

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

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

 $\mathsf{D.}\,n\Big(\!A^{-1}\!B\!A\Big)$

Answer: C

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

A. *k*^{*n*-1}

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

C. *k*^{*n*}

D. k

Answer: B

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59. Given that matrix
$$A\begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}$$
. If $xyz = 60$ and $8x + 4y + 3z = 20$, then

A(adj A) is equal to

A.
$$\begin{bmatrix}
 64 & 0 & 0 \\
 0 & 64 & 0 \\
 0 & 0 & 64
 \end{bmatrix}$$
B. $\begin{bmatrix}
 88 & 0 & 0 \\
 0 & 88 & 0 \\
 0 & 0 & 88
 \end{bmatrix}$ C. $\begin{bmatrix}
 68 & 0 & 0 \\
 0 & 68 & 0 \\
 0 & 0 & 68
 \end{bmatrix}$

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

Answer: C

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60. Let
$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 0 & 5 \\ 0 & 2 & 1 \end{bmatrix}$$
 and $B = \begin{bmatrix} 0 \\ -3 \\ 1 \end{bmatrix}$. Which of the following is true ?

A. AX = B has a unique solution

B. AX = B has exactly three solutions

C. AX = B has infinitelt many solutions

D.AX = B is inconsistent

Answer: A



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

A.*A*

B. *B*

C. |A|A

D. |B|B

Answer: A

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

A. 1/9

B. 1/3

C. 3

Answer: D

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

A. 4

B. $4\sqrt{2}$

C. 16

D. $16\sqrt{2}$

Answer: D

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

A. 2 B. 3 C. 4

D. 5

Answer: A

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

then Q^{-1} equals

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

 $B.\begin{bmatrix} 5 & 2 & 9 \\ -1 & 1 & 1 \\ 0 & 1 & 7 \end{bmatrix}$ $C.\begin{bmatrix} 2 & -1 & 0 \\ 10 & 6 & 3 \\ 8 & 6 & 4 \end{bmatrix}$

D. none of these

Answer: C

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Exercise Multiple

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

A. -*A*

 $B.A^{-1}$

C. adj A

D. ωA , where ω is cube root of unity

Answer: B::C



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

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

B. A is a symmetric matrix

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

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

minima

Answer: B::D

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

Answer: A::D

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

A. A is idempotent

B. B is idempotent

 $C.A^T$ is idempotent

D. none of these

Answer: A::B::C



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

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

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

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

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

Answer: A::B::C



6. Let A and B be two nonsingular square matrices, A^T and B^T are the tranpose matrices of A and B, respectively, then which of the following are

coorect ?

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

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

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

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

Answer: A::D

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7. If B is an idempotent matrix, and A = I - B, then

A.
$$A^2 = A$$

 $\mathsf{B}.A^2 = I$

C.AB = O

 $\mathsf{D}.\,B\!A=O$

Answer: A::C::D



$$\mathbf{8. If } A_1 = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}, A_2 = \begin{bmatrix} 0 & 0 & 0 & i \\ 0 & i & 0 & 0 \\ -i & 0 & 0 & 0 \end{bmatrix}, then A_i A_k + A_k A_i \text{ is equal to}$$

$$a. 2I \text{ if } i = k$$

$$b. O \text{ if } i \neq k$$

$$c. 2l \text{ if } i \neq k$$

$$d. O \text{ always}$$

$$A. 2I \text{ if } i = k$$

$$B. O \text{ if } i \neq k$$

$$C. 2I \text{ if } i \neq k$$

$$D. O \text{ always}$$

Answer: A::B



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

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

B. the system of equations

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

infinite number of solutions

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

D. none of these

Answer: A::B::C

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10. If

real

$$A = \begin{bmatrix} 1 & \cos(\alpha - \beta) & \cos(\alpha - \gamma) \\ \cos(\beta - \alpha) & 1 & \cos(\beta - \gamma) \\ \cos(\gamma - \alpha) & \cos(\gamma - \beta) & 1 \end{bmatrix}$$

then which of following is/are true ?

A. A is singular

B. A is symmetric

C. A is orthogonal

D. A is not invertible

Answer: A::B::D

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

A. D_1D_2 is a diagonal matrix

B. $D_1 D_2 = D_2 D_1$

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

D. none of these

Answer:

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

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

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

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

D. Number of matrices A such that A is either symmetric (or) skew

symmetric and det (A) is divisible by 2, is 5.

