Q.1: Let $A=\begin{bmatrix}0 & 1\\ 0 & 2\\ 1 & 0\end{bmatrix}$ & $B=\begin{bmatrix}1 & 2 & 3\end{bmatrix}$, then which of the following is true?

(a) AB exist (b) BA exist

(c) Given data is insufficient

(d) None of these

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Q.2. Let $A_i = \begin{bmatrix} \cos^2\theta_i & \cos\theta_i \sin\theta_i \\ \cos\theta_i \sin\theta_i & \sin^2\theta_i \end{bmatrix}$, i = 1, 2. Then

$A_1A_2 = 0$ if

(a) $\theta_1 = \theta_2 + (2k + 1)\pi/2$, k = 0, 1, 2....

(b) $\theta_1 = \theta_2 + k\pi$,, k = 0, 1, 2 ....

(c) $\theta_1 = \theta_2 + 2k\pi$, k = 0, 1, 2, ...

(d) $\theta_1 = \theta_2 + k\pi/2$, k = 0, 1, 2, ...

Q.3 How many elements do the set $S=\left\{A=\begin{bmatrix} 2 & 3x \\ \dfrac{3}{x} & 2 \end{bmatrix} : x \in R \setminus \{0\}\right\}$ Have, such that each element of the set satisfies the equation $A^2 - 4A - 5I = 0$

(a) Infinitely many

(b) 1

(c) 2

(d) 3

Q.5 If $A = \begin{bmatrix} 3 & -2 \\ 2 & -1 \end{bmatrix}$, then A^{20} equals

(a) $\begin{bmatrix} 41 & 40 \\ -40 & -39 \end{bmatrix}$ (b) $\begin{bmatrix} 41 & -40 \\ 40 & -39 \end{bmatrix}$

(c) $\begin{bmatrix} 41 & -40 \\ -40 & -39 \end{bmatrix}$ (d) $\begin{bmatrix} 41 & 40 \\ 40 & -39 \end{bmatrix}$

Q.6. If $P=\begin{bmatrix}1 & 1 & 1\\ 0 & 1 & 1\\ 0 & 0 & 1\end{bmatrix}$, then P^{50}eqals

(a) $\begin{bmatrix}1 & 100 & 500\\ 0 & 1 & 100\\ 0 & 0 & 1\end{bmatrix}$ (b) $\begin{bmatrix}1 & 50 & 100\\ 0 & 1 & 50\\ 0 & 0 & 1\end{bmatrix}$

(c) $\begin{bmatrix}50 & 100 & 150\\ 0 & 50 & 100\\ 0 & 0 & 50\end{bmatrix}$ (d) $\begin{bmatrix}1 & 50 & 1275\\ 0 & 1 & 50\\ 0 & 0 & 1\end{bmatrix}$

Q.7. The least positive integer n, such that $\begin{Bmatrix} \cos\pi/4 & \sin\pi/4 \\ -\sin\pi/4 & \cos\pi/4 \end{Bmatrix}^n$ is the identity matrix of order 2, is

(a) 4 (b) 8

(c) 12 (d) 16

Q.8 If $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ then A^{50} is

(a) $\begin{bmatrix} 1 & 0 & 0 \\ 50 & 1 & 0 \\ 50 & 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & 0 \\ 48 & 1 & 0 \\ 48 & 0 & 1 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 0 & 0 \\ 25 & 1 & 0 \\ 25 & 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 & 0 \\ 24 & 1 & 0 \\ 24 & 0 & 1 \end{bmatrix}$

Q.1 Let $A = \begin{bmatrix} a & 0 & 1 \\ 0 & 1 & 2 \\ 1 & 2 & 3 \end{bmatrix}$ be a matrix of order 3 whose Trace is 5, then value of a is

(a) 0 (b) 1

(c) 2 (d) -1

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Q.1 Let $A = \begin{bmatrix} a & 0 & 1 \\ 0 & 1 & 2 \\ 1 & 2 & 3 \end{bmatrix}$ be a matrix of order 3 whose Trace is 5, then value of a is

(a) 0 (b) 1

(c) 2 (d) -1

Q2. A real n ×n matrix A = [a_{ij}] is defined as

$$\begin{cases} a_{ij} - i & \forall\ i = j \\ 0 & Otherwise \end{cases}$$, then Trace(A) is

(a) $\dfrac{n(n+1)}{2}$ (b) $\dfrac{n(n-1)}{2}$

(c) $\dfrac{n(n+1)(2n+1)}{2}$ (d) n^2

Q.3 If A, B & C are square matrix of same order then which of the following is/are equal to Tr(ABC) is

(a) Tr(ACB) (b) Tr(BCA)

(c) Tr(BAC) (d) Tr(CAB)

Q.4. If $S = \left\{ A = [a_{ij}]_{3\times 3} \mid AA^T = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \& a_{ij} \in R \right\}$. Then

is

(a) Empty set

(b) Singleton se

(c) Countably infinite set

(d) Uncountable set

Q .5. The number of distinct real values of x for which the matrix $\begin{pmatrix} x & 1 & 1 \\ 1 & x & 1 \\ 1 & 1 & x \end{pmatrix}$ is singular is

(a) 1 (b) 2

(c) 3 (d) infinite

Q.6. Let P be 4×4 matrix whose determinant is 10. The determinant of the matrix $-3P$ is

(a) -810 (b) -30

(c) 30 (d) 810

Q7. Let $A = \begin{bmatrix} 2 & 3 & 1 \\ 5 & 1 & 2 \\ 1 & 0 & 0 \end{bmatrix}$ then

(a) A is invertible

(b) |A| is odd

(c) |A| is divisible by 2

(d) |A| is prime number

Q.8. It is known that $X = X_0 \in M_2(Z)$ is a solution of $AX - XA = A$ for some $A \in \left\{ \begin{pmatrix} 1 & 1 \\ -1 & -1 \end{pmatrix}, \begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}, \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix} \right\}$. Which of the following values are not possible for the determinant of X_0?
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(a) $\det(X_0) = 0$ (b) $\det(X_0) = 2$

(c) $\det(X_0) = 6$ (d) $\det(X_0) = 10$

Q.9. Let M & N be any two 4×4 matrices with integer entries.

