

# CUET Mathematics Test

Chapter: Unit II: Algebra (Matrices and Determinants)

## SOLUTIONS

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## Solutions

- Solution:**  $(I + A)^3 - 7A = I^3 + 3I^2A + 3IA^2 + A^3 - 7A$ . Given  $A^2 = A$ , so  $A^3 = A^2 \cdot A = A \cdot A = A$ . Expression becomes  $I + 3A + 3A + A - 7A = I + 7A - 7A = I$ . **Correct Option: (C)**
- Solution:**  $A_{2 \times 3} \times B_{3 \times 2} = (AB)_{2 \times 2}$ . The transpose of a  $2 \times 2$  matrix is also  $2 \times 2$ . **Correct Option: (B)**
- Solution:** For a singular matrix,  $|A| = 0$ .  $2(5) - 3(k) = 0 \implies 10 - 3k = 0 \implies k = 10/3$ . **Correct Option: (A)**
- Solution:** For a matrix of order  $n$ ,  $|\text{adj}(A)| = |A|^{n-1}$ . Here  $n = 3$ , so  $|\text{adj}(A)| = 5^{3-1} = 5^2 = 25$ . **Correct Option: (B)**
- Solution:** Unique solution exists if  $|A| \neq 0$ .  $|A| = 1(k + 2) - 1(2k + 3) + 1(4 - 3) = k + 2 - 2k - 3 + 1 = -k$ . For unique solution,  $-k \neq 0 \implies k \neq 0$ . **Correct Option: (A)**
- Solution:**  $A^T A = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix} \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix} = \begin{bmatrix} \cos^2 \theta + \sin^2 \theta & 0 \\ 0 & \sin^2 \theta + \cos^2 \theta \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$ . **Correct Option: (B)**
- Solution:** Let  $C = AB - BA$ .  $C^T = (AB - BA)^T = (AB)^T - (BA)^T = B^T A^T - A^T B^T$ . Since  $A, B$  are symmetric,  $A^T = A, B^T = B$ .  $C^T = BA - AB = -(AB - BA) = -C$ . Thus, it is skew-symmetric. **Correct Option: (B)**
- Solution:** For order  $n$ ,  $|kA| = k^n |A|$ . Here  $n = 3, k = 2$ , so  $|2A| = 2^3 |A| = 8 \times 2 = 16$ . **Correct Option: (C)**
- Solution:**  $|A| = 4 - 6 = -2$ .  $\text{adj}(A) = \begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$ .  $A^{-1} = \frac{1}{-2} \begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 1.5 & -0.5 \end{bmatrix}$ . **Correct Option: (A)**
- Solution:** Area =  $\frac{1}{2}|2(1 - 8) - 7(1 - 10) + 1(8 - 10)| = \frac{1}{2}|2(-7) - 7(-9) + 1(-2)| = \frac{1}{2}|-14 + 63 - 2| = \frac{1}{2}|47| = 23.5$ . **Correct Option: (B)**
- Solution:**  $AA^{-1} = I \implies \det(A \cdot A^{-1}) = \det(I) \implies \det(A) \cdot \det(A^{-1}) = 1 \implies \det(A^{-1}) = 1/\det(A)$ . **Correct Option: (B)**
- Solution:**  $x + y = 6, xy = 8$ . These are roots of  $t^2 - 6t + 8 = 0$ , which are 4 and 2.  $5 + z = 5 \implies z = 0$ . So  $(4, 2, 0)$  or  $(2, 4, 0)$ . **Correct Option: (C)**
- Solution:**  $A^2 = \begin{bmatrix} 0 & 2 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 2 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = O$ . Thus  $A^3 = A^4 = \dots = O$ .  $f(A) = I + A + O + \dots = I + A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 2 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ . **Correct Option: (A)**
- Solution:** Determinant of a skew-symmetric matrix of odd order is always 0. **Correct Option: (C)**
- Solution:** This is the condition for an inconsistent system with no solution. **Correct Option: (C)**
- Solution:**  $a_{ji} = j - i = -(i - j) = -a_{ij}$ . Therefore  $A^T = -A$ , making it skew-symmetric. **Correct Option: (B)**

17. **Solution:** For  $2 \times 2$  matrix, interchange diagonal elements and change signs of off-diagonal elements. **Correct Option: (A)**
18. **Solution:**  $(A - B)(A + B) = A^2 + AB - BA - B^2$ . For this to equal  $A^2 - B^2$ ,  $AB - BA$  must be  $O$ , so  $AB = BA$ . **Correct Option: (A)**
19. **Solution:** Trace is sum of diagonal elements:  $1 + 5 + 9 = 15$ . **Correct Option: (A)**
20. **Solution:** Use Mathematical Induction or verify for  $k = 1, 2$ . For  $k = 1$ :  $\begin{bmatrix} 1+2 & -4 \\ 1 & 1-2 \end{bmatrix} = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix} = A$ . **Correct Option: (A)**

Would you like me to generate a **\*\*Case Study\*\*** based on a system of linear equations (Word Problem) or convert this into an **\*\*interactive HTML quiz\*\***?