Answer:

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13. If
$$S = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$
 and $A = \begin{bmatrix} b+c & c-a & b-a \\ c-b & c+b & a-b \\ b-c & a-c & a+b \end{bmatrix}$

 $(a, b, c \neq 0)$, then SAS⁻¹ is

A. symmetric matrix

B. diagonal matrix

C. invertible matrix

D. singular matrix

Answer:

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

A. A is invertible iff B is invertib,e

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

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

D. A and B are both singular matrices

Answer:

15. Let
$$A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$$
. Then
A. $A^2 - 4A - 5I_3 = O$
B. $A^{-1} = \frac{1}{5}(A - 4I_3)$

 $C. A^3$ is not invertible

 $D.A^2$ is invertible

Answer:

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$$\mathbf{16. If } A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}, \text{ then}$$
$$A. A^{3} - A^{2} = A - I$$
$$B. \det (A^{100} - I) = 0$$
$$C. A^{200} = \begin{bmatrix} 1 & 0 & 0 \\ 100 & 1 & 0 \\ 100 & 0 & 1 \end{bmatrix}$$
$$D. A^{100} = \begin{bmatrix} 1 & 1 & 0 \\ 50 & 1 & 0 \\ 50 & 0 & 1 \end{bmatrix}$$

Answer:

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

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

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

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

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

Answer:

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

B. sinA = cosA

C. sinA is orthogonal

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

Answer:

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

is/are true ?

A. A is nonsingular

B. A is symmetric

C. A cannot be skew-symmetric

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

Answer:

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

A. adj(adjA) = A

B. |adj (adj A)|=1

C. |adj A|=1

D. none of these

Answer: B

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

A. $a = \cos 2\theta$

B. *a* = 1

 $\mathsf{C.} b = \sin 2\theta$

D.b = -1

Answer:



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

A.
$$|A| = -1$$

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

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

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

Answer:

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

A d. (detA)A

A. adj. $\left(A^{-1}\right)$ B. $\frac{A}{\det A}$ C. A

D. (det. A) A

Answer:

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

is equal to

A. adj (B) adj (A)

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

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

D. |A||B|(AB)⁻¹

Answer:

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 $\ensuremath{\textbf{25.}}$ If A, B, and C are three square matrices of the same order, then

 $AB = AC \Rightarrow B = C$. Then

A. $|A| \neq 0$

B. A is invertible

C. A may be orthogonal

D. A is symmetric

Answer:



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

A. *A*⁻¹*B*

B. AB⁻¹

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

D. none of these

Answer:

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

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

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

Answer:

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

A. I - A is non-singular

B. I - B is non-singular

- C. I A is singular
- D. I B is singular

Answer:

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29. Let A and B be square matrices of the same order such that $A^2 = I$ and

 $B^2 = I$, then which of the following is CORRECT ?

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

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

C. If AB = BA, then there exists matrix D = AB - BA such that $D^n = O$

for some $n \in N$.

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

Answer:

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

A. A is an identity matrix

B. B is symmetric matrix

C. A is a skew-symmetric matrix

D. B is skew symmetic matrix

Answer: A

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

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

A. - 2	
B 1	
C. 0	

D. 1

Answer:

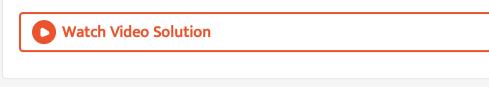
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32. Let A be a square matrix of order 3 satisfies the relation $A^3 - 6A^2 + 7A - 8I = O$ and B = A - 2I. Also, det. A = 8, then

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

B. adj. $\left(\left(\frac{B}{2}\right)^{-1}\right) = \frac{B}{10}$
C. det. $\left(\operatorname{adj.} \left(I - 2A^{-1}\right)\right) = \frac{75}{32}$
D. adj. $\left(\left(\frac{B}{2}\right)^{-1}\right) = \frac{2B}{5}$

Answer:



33. Which of the following matericeshave eigen values as 1 and -1?

$$A. \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$
$$B. \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$$
$$C. \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$
$$D. \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Answer:

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Exercise Comprehension

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

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

A. I

B. *O*

C. -*I*

D. none of these

Answer: B

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2. Let a be a matrix of order 2×2 such that $A^2 = O$.

tr (A) is equal to

A. 1

B. 0

C. - 1

D. none of these

Answer: B



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

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

A. 100 A

B. 100(*I* + *A*)

C. 100*I* + *A*

D. *I* + 100*A*

Answer: D

4. If A and B are two square matrices of order 3×3 which satify AB = Aand BA = B, then

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

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

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

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

D. Cannot say anything.

Answer: C

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

A. 7(A + B)

B. 7. *I*_{3×3}

C. 64(A + B)

D. 128I

Answer: C

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6. If A and B are two square matrices of order 3×3 which satify AB = A

and BA = B, then

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

A. I + 60I

B. I + 16A

C. I + 31A

D. none of these

Answer: C

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

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

A. skew-symmetric

B. null matrix

C. diagonal matrix

D. none of these

Answer: D

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8. Let $A = \begin{bmatrix} a_{ij} \end{bmatrix}$ be 3 × 3 matrix and $B = \begin{bmatrix} b_{ij} \end{bmatrix}$ be 3 × 3 matrix such that b_{ij} is the sum of the elements of i^{th} row of A except a_{ij} . If det, (A) = 19, then the value of det. (B) is _____.