Satisfying $MN = 2\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$. Then the maximum value of det(M) + det(N) is

(a) 16 (b) 17

(c) 18 (d) 19

Q.1 Let $S = \{A \in M_{n\times n};\ A = A^T \ \&\ A^T = -A\}$, then cardinality of S is

(a) 1

(b) ϕ

(c) infinite

(d) 2022

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Q.3. Suppose A is a real square matrix of odd order such that $A + A^T = 0$. Then which of the

following is true?

(a) A is singular matrix

(b) A is non-singular matrix

(c) A is symmetric matrix

(d) A is skew-symmetric matrix

Q.6. The diagonal elements of Hermitian matrix are –

(a) Complex number

(b) Real numbers

(c) Natural numbers

(d) None of these

Q.7. The diagonal elements of Skew-Hermitian matrix are –

(a) Pure real numbers or zero

(b) Pure imaginary or zero

(c) Complex number

(d) None of these

Q.1 It is known that $X = X_0 \in M_2(Z)$ is a solution of $AX - XA = A$ for some $A \in \left\{ \begin{pmatrix} 1 & 1 \\ -1 & -1 \end{pmatrix}, \begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}, \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix} \right\}$. Which of the following values are not possible for the determinant of X_0?

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(a) $\det(X_0) = 0$ (b) $\det(X_0) = 2$

(c) $\det(X_0) = 6$ (d) $\det(X_0) = 10$

Q2. The determinant of the matrix $\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 2 \\ 0 & 1 & 0 & 0 & 2 & 0 \\ 0 & 0 & 1 & 2 & 0 & 0 \\ 0 & 0 & 2 & 1 & 0 & 0 \\ 0 & 2 & 0 & 0 & 1 & 0 \\ 2 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$ is

(a) 0 (b) -9

(c) -27 (d) 1

Q.4. Let $D_1 = \det\begin{bmatrix} a & b & c \\ x & y & z \\ p & q & r \end{bmatrix}, D_2 = \det\begin{bmatrix} -x & a & -p \\ y & -b & q \\ z & -c & r \end{bmatrix}$. Then

(a) $D_1 = D_2$ (b) $D_1 = 2D_2$

(c) $D_1 = -D_2$ (d) $2D_1 = D_2$

Q.1. A & B are square matrix such that $AB = A$ & $BA = B$, then

(a) $A^2 = A, B^2 = B$ **(b)** $A^2 = A, B^2 \neq B$

(c) $A^2 \neq A, B^2 = B$ (d) $A^2 \neq A, B^2 \neq B$

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Q.2. Let A & B are two nilpotent matrix of index 15 & 13 then which of the following are true?

(a) Index of A^2 is 9.

(b) Index of A^4 is 4

(c) Index of B^3 is 6

(d) Index of B^5 is 3

Q.3. Number of orthogonal matrix of order n whose entries are 0 & 1 only

(a) n (b) n!

(c) n – 1 (d) None of these

Q.4. If A is orthogonal matrix then which of the following are true?

(a) 2A is orthogonal

(b) A^2 is orthogonal

(c) $-A$ is orthogonal

(d) None of these

Q.5. The number of orthogonal matrix of order 5 whose entries are 0 & 1 only

(a) 5^2 (b) $5!$

(c) 120 (d) 0

Q.6. The matrix $M = \begin{bmatrix} \cos\alpha & \sin\alpha \\ i\sin\alpha & i\cos\alpha \end{bmatrix}$ is a unitary matrix when α is

(a) $(2n+1)\frac{\pi}{2}, n \in Z$ (b) $(3n+1)\frac{\pi}{3}, n \in Z$

(c) $(4n+1)\frac{\pi}{4}, n \in Z$ (d) $(5n+1)\frac{\pi}{5}, n \in Z$

Q.7 Suppose A is idempotent matrix of order n , then which of the following is true?

(a) $Tr(A) > n$ (b) $|A| > n$

(c) $Tr(A) \in N$ (d) $Tr(A) \in Z$

Q.8. Suppose A is involutory matrix of order n , then which of the following is true?

(a) $I - A$ is involutory (b) $3A$ is involutory

(c) $Tr(A)$ may be $n/2$ (d) $Tr(A) \in Z$

Q.9. If A is nilpotent matrix of index 2022, then matrix A^{2011} is

(a) nilpotent matrix of index 1

(b) nilpotent matrix of index 2

(c) nilpotent matrix of index 2022

(d) nilpotent matrix of index 2011

Q.10. If A and B are orthogonal matrix then which of the following is true?

(a) $A + B$ is orthogonal (b) AB is orthogonal

(c) $2A$ is orthogonal (d) B^2 is orthogonal

Q.1. Number of orthogonal matrix of order n whose entries are 0 & 1 only

(a) n (b) $n!$

(c) $n-1$ (d) None of these

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Q.2. If A is orthogonal matrix then which of the following are true?

