CUET (UG) – MATHEMATICS

Chapter Test - Unit II: Algebra - Matrices

SOLUTIONS

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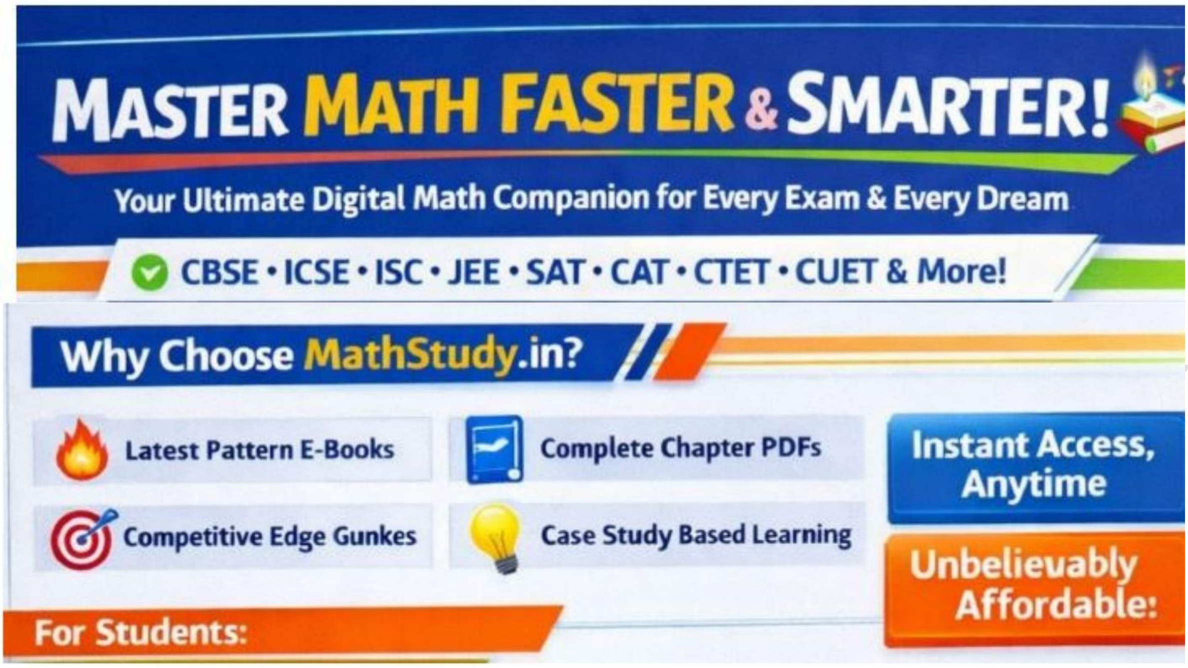

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Solutions

1. **Correct Option: (D)**. Expand $(A-I)^3+(A+I)^3 = (A^3-3A^2+3A-I)+(A^3+3A^2+3A+I) = 2A^3+6A$. Since $A^2 = I$, then $A^3 = A$. So $2A+6A = 8A$. Thus $8A-7A = A$. (Wait, re-calculating: $(A-I)^3+(A+I)^3-7A = (A^3-3A^2+3A-I)+(A^3+3A^2+3A+I)-7A = 2A^3+6A-7A$. Since $A^3 = A$, $2A+6A-7A = A$. Correct option: (A).

2. **Correct Option: (A)**. $a_{ij} = \frac{(i+2j)^2}{2}$. For a_{23}, $i = 2, j = 3$. $a_{23} = \frac{(2+2(3))^2}{2} = \frac{(8)^2}{2} = \frac{64}{2} = 32$.

3. **Correct Option: (B)**. Let $B = A - A'$. $B' = (A-A')' = A' - (A')' = A' - A = -(A-A') = -B$. Thus, it is skew-symmetric.

4. **Correct Option: (B)**. $A^2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$. Since $A^2 = I$, $A^4 = (A^2)^2 = I^2 = I$.

5. **Correct Option: (B)**. $A^2 = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$. $2A = \begin{bmatrix} 2 & 4 \\ 4 & 2 \end{bmatrix}$. $3I = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$. $A^2-2A-3I = \begin{bmatrix} 5-2-3 & 4-4-0 \\ 4-4-0 & 5-2-3 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = O$.

6. **Correct Option: (B)**. Symmetric: $A' = A$. Skew-symmetric: $A' = -A$. Therefore $A = -A \implies 2A = O \implies A = O$.

7. **Correct Option: (A)**. $AB = \begin{bmatrix} 1(2)+0(1) & 1(0)+0(1) \\ 1(2)+1(1) & 1(0)+1(1) \end{bmatrix} = \begin{bmatrix} 2 & 0 \\ 3 & 1 \end{bmatrix}$.

8. **Correct Option: (A)**. $A^2 = A \cdot A = (AB)A = A(BA) = AB = A$. Similarly $B^2 = B$. So $A^2 + B^2 = A + B$.

9. **Correct Option: (A)**. Matrix of order 2×3 has 6 elements. Each element has 3 choices. Total $= 3^6$.

10. **Correct Option: (C)**. $a_{12} = a_{21} \implies x-1 = 2x+3 \implies x = -4$.

11. **Correct Option: (A)**. Let $C = AB - BA$. $C' = (AB-BA)' = B'A' - A'B'$. Given $A' = A, B' = -B$. $C' = (-B)A - A(-B) = -BA + AB = AB - BA = C$. Hence, symmetric.

12. **Correct Option: (A)**. The standard formula for the inverse of a 2×2 matrix is $\frac{1}{\det(A)}\text{adj}(A)$.

13. **Correct Option: (C)**. $A' = \begin{bmatrix} 0 & -5 \\ 5 & 0 \end{bmatrix} = -A$. Hence, skew-symmetric.

14. **Correct Option: (B)**. In an $m \times n$ matrix, each row has n elements. Here $n = 4$.

15. **Correct Option: (A)**. $A^2 = \begin{bmatrix} 10 & 15 \\ 15 & 25 \end{bmatrix}$. $kA + 5I = \begin{bmatrix} k+5 & 3k \\ 3k & 4k+5 \end{bmatrix}$. Comparing $3k = 15$, we get $k = 5$.

16. **Correct Option: (C)**. The transpose of the sum of matrices is the sum of their transposes.

17. **Correct Option: (A)**. This can be proven by induction. For $n = 2$, $A^2 = \begin{bmatrix} \lambda^2 & 2\lambda \\ 0 & \lambda^2 \end{bmatrix}$, which fits the formula.

18. **Correct Option: (B)**. Scalar multiplication and transpose commute: $(kA)' = kA'$.
19. **Correct Option: (C)**. Matrix multiplication is not generally commutative ($AB \neq BA$ in most cases).
20. **Correct Option: (B)**. $A^2 = \begin{bmatrix} i^2 & 0 \\ 0 & i^2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = -I$.