A. |A|

B. |*A*|/2

C. 2|*A*|

D. none of these

Answer: C

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9. Let
$$A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$
 satisfies $A^n = A^{n-1} + A^2 - I$ for $n \ge 3$. And trace of a

square matrix X is equal to the sum of elements in its proncipal diagonal. Further consider a matrix $U_{3\times3}$ with its column as U_1 , U_2 , U_3 such that

$$A^{50} \mathbf{U}_{1} = \begin{bmatrix} 1\\25\\25 \end{bmatrix}, A^{50} \mathbf{U}_{2} = \begin{bmatrix} 0\\1\\0 \end{bmatrix}, A^{50} \mathbf{U}_{3} = \begin{bmatrix} 0\\0\\1 \end{bmatrix}$$

Then answer the following question :

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

A. 0

B. 1

C. - 1

D. 25

Answer: B

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10. Let
$$A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$
 satisfies $A^n = A^{n-1} + A^2 - I$ for $n \ge 3$. And trace of a

square matrix X is equal to the sum of elements in its proncipal diagonal. Further consider a matrix $U_{3\times3}$ with its column as U_1 , U_2 , U_3 such that

$$A^{50} \mathsf{U}_{1} = \begin{bmatrix} 1\\ 25\\ 25 \end{bmatrix}, A^{50} \mathsf{U}_{2} = \begin{bmatrix} 0\\ 1\\ 0 \end{bmatrix}, A^{50} \mathsf{U}_{3} = \begin{bmatrix} 0\\ 0\\ 1 \end{bmatrix}$$

Then answer the following question :

Trace of A^{50} equals

A. 0	
B. 1	
C. 2	
D. 3	

Answer: D

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11. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ satisfies $A^n = A^{n-1} + A^2 - I$ for $n \ge 3$. And trace of a

square matrix X is equal to the sum of elements in its proncipal diagonal. Further consider a matrix $U_3 \times 3$ with its column as U_1 , U_2 , U_3 such that

$$A^{50} \cup_{1} = \begin{bmatrix} 1 \\ 25 \\ 25 \end{bmatrix}, A^{50} \cup_{2} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, A^{50} \cup_{3} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Then answer the following question :

Trace of A^{50} equals

A. 0

B. 1

C. 2

D. - 1

Answer: B

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

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

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

A. - 2

B. - 1

C. 2

D. 3

Answer: D

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

in order, then

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

A. - 27

B. - 9

C. - 3

D. 9

Answer: A

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

, and A(adj. A + adj. B) = B.

The value of det (A + B) is

A. - 2

B. - 1

C. 0

Answer: D



15. A and B are square matrices such that det. (A) = 1, $BB^T = I$, det (B) > 0 , and A(adj. A + adj. B)=B. $AB^{-1} =$ A. $B^{-1}A$ B. AB^{-1} C. A^TB^{-1}

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

Answer: A

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

For example, to find right inverse of matrix

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

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

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

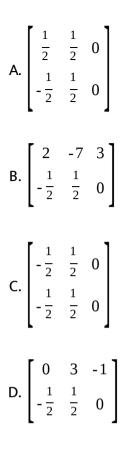
$$\Rightarrow \quad x - u = 1 \qquad y - v = 0 \qquad z - w = 0$$

$$x + u = 0 \qquad y + v = 1 \qquad z + w = 0$$

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

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

Which of the following matrices is NOT left inverse of matrix
$$\begin{bmatrix} 1 & -1 \\ 1 & 1 \\ 2 & 3 \end{bmatrix}$$
?



Answer: C



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

For example, to find right inverse of matrix

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

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

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

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

$$x + u = 0 \qquad y + v = 1 \qquad z + w = 0$$

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

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

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

A. 0

B. 1

C. 2

D. infinite

Answer: D



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

For example, to find right inverse of matrix

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

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

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

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

$$x + u = 0 \qquad y + v = 1 \qquad z + w = 0$$

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

As this system of equations is inconsistent, we say there is no right

inverse for matrix A.

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

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

Answer: C

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Exercise Matrix

1. Match the following lists :

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

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2. Match the following lists :

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

3. Match the following lists :

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

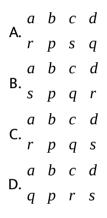
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4. Consider a matrix $A = [a_{ij}]$ of order 3×3 such that $a_{ij} = (k)^{i+j}$ where $k \in I$.

Match List I with List II and select the correct answer using the codes

given below the lists.

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



Answer: C

5. Match the following lists :

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



Answer: C

1. $A = [0130]andA^8 + A^6 + A^2 + IV = [011](where I is the 2 \times 2 identity)$

matrix), then the product of all elements of matrix V is _____.

O Watch Video Solution

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

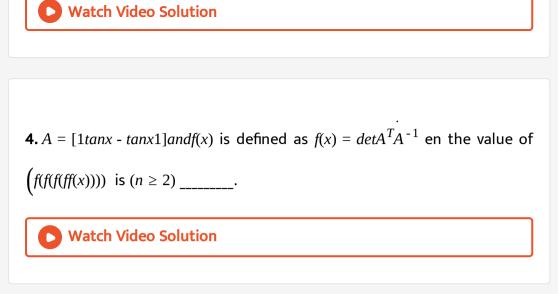
the value of 1/f(a) is _____.