(a) 2A is orthogonal

(b) A^2 is orthogonal

(c) $-A$ is orthogonal

(d) None of these

Q.3. The number of orthogonal matrix of order 5 whose entries are 0 & 1 only

(a) 5^2 (b) $5!$

(c) 120 (d) 0

Q4. The matrix $M=\begin{bmatrix}\cos\alpha & \sin\alpha\\ i\sin\alpha & i\cos\alpha\end{bmatrix}$ is a unitary matrix when α is

(a) $(2n+1)\frac{\pi}{2}, n\in Z$ (b) $(3n+1)\frac{\pi}{3}, n\in Z$

(c) $(4n+1)\frac{\pi}{4}, n\in Z$ (d) $(5n+1)\frac{\pi}{5}, n\in Z$

Q.5. If A and B are orthogonal matrix then which of the following is true?

(a) $A+B$ is orthogonal (b) AB is orthogonal

(c) $2A$ is orthogonal (d) B^2 is orthogonal

Q.6. Let $\underline{u}$ be a real $n \times 1$ vector satisfying $\underline{u}'\underline{u} = 1$ where $\underline{u}'$ is the transpose of $\underline{u}$. Define $A = I - 2\underline{uu}'$ where I is the nth order identity matrix. Which of the following statements are true?

(a) A is singular

(b) $A^2 = A$

(c) Trace $(A) = n - 2$

(d) $A^2 = I$

Q.7. Let $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 3 & 1 & 2 & 5 & 4 \end{pmatrix}$ and matrix A is denoted to the one whose i^{th} column is the $\sigma(i)^{th}$ column of the identity matrix I. Which of the following is true?

(a) $A^2 = A$ (b) $A^{-4} = A$

(c) $A^{-5} = A$ (d) $A = A^{-1}$

Q.8. Let $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 3 & 1 & 2 & 5 & 4 \end{pmatrix}\begin{pmatrix} 5 & 6 & 7 \\ 6 & 5 & 7 \end{pmatrix}$ and matrix A is denoted to the one whose i^{th} column is the $\sigma(i)^{th}$ column of the identity matrix I. Which of the following is true?

(a) A is involutory matrix (b) $|A| = 1$

(c) $Tr(A) = 1$ (d) $A^2 = A^{-1}$

Q.9. Let $A = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}_{6\times 6}$. Then which of the following is true?

(a) A is involutory matrix

(b) $|A| = 1$

(c) A is idempotent matrix

(d) $|A| = 0$

Q.2. Suppose A be a 3×3 matrix of determinant 6, then determinant of (adj A)

(a) 36 (b) 9

(c) 25 (d) None of these

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Q.3. Let A be a 5×5 skew-symmetric matrix with entries in R and B be the 5×5 symmetric matrix whose $(i, j)^{th}$ entry is the binomial coefficient $\binom{i}{j}$ for $1 \le i \le j \le 5$. Consider the 10×10 matrix, given in block form by $C = \begin{pmatrix} A & A+B \\ 0 & B \end{pmatrix}$. Then

(a) $\det C = 1$ or -1 (b) $\det C = 0$

(c) trace of C is 0 (d) trace of C is 5

Q.4. Let $A = \begin{bmatrix} 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 1 & 0 \end{bmatrix}$, then which of the following is true?

(a) $|A| = 0$ (b) $|A| = 1$

(c) $|A| = 2$ (d) $|A| = -1$

Q5. Let $A = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & -2 \end{bmatrix}$ then characteristic polynomial.

(a) $x^3 - 2x^2 + 1$

(b) $x^2 - 2x + 1$

(c) $x^3 - 2x^2 - 1$

(d) None of these

Q6. Let $\alpha, \beta, \gamma, \delta$ be the eigenvalues of the matrix

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & -2 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 2 \end{bmatrix}. \text{ Then } \alpha^2+\beta^2+\gamma^2+\delta^2 = \_\_\_\_\_\_\_.$$

Q.1. Find elementary matrix

(a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 2 & 0 \\ 1 & 2 & 0 \\ 1 & 2 & 2 \end{bmatrix}$

Q.2. Let $A=\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 151 & 262 & 373 & 484 \end{bmatrix}$.

Then Rank(A) is

(a) 1 (b) 2

(c) 3 (d) 4

Q.1. Find elementary matrix

(a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 2 & 0 \\ 1 & 2 & 0 \\ 1 & 2 & 2 \end{bmatrix}$

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Q.2. Let $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 151 & 262 & 373 & 484 \end{bmatrix}$.

Then Rank(A) is

(a) 1 (b) 2

(c) 3 (d) 4

Q.3. Let $A = \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & 2 & 2 & \cdots & 2 \\ 1 & 2 & 3 & \cdots & 3 \\ 1 & 2 & 3 & \cdots & 4 \\ \vdots & & & & \\ 1 & 2 & 3 & \cdots & n \end{bmatrix}$, then $\rho(A)$ is

(a) 0 (b) 1

(c) 2 (d) n

Q.4. Let $S = \{A = [a_{ij}]_{n\times n} \mid A^k = 0 \ \& \ \rho(A) = n, \text{ for some } k\}$ then cardinality of S is

(a) ϕ (b) 1

(c) 2 (d) n

Q.5. Let $A=[a_1\ a_2\ \ldots..\ a_n]^T_{1\times n}$ and $B=[b_1\ b_2\ \ldots..\ b_n]_{1\times n}$ both are non-zero matrix then ρ(AB) is

(a) 1

(b) n

(c) n + 1

(d) n – 1

Q.6 Let A be a 3×4 matrix and B be a 4×3 matrix with real entries such that AB is non- singular. Consider the following statements :

P : Nullity of A is 0.