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3. Let x be the solution set of equation $A^{x} = I$, where $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$ and

I is the corresponding unit matrix and $x \subseteq N$, then the minimum value of

$$\sum \left(\cos^x \theta + \sin^x \theta\right), \theta \in R$$



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

0). Then the value of k is ______ .

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

$$A = \left[3x^{2}16x\right], B = [abc], and C = \left[(x+2)^{2}5x^{2}2x5x^{2}2x(x+2)^{2}2x(x+2)^{2}5x^{2}\right]$$

be three given matrices, where $a, b, candx \in R$ Given that $f(x) = ax^2 + bx + c$, then the value of f(I) is _____.

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

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

Let

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

then the value of λ is

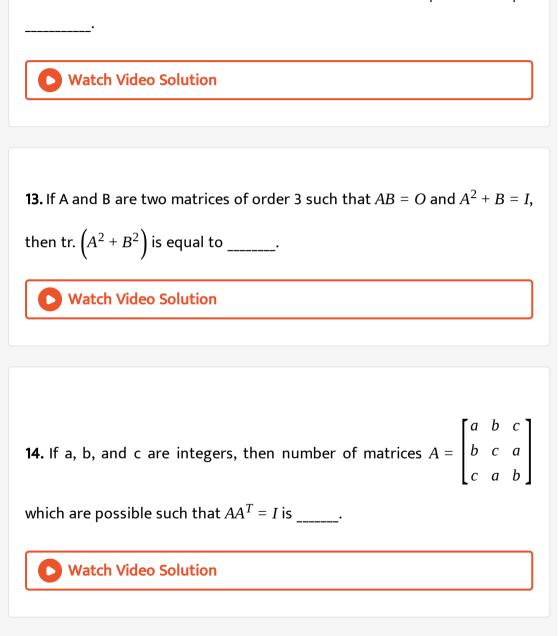


10. Let *S* be the set which contains all possible vaues fo *I*, *m*, *n*, *p*, *q*, *r* for which $A = [I^2 - 3p00m^2 - 8qr0n^2 - 15]$ be non-singular idempotent matrix. Then the sum of all the elements of the set *S* is _____.

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11. If A is a diagonal matrix of order 3×3 is commutative with every square matrix of order 3×3 under multiplication and trace (A)=12, then

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



15. Let $A = \begin{bmatrix} a_{ij} \end{bmatrix}$ be 3 × 3 matrix and $B = \begin{bmatrix} b_{ij} \end{bmatrix}$ be 3 × 3 matrix such that b_{ij} is the sum of the elements of i^{th} row of A except a_{ij} . If det, (A) = 19, then the value of det. (B) is _____.

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16. A square matrix M of order 3 satisfies $M^2 = I - M$, where I is an identity

matrix of order 3. If $M^n = 5I - 8M$, then *n* is equal to _____.

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

18. If A is a square matrix of order 2×2 such that |A| = 27, then sum of

the infinite series
$$|A| + \left|\frac{1}{2}A\right| + \left|\frac{1}{4}A\right| + \left|\frac{1}{8}A\right| + \dots$$
 is equal to _____

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

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20. Let A and B are two square matrices of order 3 such that det. (A) = 3

and det. (B) = 2, then the value of det. $\left(\left(\text{adj. } \left(B^{-1}A^{-1} \right) \right)^{-1} \right)$ is equal to

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

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

then the value of x is _____ .

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

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

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Jee Main Previous Year

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

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

explanation for statement 1.

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

explanation for statement 1.

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

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

C. 5

D. 6

Answer: A

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3. Let A be a 2×2 matrix with non-zero entries and let A²=I, where i is a

 2×2 identity matrix, Tr(A) i= sum of diagonal elements of A and |A| =

determinant of matrix A. Statement 1:Tr(A)=0 Statement 2:|A|=1

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

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

explanation for statement 1.

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

explanation for statement 1.

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

Answer: D

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

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

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

commutative.

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

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

explanation for statement 1.

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

explanation for statement 1.

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

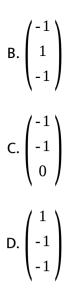
Answer: C



5. Let
$$A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$$
. If u_1 and u_2 are column matrices such that

$$Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$
 and $Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$, then $u_1 + u_2$ is equal to :

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



Answer: D



6. Let P and Q be 3×3 matrices with $P \neq Q$. If $P^3 = Q^3 and P^2 Q = Q^2 P$,

then determinant of $(P^2 + Q^2)$ is equal to (1) 2 (2) 1 (3) 0 (4) 1

A. - 2

B. 1

C. 0

D. - 1

Answer: C



7. If
$$P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$$
 is the adjoint of a 3 x 3 matrix A and $|A| = 4$, then α is
equal to
A. 4
B. 11
C. 5
D. 0
Answer: B

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

A. I + B

В. І

C. *B*⁻¹

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

Answer: B

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

 $Iis3 \times 3$ identity matrix, then the ordered pair (a,b) is equal to

A. (2, -1)

B. (-2, 1)

C. (2, 1)

D. (-2, -1)

Answer: D

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10. If
$$A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$$
 and $AadjA = \forall^T$, then $5a + b$ is equal to:
A. 5
B. 4
C. 13
D. -1

Answer: A

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11. if
$$A = \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$$
 then $adj(3A^2 + 12A) = ?$
A. $\begin{bmatrix} 72 & -63 \\ -84 & 51 \end{bmatrix}$
B. $\begin{bmatrix} 72 & -84 \\ -63 & 51 \end{bmatrix}$
C. $\begin{bmatrix} 51 & 63 \\ 84 & 72 \end{bmatrix}$
D. $\begin{bmatrix} 51 & 84 \\ 63 & 72 \end{bmatrix}$

Answer: C

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Jee Advanced Previous Year

1. The number of 3×3 matrices A whose entries are either 0 or 1 and for which the system A[xyz] = [100] has exactly two distinct solution is a. 0 b. $2^9 - 1$ c. 168 d. 2

A. 0

B. 2⁹ - 1

C. 168

D. 2

Answer: A

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2. Let $\omega \neq 1$ be cube root of unity and S be the set of all non-singular

matrices of the form
$$\begin{bmatrix} 1 & a & b \\ \omega & 1 & c \\ \omega^2 & \omega & 1 \end{bmatrix}$$
, where each of a, b and c is either

 ω or ω^2 Then the number of distinct matrices in the set S is

a. 2

b.6

c. 4

d. 8

A. 2	
B. 6	
C. 4	
D. 8	

Answer: A

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3. Let $P = \begin{bmatrix} a_{ij} \end{bmatrix}$ be a 3 × 3 matrix and let $Q = \begin{bmatrix} b_{ij} \end{bmatrix}$, where $b_{ij} = 2^{i+j}a_{ij}$ for $1 \le i, j \le 3$. If the determinant of P is 2, then the determinant of the matrix Q is

A. 2¹⁰

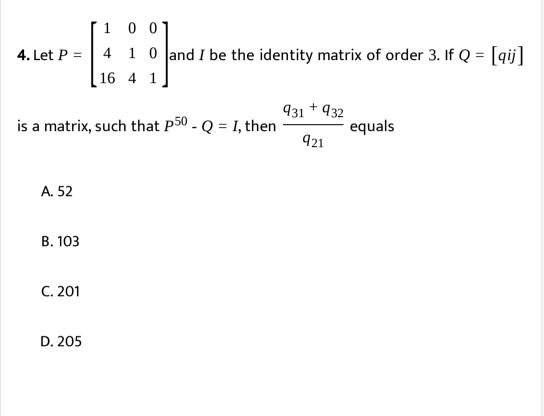
B. 2¹¹

C. 2¹²

D. 2¹³

Answer: D





Answer: B

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

A. 198

B. 126

C. 135

D. 162

Answer: A

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6. Let *MandN* be two 3×3 non singular skew-symmetric matrices such that MN = NM If P^T denote 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*

A. M^2

B. - N^2

C. -*M*²

 $\mathsf{D}.\,M\!N$

Answer: C

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7. Let ω be a complex cube root of unity with $\omega \neq 1$ and $P = \left[p_{ij}\right]$ be a $n \times n$

matrix withe
$$p_{ij}$$
 = ω^{i+j} Then $p^2
e O$, when n =

a.57

b. 55

c. 58

d. 56

A. 57

B. 55

C. 58

D. 56

Answer: B::C::D



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

A. *N^TMN* is symmetric or skew-symmetric, according as M is symmetric or skew-symmetric

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

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

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

Answer: C::D

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

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

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

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

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

of an integer

Answer: C::D



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

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

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

zero matrix

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

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

Answer: A::B

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

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

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

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

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

Answer: C::D

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12. Let $p = \begin{bmatrix} 3 & -1 & -2 \\ 2 & 0 & \alpha \\ 3 & -5 & 0 \end{bmatrix}$, where $\alpha \in \mathbb{R}$. Suppose $Q = \begin{bmatrix} q_{ij} \end{bmatrix}$ is a matrix

such that PQ = kl, where $k \in \mathbb{R}, k \neq 0$ and l is the identity matrix of

order 3. If
$$q_{23} = -\frac{k}{8}$$
 and $\det(Q) = \frac{k^2}{2}$, then

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

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

C. det (P adj (Q)) = 2^9

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

Answer: B::C

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

real entries ?

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

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

Answer: A::C



14. Let S be the set of all column matrices
$$\begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$$
 such that $b_1, b_2, b_2 \in R$

and the system of equations (in real variables)

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

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

 $x - 2y + 2z = b_3$

has at least one solution. The, which of the following system (s) (in real

variables) has (have) at least one solution for each
$$\begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} \in S$$
?