Q : BA is a non-singular matrix.

Then

(a) both P and Q are true

(b) P is true and Q is false

(c) P is false and Q is true

(d) Both P and Q are false

Q.7. Let A be an $n \times n$ matrix such that the first 3 rows of A are linearly independent and the first 5 columns of A are linearly independent. Which of the following statements are true?

(a) A has at least 5 linearly independent rows

(b) $3 \le \text{rank } A \le 5$

(c) Rank $A \ge 5$ (d) Rank $A^2 \ge 5$

Q.8. What is the rank of the matrix $\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 & 3 \\ 1 & 2 & 3 & 4 & 4 \\ 1 & 2 & 3 & 4 & 5 \end{pmatrix}$.

(a) 2 (b) 3

(c) 4 (d) 5

Q.9 Let J denote the matrix of order $n \times n$ with all entries 1

and let B be a $(3n)\times(3n)$ matric given by $B = \begin{pmatrix} 0 & 0 & J \\ 0 & J & 0 \\ J & 0 & 0 \end{pmatrix}$

. Then the rank of B is

(a) $2n$ (b) $3n - 1$

(c) 2 (d) 3

Q.10. Let A be an $n \times m$ matrix with each entry equal to +1, -1 or 0 such that every column has exactly one +1 and exactly one -1. We can conclude that

(a) Rank $A \le n - 1$ (b) Rank $A = m$

(c) $n \le m$ (d) $n - 1 \le m$

Q.11 Let A and B be $n \times n$ real matrices such that $AB = BA = 0$ and $A + B$ is invertible.

Which of the following are always true?

(a) Rank (A) = rank (B)

(b) Rank (A) + rank (B) = n

(c) Nullity (A) + nullity (B) = n

(d) A – B is invertible

Q.1. Find elementary matrix

(a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 2 & 0 \\ 1 & 2 & 0 \\ 1 & 2 & 2 \end{bmatrix}$

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Q.2. Let $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 151 & 262 & 373 & 484 \end{bmatrix}$.

Then Rank(A) is

(a) 1 (b) 2

(c) 3 (d) 4

Q.3. Let $A=\begin{bmatrix}1 & 1 & 1 & \cdots & 1\\ 1 & 2 & 2 & \cdots & 2\\ 1 & 2 & 3 & \cdots & 3\\ 1 & 2 & 3 & \cdots & 4\\ \vdots & & & & \\ 1 & 2 & 3 & \cdots & n\end{bmatrix}$, then $\rho(A)$ is

(a) 0 (b) 1

(c) 2 (d) n

Q.4. Let $S = \{A = [a_{ij}]_{n\times n} \mid A^k = 0 \;\&\; \rho(A) = n, \text{ for some } k\}$ then cardinality of S is

(a) ϕ (b) 1

(c) 2 (d) n

Q.5. Let $A=[a_1\ a_2\ \ldots\ldots\ a_n]^T_{1\times n}$ and $B=[b_1\ b_2\ \ldots\ldots\ b_n]_{1\times n}$ both are non-zero matrix then $\rho(AB)$ is

(a) 1 (b) n

(c) n + 1 (d) n – 1

Q.6 Let A be a 3×4 matrix and B be a 4×3 matrix with real entries such that AB is non- singular. Consider the following statements :

P : Nullity of A is 0.

Q : BA is a non-singular matrix.

Then

(a) both P and Q are true

(b) P is true and Q is false

(c) P is false and Q is true

(d) Both P and Q are false

Q.7. Let A be an $n \times n$ matrix such that the first 3 rows of A are linearly independent and the first 5 columns of A are linearly independent. Which of the following statements are true?

(a) A has at least 5 linearly independent rows

(b) $3 \leq \text{rank } A \leq 5$

(c) Rank $A \geq 5$ (d) Rank $A^2 \geq 5$

Q.8. What is the rank of the matrix $\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 & 3 \\ 1 & 2 & 3 & 4 & 4 \\ 1 & 2 & 3 & 4 & 5 \end{pmatrix}$.

(a) 2 (b) 3

(c) 4 (d) 5

Q.9 Let J denote the matrix of order n × n with all entries 1

and let B be a (3n)×(3n) matric given by $B = \begin{pmatrix} 0 & 0 & J \\ 0 & J & 0 \\ J & 0 & 0 \end{pmatrix}$

. Then the rank of B is

(a) 2n (b) 3n – 1

(c) 2 (d) 3

Q.10. Let A be an $n \times m$ matrix with each entry equal to +1, -1 or 0 such that every column has exactly one +1 and exactly one -1. We can conclude that

(a) Rank $A \le n-1$ (b) Rank $A = m$

(c) $n \le m$ (d) $n - 1 \le m$

Q.11 Let A and B be $n \times n$ real matrices such that $AB = BA = 0$ and $A + B$ is invertible.

Which of the following are always true?

(a) Rank (A) = rank (B)

(b) Rank (A) + rank (B) = n

(c) Nullity (A) + nullity (B) = n

(d) $A - B$ is invertible

Q.1 If system of linear equation

$$kx + y + 2z = 0$$

$$x - y - 2z = 0$$

$$x + y + 4z = 0$$

have a unique solution, then k is not equal to

(a) -1 (b) 0

(c) 1 (d) 2

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Q.2. Let $M = \begin{bmatrix} \alpha & 1 & 1 \\ 1 & \beta & 1 \\ 1 & 1 & \gamma \end{bmatrix}$, $\alpha\beta\gamma = 1$, $\alpha, \beta, \gamma \in R$ and

$x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \in R^3$. Then Mx = 0 has infinitely many solution

if trace (M) is

(a) 0 (b) 1

(c) 2 (d) 3

Q.3 Consider the following system of three linear equation in three unknown x_1, x_2, & x_3.

$$x_1 + x_2 + x_3 = 0$$

$$x_1 + kx_2 + 2x_3 = 0$$

$$2x_1 + 3x_2 + x_3 = 0$$

If system has infinitely many solution then value of k is

(a) 0 (b) 1

(c) 2 (d) 3

Q.4. Let A be a 5×4 matrix with real entries such that $Ax = 0$ iff $x = 0$ where x is a 4×1 vector and 0 is null vector. Then the rank of A is

(a) 4 (b) 5

(c) 2 (d) 1

Q.5 Consider a homogeneous system of linear equation $Ax = 0$ where A is an $m \times n$ real matrix and $n > m$. Then which of the following statements are always true?

(a) $Ax = 0$ has a solution

(b) $Ax = 0$ has no non-zero solution.

(c) $Ax = 0$ has a non-zero solution

(d) Dimension of the space of all solutions is

Q.6. Let S be the solution space of system of linear equation

$x + 2y + 3z = 0$

$3x + 4y + 4z = 0$

$7x + 10y + 12z = 0$

Then dimension of S is

(a) 0 (b) 1

(c) 2 (d) 3

Q.1. Consider the following system

$$x + y + z + w = 4$$

$$x + 2y + 3z + 4w = 5$$

$$x + 3y + 5z + kw = 5$$

If the system has no solution then k is

(a) 4 (b) 5

(c) 7 (d) 6

Q.3. Consider the system

$$2x + ky = 2 - k$$

$$kx + 2y = k$$

$$ky + kz = k - 1$$

in three unknowns and one real parameter k. For which of the following values of k is the system of linear equation consistent?

(a) 1 (b) 2

(c) -1 (d) -2

Q1. Consider the system

$$2x + ky = 2 - k$$

$$kx + 2y = k$$

$$ky + kz = k - 1$$

in three unknowns and one real parameter k. For which of the following values of k is the system of linear equation consistent?

(a) 1 (b) 2

(c) -1 (d) -2

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Q.2. The system of equation

$$x + 3y + 2z = k$$

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

$$5x - 14z = 10$$

(a) has unique solution for $k = 2$

(b) has infinitely many solution for $k = 2$

(c) has no solution for $k = 2$

(d) has unique solution for any $k \neq 2$

Q.3. Let $A=\begin{pmatrix} 2 & 0 & 5 \\ 1 & 2 & 3 \\ -1 & 5 & 1 \end{pmatrix}$. The system of linear equations

AX = Y has a solution

(a) only for $Y=\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$, $x \in R$

(b) only for $Y=\begin{pmatrix} 0 \\ y \\ 0 \end{pmatrix}$, $y \in R$

(c) only for $Y=\begin{pmatrix} 0 \\ y \\ z \end{pmatrix}$, $y, z \in R$

(d) for all $Y \in R^3$

Q4. Let A be an $m \times m$ matrix with real entries and let x be an $m \times 1$ vector of unknowns. Now consider the two statements given below :

I There exists non-zero vector $b_1 \in R^m$ such that the linear system $Ax = b_1$ has no solution.

II There exist non-zero vectors $b_2, b_3 \in R^m$, with $b_2 \neq cb_3$ for any $c \in R$, such that the linear systems $Ax = b_2$ and $Ax = b_3$ have solutions.

Which of the following statements are true?

(a) II is true whenever A is singular

(b) I is true whenever A is singular

(c) Both I and II can be true simultaneously

(d) If m = 2, then at least one of I and II is false.

Q.5. The system of equations :

$$1 \,.\, x + 2 \,.\, x^2 + 3 \,.\, xy + 0 \,.\, y = 6$$

$$2 \,.\, x + 1 \,.\, x^2 + 3 \,.\, xy + 1 \,.\, y = 5$$

$$1 .\, x - 1 \,.\, x^2 + 0 \,.\, xy + 1 \,.\, y = 7$$

(a) has solution in rational numbers

(b) has solutions in real numbers

(c) has solutions in complex numbers

(d) has no solution

Q.6 Let $m > 1$ and $n > 1$ be integers. Let A be an $m \times n$ matrix such that for some $m \times 1$ matrix b_1, the equation $AX = b_1$ has infinitely many solutions. Let b_2 denote an $m \times 1$ different from b_1. Then $AX = b_2$ has

(a) infinitely many solutions for some b_2.

(b) a unique solution for some b_2.

(c) finitely many solutions for some b_2.

(d) no solution for some b_2.

Q.7 Let A be an $n \times n$ real matrix. Let b be an $n \times 1$ vector. Suppose $Ax = b$ has no solution. Which of the following statements are true?

(a) There exists an $n \times 1$ vector c such that $Ax = c$ has a unique solution

(b) There exist infinitely many vectors c such that $Ax = c$ has no solution

(c) If y is the first column of A then $Ax = y$ has a unique solution

(d) $\det A = 0$

Q.8. Number of solution of system of linear equation

$$3x + 4y - z - 6w = 0$$

$$2x + 3y + 2z - 3w = 0$$

$$2x + y - 14z - 9w = 0$$

$$x + 3y + 13z + 3w = 0$$

(a) unique solution (b) two solution

(c) more than 2 but finite solution

(d) infinite solution

Q.1. Let A be a 3×3 matrix with eigen value 1, -1, 0. Then the determinant of $I + A^{100}$ is

(a) 6 (b) 4

(c) 9 (d) 100

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Q.2. Let $A=\begin{pmatrix} 2 & -1 & 3 \\ 2 & -1 & 3 \\ 3 & 2 & -1 \end{pmatrix}$. Then the largest eigenvalue of A is

(a) 1 (b) 2

(c) 3 (d) 4

(7) Eigen value of permutation matrix.