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

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

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

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

Answer: A::D

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15. Let A be the set of all 3×3 symmetric matrices all of whose entries are either 0 or 1. Five of these entries are 1 and four of them are 0. The number of matrices in A is

Β.	6
----	---

C. 9

D. 3

Answer: A

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16. Let A be the set of all 3×3 symmetric matrices all of whose either 0 or

1. Five of these entries are 1 and four of them are 0.

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

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

has a unique solution is

A. less than 4

B. at least 4 but less than 7

C. at least 7 but less than 10

D. at leat 10

Answer: B



17. Let A be the set of all 3×3 symmetric matrices all of whose either 0 or

1. Five of these entries are 1 and four of them are 0.

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

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

is inconsistent is

A. 0

B. more than 2

C. 2

D. 1

Answer: B



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

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

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

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

The number of A in T_p such that A is either symmetric or skew-symmetric or both, and det (A) divisible by p, is

A. $(p - 1)(p^2 - p + 1)$ B. $p^3 - (p - 1)^2$ C. $(p - 1)^2$ D. $(p - 1)(p^2 - 2)$

Answer: C

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20. Let p be an odd prime number and T_p , be the following set of 2×2

matrices
$$T_p = \left\{ A = \begin{bmatrix} a & b \\ c & a \end{bmatrix} : a, b, c \in \{0, 1, 2, \dots, p-1\} \right\}$$
 The number of

A in T_p , such that A is either symmetric or skew-symmetric or both, and det (A) divisible by p is

A. $2p^2$ B. $p^3 - 5p$ C. $p^3 - 3p$ D. $p^3 - p^2$

Answer: D

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21. Let a,b, and c be three real numbers satisfying $[a, b, c] \begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix} = [0, 0, 0] \text{ If the point } P(a, b, c) \text{ with reference to (E),}$

lies on the plane 2x + y + z = 1, the the value of 7a + b + c is (A) 0 (B) 12 (C) 7 (D) 6 B. 12

C. 7

D. 6

Answer: D

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22. Let a,b, and c be three real numbers satisfying

$$\begin{bmatrix} a, b, c \end{bmatrix} \begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix} = \begin{bmatrix} 0, 0, 0 \end{bmatrix}$$
 Let ω be a solution of $x^3 - 1 = 0$ with
 $Im(\omega) > 0.$ If $a = 2$ with b nd c satisfying (E) then the value of
 $\frac{3}{\omega^a} + \frac{1}{\omega^b} + \frac{3}{\omega^c}$ is equa to (A) -2 (B) 2 (C) 3 (D) -3
A. -2
B. 2

C. 3

D. - 3

Answer: A



23. Let a,b, and c be three real numbers satisfying

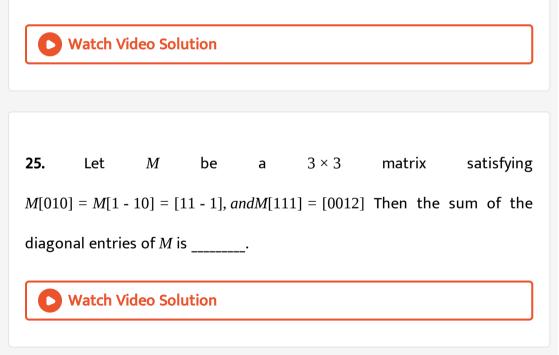
$$\begin{bmatrix} a, b, c \end{bmatrix} \begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix} = \begin{bmatrix} 0, 0, 0 \end{bmatrix} \text{Let b=6, with a and c satisfying (E). If alpha}$$
and beta are the roots of the quadratic equation

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

D. ∞

Answer: B

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



26. let
$$z = \frac{-1 + \sqrt{3i}}{2}$$
, where $i = \sqrt{-1}$ and $r, s \in P1, 2, 3$. Let $P = \begin{bmatrix} (-z)^r & z^{2s} \\ z^{2s} & z^r \end{bmatrix}$

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

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Single Correct Answer

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

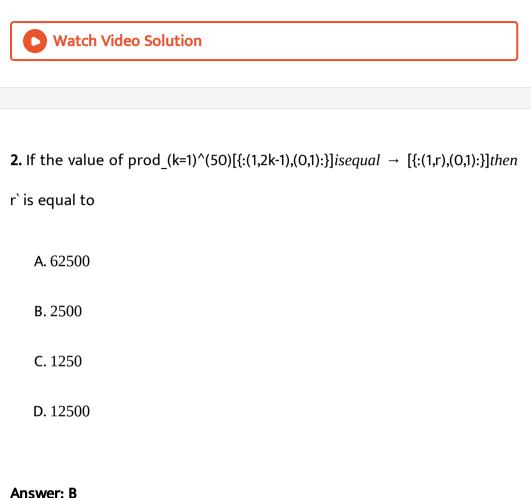
A.*A*

B. *B*

C. I

D. $A^2 + B^2$

Answer: D





3. A square matrix P satisfies $P^2 = I - P$ where I is identity matrix. If

 $P^n = 5I - 8P$, then *n* is

A . 4		
B. 5		
C . 6		
D. 7		

Answer: C

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

A. 1001

B. 1023

C. 1042

D. none of these

Answer: B

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

A. Singular

B. Zero matrix

C. Symmetric

D. Skew-Symmetric matrix

Answer: A

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

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

Answer: D



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

the value of x + y is

A. - 1

	-2
--	----

C. 1

D. 2

Answer: B

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

of the following is correct ?

$$A. M = \begin{bmatrix} a^{2m} & b^{2m} \\ b^{2m} & -a^{2m} \end{bmatrix}$$
$$B. M = \begin{pmatrix} a^2 + b^2 \end{pmatrix}^m \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$
$$C. M = \begin{pmatrix} a^m + b^m \end{pmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$
$$D. M = \begin{pmatrix} a^2 + b^2 \end{pmatrix}^{m-1} \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$$

Answer: D



9. If
$$A = [a_{ij}]_{m \times n}$$
 and $a_{ij} = (i^2 + j^2 - ij)(j - i)$, *n* odd, then which of the

following is not the value of *Tr*(*A*)

A. 0

B. |A|

C. 2|A|

D. none of these

Answer: D



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

A. 0

B. 1

C. $3|A|^3$

D. 6

Answer: A

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

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

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

Answer: C

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

A. symmetric

B. skew symmetric

C. I - XY

D. - *YX*

Answer: D

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13. If A and P are different matrices of order n satisfying $A^3 = P^3$ and

$$A^2P = P^2A$$
 (where $|A - P| \neq 0$) then $|A^2 + P^2|$ is equal to

B. 0

 $\mathsf{C}.\left|A\right|\left|P\right|$

D. |A + P|

Answer: B

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14. Let A, B are square matrices of same order satisfying AB = A and

$$BA = B$$
 then $\left(A^{2010} + B^{2010}\right)^{2011}$ equals.

A. A + B

B. 2010(A + B)

C. 2011(A + B)

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

Answer: D

15. The number of 2 × 2 matrices A, that are there with the elements as real numbers satisfying $A + A^T = I$ and $AA^T = I$ is

A. zero

B. one

C. two

D. infinite

Answer: C

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

A. - 1

B. 1

C. 0

D. none of these

Answer: C

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

Answer: D

18. Let A be a 3×3 matrix given by $A = (a_{ij})_{3 \times 3}$. If for every column vector X satisfies X'AX = 0 and $a_{12} = 2008$, $a_{13} = 1010$ and $a_{23} = -2012$. Then the value of $a_{21} + a_{31} + a_{32} =$

A. - 6

B. 2006

C.-2006

D. 0

Answer: C

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19. Suppose A and B are two non singular matrices such that $B \neq I$, $A^6 = I$

and $AB^2 = BA$. Find the least value of k for $B^k = 1$

B. 32

C. 64

D. 63

Answer: D

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20. Let A be a 2×3 matrix, whereas B be a 3×2 amtrix. If det. (AB) = 4,

then the value of det. (BA) is

A. -4

B.2

C. - 2

D. 0

Answer: D

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

A. 1 B. 3 C. 0 D. 6

Answer: B

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

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

B. |A| = |B|

 $C.A^2 = B^2$

D. none of these

Answer: A



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

A. 2

B. - 2

C. 1

D. 0

Answer: D

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

A. $5^3 \times 4^2$ B. $5^2 \times 4^3$ C. $5^2 \times 16^3$ D. $5^3 \times 16^2$

Answer: C

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25. If A and B are symmetric and commute, then which of the following is/are symmetric ?

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

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

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

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

Watch Video Solution 26. If A is a square matrix of order 3 such that $ A = 2$, then $\left (adjA^{-1})^{-1} \right $ is 	Answer: A
A. 1 B. 2 C. 4	Watch Video Solution
A. 1 B. 2 C. 4	
A. 1 B. 2 C. 4	
B. 2 C. 4	26. If <i>A</i> is a square matrix of order 3 such that $ A = 2$, then $\left \left(adjA^{-1} \right)^{-1} \right $ is
B. 2 C. 4	·
C. 4	A. 1
	B. 2
D. 8	C. 4
	D. 8
Answer: C	Answer: C
Watch Video Solution	Watch Video Solution

27. Let matrix
$$A = \begin{bmatrix} x & y & -z \\ 1 & 2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$$
, where $x, y, z \in N$. If

 $|adj(adj(adj(adjA)))| = 4^8 \cdot 5^{16}$, then the number of such (x, y, z) are

A. 28

B. 36

C. 45

D. 55

Answer: B

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

D		n
D	•	2

C. 3

D. 4

Answer: D

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29. If S is a real skew-symmetric matrix and det. $(I - S) \neq 0$, then prove that

matrix $A = (I + S)(I - S)^{-1}$ is orthogonal.