Let $\sigma = c_1.c_2. \ldots.. c_k$ product of disjoint cycles such that $l(c_i) = r_i$ where $l(c_i)$ = length of c_i.

Then characteristic of A is $c(x) = \prod_{ri} (x^{r_i} - 1)$

i.e. $\sigma = (12)\,(3) \in S_3$

$c_1 = (12)$ and $l(c_1) = 2 = r_1$

$c_2 = (3)$ and $l(c_2) = 1 = r_2$ then $c(x) = (x^2 - 1)(x - 1)$

Q.3. Which of the following properties are true?

(a) If λ is an eigen value of A then 2λ is an eigen value of A^{-1}.

(b) If λ is an eigen value of A then $1/\lambda$ is an eigen value of A^{-1}.

(c) If λ is an eigen value of an orthogonal matrix, then $1/\lambda$ is also its eigen value.

(d) All of the above.

Q.4. The square matrix A is said to be an idempotent if $A^2 = A$.

An idempotent matrix is non-singular iff

(a) All E.V. are real

(b) All E.V. are real non-negative

(c) All E.V. are either 0 or 1

(d) All E.V. are 1

Q.5 The trace of the matrix $A = \begin{bmatrix} 3 & 2 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}^{15}$ is

(a) $1 + 3^{15}$ (b) $2 + 3^{15}$

(c) 3^{15} (d) 0

Q.6. Let A be 3×3 matrix with real entries such that 1, -1, 2 are its eigenvalues if $B = A^3 + 2A^2 + I$, then

(a) det (B) = 50 (b) det (B) = 136

(c) det (B) = 23 (d) det(B) = 17

Q.7.. Let A and B be $n \times n$ real matrices and let $C = \begin{pmatrix} A & B \\ B & A \end{pmatrix}$

.Which of the following statements are true?

(a) If λ is an eigenvalue of $A + B$ then λ is an eigen value of C

(b) If λ is an eigenvalue of $A - B$ then λ is an eigen value of C

(c) If λ is an eigen value of A or B then λ is an eigen value of C

(d) All eigen values of C are real

Q.8. Which of the following eigen values of the matrix.

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

(a) 1 (b) -1

(c) i (d) –i

Q.1. Let $M_n(R)$ be the set of $n \times n$ matrices with real entries.

Which of the following is true?

(a) Any matrix $A \in M_4(R)$ has a real eigen value.

(b) Any matrix $A \in M_5(R)$ has a real eigen value.

(c) Any matrix $A \in M_2(R)$ has a real eigen value

(d) None of these

Q.1. Let A be a 3 $\times$ 3 matrix with eigen value 1, -1, 0. Then the determinant of $I + A^{100}$ is

(a) 6 (b) 4

(c) 9 (d) 100

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i.e. $\sigma = (12)\,(3) \in S_3$

$c_1 = (12)$ and $l(c_1) = 2 = r_1$

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(b) If λ is an eigenvalue of $A - B$ then λ is an eigen value of C

(c) If λ is an eigen value of A or B then λ is an eigen value of C

(d) All eigen values of C are real

Q.8. Which of the following eigen values of the matrix.

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

(a) 1 (b) -1

(c) i (d) –i

Q.1. Let $M_n(R)$ be the set of $n \times n$ matrices with real entries.

Which of the following is true?

(a) Any matrix $A \in M_4(R)$ has a real eigen value.

(b) Any matrix $A \in M_5(R)$ has a real eigen value.

(c) Any matrix $A \in M_2(R)$ has a real eigen value

(d) None of these

Q.1. Which one of the following sets of vectors $\alpha = (a_1, a_2, \ldots, a_n)$ in R^n is a subspace of $R^{n (n \geq 3)}$?

(a) all α such that $a_1 \geq 0$

(b) all α such that $a_1 + 3a_2 = a_3$

(c) all α such that $a_2 = a_1^2$

(d) all α such that $a_1 a_2 = 0$

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Q.2. Which of the following subsets are subspace?

(a) $W = \{(x, y) \in R^2; xy = 0\}$

(b) $X = \{(x, y) \in R^2; y = 3x\}$

(c) $Y = \{(x, y) \in R^2; x^2 - y^2 = 0\}$

(d) $Z = \{(x, y) \in R^2; x^2 + y^2 = 0\}$

Q.3 Which one of the following is a subspace of R^3?

(a) $(x, y, z) \in R^3 \mid x + 2y = 0, 2x + 3z = 0\}$

(b) $\{(x, y, z) \in R^3 \mid 2x + 3y + 4z - 3 = 0, z = 0\}$

(c) $\{(x, y, z) \in R^3 \mid x \geq 0, y \geq 0\}$

(d) $\{(x, y, z) \in R^3 \mid x - 1 = 0, y = 0\}$

Q.4 Which of the following sets of functions from R to R is a vector space over R?

$$S_1 = \{f \mid \lim_{x\to 3} f(x) = 0\}$$

$$S_2 = \{g \mid \lim_{x\to 3} g(x) = 1\}$$

$$S_3 = \{h \mid \lim_{x\to 3} h(x) exists\}$$

(a) Only S_1 (b) Only S_2

(c) S_1 and S_3 but not S_2

(d) All the three vector spaces

Q.5 Let M_n denote the vector space of all $n \times n$ real matrices. Among the following subsets of M_n, decide which are linear subspaces.

(a) $V_1 = \{A \in M_n : A \text{ is non-singular}\}$

(b) $V_2 = \{A \in M_n : \det(A) = 0\}$

(c) $V_3 = \{A \in M_n : \operatorname{trace}(A) = 0\}$

(d) $V_3 = \{BA : A \in M_n\}$, where B is some fixed matrix in M_n.

Q.1. Let $W_1 = \{(a, 2a, 0) \mid a \in R\}$, $W_2 = \{(a, 0, -a) \mid a \in R\}$. Then

(a) $W_1 + W_2$ is a subspace of R_3 but $W_1 \cup W_2$ is not

(b) $W_1 + W_2$, $W_1 \cup W_2$ are both subspaces of R^3.

(c) Neither $W_1 + W_2$ nor $W_1 \cup W_2$ is a subspace of R^3.

(d) $W_1 \cup W_2$ is a subspace of R^3 but $W_1 + W_2$ is not.

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Q.2. Let $V = \{[a_{ij}]_{m\times n}; a_{ij} \in F\}$ be a vector space

$W_1 = \{A = [a_{ij}]_{m\times n} / A^k = 0; k \in N; A \text{ is diagonalizable matrix}\}$
and $W_2 = \{A = [a_{ij}]_{m\times n} / A \text{ is diagonal matrix}\}$

then which of the following is true

(a) W_1 is subspace of V

(b) W_2 is subspace of V

(c) $W_1 \cap W_2$ is non - subspace of V

(d) $W_1 \cup W_2$ is subspace of V

Q.3. Let $H_1 = \{(x, y) \mid y = x\}$ and $H_2 = \{(x, y) \mid y = -x\}$ be subspaces of a vector space $R^2(R)$.

Then which of the following statement is correct?

(a) $H_1 + H_2$ is an improper subspace of R^2

(b) $H_1 + H_2$ is a proper subspace of R^2

(c) $H_1 + H_2$ is not a subspace of R^2

(d) $H_1 + H_2$ is a trivial subgroup of R^2.

Q.4. Which one of the following is correct?

(a) $S = \{(1, 0, 0), (0, -1, 0), (1, 1, 0)\}$ is a linearly independent set of vectors in R^3.

(b) $S = \{(1, 0, 0), (0, 2, 0), (1, 1, 0)\}$ is a linearly independent set of vectors in R^3.

(c) A subset of a linearly dependent set of vectors is linearly independent.

(d) A subset of a linearly independent set of vectors is linearly independent.

Q.5. If $A = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} = \alpha M_1 + \beta M_2 + \gamma M_3$, where

$M_1 = I_{2\times 2}, M_2 = \begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix} \& M_3 = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$ then

(a) $\alpha = \beta = 1, \gamma = 2$ (b) $\alpha = \beta = -1, \gamma = 2$

(c) $\alpha = 1, \beta = -1, \gamma = 2$ (d) $\alpha = -1, \beta = 1, \gamma = 2$

Q.6. If the set $\left\{\begin{bmatrix} x & -x \\ -1 & 0 \end{bmatrix}, \begin{bmatrix} 0 & -1 \\ x & x \end{bmatrix}, \begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}\right\}$ is linearly dependent in the vector space of all 2×2 matrices with real entries, then x is equal to

(a) 1 (b) -1

(c) 2 (d) -2

Q.7. In vector space $R^3(R)$ over the field of real numbers R t hen the set $S = \{(-1, 2, 1), (3, 0, -1), (-5, 4, 3)\}$ is

(a) LI

(b) LD

(c) Data is insufficient

(d) None of these

Q.8. If α, β, γ are LI vector of V(F) then which of the following is LI.

(a) $2\alpha, \beta, 2$

(b) $\alpha + \beta, \alpha - \beta, \alpha - 2\beta + \gamma$

(c) $\alpha - \beta, \beta + \gamma, \gamma + \alpha$

(d) $\alpha + \beta, 2\alpha + \gamma, \alpha - \beta + \gamma$

Q.9. Let $p_n(x) = x^n$ for $x \in R$ and let $\wp = \text{span}\{p_0, p_1, p_2, \ldots\}$. Then

(a) $\wp$ is the vector space of all real valued continuous function on R.

(b) $\wp$ is a subspace of all real valued continuous function on R.

(c) $\{p_0, p_1, p_3, \ldots\}$ is a linearly independent set in the vector space of all continuous functions on R.

(d) Trignometric functions belong to $\wp$

Q.1. Let us define a sequence $(a_n)_{n \in N}$ of real number to be a Fibonacci like sequence if $a_n = a_{n-1} + a_{n-2}$ for $n \geq 3$. What is the dimension of the R-vector space of Fibonacci like sequence?