A. idempotent matrix

B. symmetric matrix

C. orthogonal matrix

D. none of these

Answer: C

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

Answer: A

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

A. 25

C. 1

D. 5

Answer: C

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32. Let A and B be two non-singular square matrices such that $B \neq I$ and

 $AB^2 = BA$. If $A^3 - B^{-1}A^3B^n$, then value of *n* is

A. 4

B. 5

C. 8

D. 7

Answer: C

33. If *A* is an idempotent matrix satisfying $(I - 0.4A)^{-1} = I - \alpha A$ where *I* is the unit matrix of the same order as that of *A* then the value of α is

A. - 1/3

B. 1/3

C. - 2/3

D.2/3

Answer: C

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

A. A + B

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

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

D. none of these

Answer: A

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Multiple Correct Answer

1. If
$$A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$
, then
A. $A^3 - A^2 = A - I$
B. $Det(A^{2010} - I) = 0$
C. $A^{50} = \begin{bmatrix} 1 & 0 & 0 \\ 25 & 1 & 0 \\ 25 & 0 & 1 \end{bmatrix}$

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

Answer: A::B::C

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2. If the elements of a matrix A are real positive and distinct such that

$$det(A + A^T)^T = 0$$
 then

A. detA > 0

B. det $A \ge 0$

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

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

Answer: A::C::D

3. If $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ and X is a non zero column matrix such that

 $AX = \lambda X$, where λ is a scalar, then values of λ can be

A. 3

B.6

C. 12

D. 15

Answer: A::D

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4. If A, B are two square matrices of same order such that A + B = AB and

I is identity matrix of order same as that of A,B, then

A.AB = BA

B. |A - I| = 0

 $\mathsf{C}. |B - I| \neq 0$

D. |A - B| = 0

Answer: A::C

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

A. A and B both are identity matrices

$$\mathsf{B.}\left|A+B\right|=0$$

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

D.A + B is not a singular matrix

Answer: B::C

6. If the matrix A and B are of 3×3 and (I - AB) is invertible, then which of

the following statement is/are correct ?

A. I - BA is not invertible

B. I - BA is invertible

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

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

Answer: B::C

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7. If A is a square matrix such that
$$A \cdot (AdjA) = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$
, then

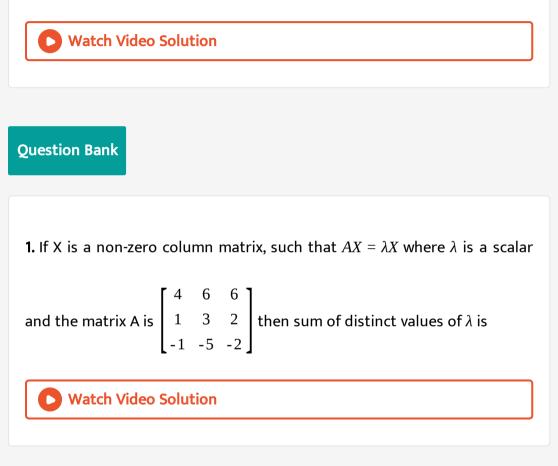
A. |A| = 4

B. |adjA| = 16

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

D. |adj2A| = 128

Answer: A::B::C



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

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

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

c is equal to

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

6. For
$$\alpha, \beta, \gamma \in R$$
, let $A = \begin{bmatrix} \alpha^2 & 6 & 8 \\ 3 & \beta^2 & 9 \\ 4 & 5 & \gamma^2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & \alpha & 3 & 5 \\ 2 & 2 & \beta & 6 \\ 1 & 4 & 2\gamma & -3 \end{bmatrix}$. If trace

A = traceB, then the value of $\left(\alpha^{-1} + \beta^{-1} + \gamma^{-1}\right)$ is equal to

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

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

9. Let
$$A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$$
 and $10B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$.

If B is the inverse of A, then find the value α .

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

tr(B).

11. If the product of n matrices
$$\begin{bmatrix} [1, n][0, 1] \\ 0 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix}$$
 is equal to the matrix $\begin{bmatrix} 1 & 378 \\ 0 & 1 \end{bmatrix}$ then the value of n is equal to **Watch Video Solution**

12.

$$\left\{ \begin{bmatrix} 3 & 1 & 2 \\ 8 & 9 & 5 \\ 1 & 1 & 3 \end{bmatrix} [[1, 3, 3], [3, 2, 7][3, 7, 9]] \right\}^{2} = \left(\begin{bmatrix} 3 & 8 & 1 \\ 1 & 9 & 1 \\ 2 & 5 & 3 \end{bmatrix} \right\}$$
 then the values of

|a_2-b_1| + |a_3 -c_1| +|b_3 - c_2|` is

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13. Let A=[[1, 2], [3, 4]] and B = [[a, b], [c, d]]betwomatricessucht they are computative and c ne 3 bthen the value of |(a-d)/(2 b-c)| is

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

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lf

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