(a) 1 (b) 2

(c) Infinnite & countable

(d) Infinite & uncountable

2022_09_27_09

Q.1 Let V be the vector space of all 6×6 real matrices then dimension of subspace of V consisting of all symmetric matrices is

(a) 15 (b) 18

(c) 21 (d) 35

Q.2. Let V denote the vector space of real valued continuous functions on the closed interval [0, 1]. Let W be the subspace of V spanned by $\{\sin(x), \cos(x), \tan(x)\}$. Then the dimension of W over R is

(a) 1 (b) 2

(c) 3 (d) infinite

Q.3. Let $M_2(R)$ be the vector space of 2×2 real matrices. Let V be a subspace of $M_2(R)$ defined by

$$V = \left\{ A \in M_2(R); A\begin{bmatrix} 0 & 2 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ 3 & 1 \end{bmatrix} A \right\}$$

Then the dimension of V is

(a) 1 (b) 2

(c) 3 (d) 4

Q.4. Consider the following subspace of R^3

$$W=\{(x,y,z)\in R^3 \mid 2x+2y+z=0, 3x+3y-2z=0, x+y-3z=0\}$$

Then dimension of W is

(a) 0 (b) 1

(c) 2 (d) 3

Q.1 Let $W_1 = \{(u, v, w, x) \in R^4 \mid u + v + w = 0, 2v + x = 0, 2u + 2w - x = 0\}$ & $W_2 = \{(u, v, w, x) \in R^4 \mid u + w + x = 0, u + w - 2x = 0, v - x = 0\}$. Then which among the following is true.

(a) $\dim(W_1) = 1$ (b) $\dim(W_2) = 2$

(c) $\dim(W_1 \cap W_2) = 1$ (d) $\dim(W_1 + W_2) = 3$

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Q.2. Consider the subspace $W = \{(x_1, x_2, \ldots, x_{10}) \in R^{10};$ $x_n = x_{n-1} + x_{n-2}$ for $3 \le n \le 10\}$ of the vector space R^{10}.

The dimension of W is

(a) 2 (b) 3

(c) 9 (d) 10

Q.3. Let $W_1 = \{(x, y, z) \in R^3; 3x + y = 0\}$ & $W_2 = \{(x, y, z) \in R^3; z = 0\}$. Then $\dim (W_1 \cap W_2)$ is

(a) 0 (b) 1

(c) 2 (d) 3

Q4. Let V be the vector space of all 2×2 matrices over R.

Consider the subspace $W_1 = \left\{ \begin{bmatrix} a & -a \\ c & d \end{bmatrix}; a, c, d \in R \right\}$ &

$W_2 = \left\{ \begin{bmatrix} a & b \\ -a & d \end{bmatrix}; a, b, d \in R \right\}$.

If $m = \dim(W_1 \cap W_2)$ & $n = \dim(W_1 + W_2)$ then $m + n$ is

(a) 5 (b) 6

(c) 7 (d) 8

Q.5. Let $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 3 \\ x & y & z \end{bmatrix}$ and let $V = \{(x, y, z) \in R^3; \det A = 0\}$.

Then dimension of V equals to

(a) 0 (b) 1

(c) 2 (d) 3

Q.1. Which of the following is a linear transformation from R^3 to R^2?

(A) $f\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 4 \\ x+y \end{pmatrix}$

(B) $g\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} xy \\ x+y \end{pmatrix}$

(C) $h\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} z-x \\ x+y \end{pmatrix}$

(a) Only f

(b) Only g

(c) Only h

(d) All of the above

Q.2. Let $T : R^3 \rightarrow R^3$ be the linear transformation defined by $T(x, y, z) = (x + y, y + z, z + x)$ for all $(x, y, z) \in R^3$. Then

(a) rank (T) = 0, nullity (T) = 3

(b) rank(T) = 2, nullity (T) = 1

(c) rank(T) = 1, nullity (T) = 2

(d) rank (T) = 3, nullity (T) = 0

2022_09_29_09

Q.3 Let $T : R^4 \to R^4$ be a linear map defined by $T(x, y, z, w) = (x + z, 2x + y + 3z, 2y + 2z, w)$. The rank of T is equal to

(a) 1 (b) 2

(c) 3 (d) 4

Q.4. Let N be the vector space of all real polynomial of degree atmost 3. Define $S : N \to N$ by $(S)p(x) = p(x + 1)$, $p \in N$. and the matrix of S in the basis $\{1, x, x^2, x^3\}$ considered as column vector then which of the following is true?

(a) S is upper triangular matrix with determinant 1.

(b) S is singular matrix

(c) S is upper triangular matrix with trace 1.

(d) S is identity matrix.

Q.5. Let A be a matrix of order n and let V be the vector space of all real $n \times n$ matrix X such that $AX = 0$. what is dimension of V. **CSIR NET JUNE 2022**

(a) nr (b) n^2r

(c) $n^2 - nr$ (d) n

Q.6 Let $M_2(R)$ denote the set of 2×2 real matrices. Let $A \in M_2(R)$ be a trace 2 and determinant -3. Identifying $M_2(R)$ with R^4, consider the linear transformation $T : M_2(R) \to M_2(R)$ defined by $T(B) = AB$. Then which of the following statements are true?

(a) T is diagonalizable

(b) 2 is an eigenvalues of T

(c) T is invertible

(d) $T(B) = B$ for some $0 \neq B$ is $M_2(R)$

Q.7 Let $T : R^4 \to R^4$ be the linear map satisfying $T(e_1) = e_2$, $T(e_2) = e_3$, $T(e_3) = 0$, $T(e_4) = e_3$ where $\{e_1, e_2, e_3, e_4\}$ is the standard basis of R^4. Then

(a) T is idempotent
(b) T is invertible
(c) $\text{Rank}(T) = 3$
(d) T is nilpotent

Q.8 Let $R^{2\times2}$ be the real vector space of all 2×2 real matrices for $Q=\begin{bmatrix}1 & -2\\ -2 & 4\end{bmatrix}$, define a linear transformation T on $R^{2\times2}$ as $T(P)=QP$. Then the rank of T is

(a) 1 (b) 2

(c) 3 (d) 4