CUET Mathematics Test

Section B2: Applied Mathematics - Unit II: Algebra

General Instructions

1. Total Questions: **15**
2. Duration: **60 Minutes**
3. All questions are compulsory.
4. Each question carries **5 marks**.
5. For each correct answer: **+5 marks**.
6. For each incorrect answer: **-1 mark**.
7. No negative marking for unanswered questions.
8. Use of calculator or electronic devices is strictly prohibited.
9. Choose the most appropriate answer from the given options.

1. If A is a square matrix of order 3 such that $|A| = 5$, then the value of $|adj(A)|$ is:
   (A) 5
   (B) 25
   (C) 125
   (D) $1/5$

2. If $A = \begin{bmatrix} 2 & \lambda \\ -3 & 4 \end{bmatrix}$ is a non-invertible matrix, then the value of λ is:
   (A) $8/3$
   (B) $-8/3$
   (C) 6
   (D) -6

3. For a system of linear equations $AX = B$, if $|A| = 0$ and $(adjA)B \neq O$, then the system has:
   (A) A unique solution
   (B) Infinitely many solutions
   (C) No solution
   (D) Exactly two solutions

4. If A and B are invertible matrices of the same order, then $(AB)^{-1}$ is equal to:
   (A) $A^{-1}B^{-1}$
   (B) $B^{-1}A^{-1}$
   (C) AB^{-1}
   (D) BA^{-1}

5. The value of the determinant $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix}$ is:
   (A) 0
   (B) $a + b + c$
   (C) 1
   (D) $(a - b)(b - c)(c - a)$

6. If A is a 3×3 matrix and $|3A| = k|A|$, then the value of k is:
   (A) 3
   (B) 9
   (C) 27
   (D) 81

7. The area of a triangle with vertices $(2, -6), (5, 4)$ and $(k, 4)$ is 35 sq units. The values of k are:
   (A) $12, -2$
   (B) $-12, -2$
   (C) $12, 2$
   (D) $8, -2$

8. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then $A^2 - 5A$ is equal to:
   (A) $2I$
   (B) $-2I$
   (C) I
   (D) O

9. Let A be a non-singular matrix of order 3. If $A^2 = I$, then $|A|$ is:
   (A) 1 only
   (B) -1 only
   (C) ± 1
   (D) 0

10. If x, y, z are non-zero real numbers, the inverse of matrix $A = \begin{bmatrix} x & 0 & 0 \\ 0 & y & 0 \\ 0 & 0 & z \end{bmatrix}$ is:
   (A) $\begin{bmatrix} x^{-1} & 0 & 0 \\ 0 & y^{-1} & 0 \\ 0 & 0 & z^{-1} \end{bmatrix}$
   (B) $\frac{1}{xyz}\begin{bmatrix} x & 0 & 0 \\ 0 & y & 0 \\ 0 & 0 & z \end{bmatrix}$
   (C) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
   (D) $\begin{bmatrix} x & 0 & 0 \\ 0 & y & 0 \\ 0 & 0 & z \end{bmatrix}$

11. If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, then $A + A^T = I$, if the value of α is:
   (A) $\pi/6$
   (B) $\pi/3$
   (C) π
   (D) $3\pi/2$

12. The sum of the products of elements of any row with the cofactors of the same row is:
   (A) 0
   (B) 1
   (C) $|A|$
   (D) $|A|^2$

13. If $A = \begin{bmatrix} 0 & 2 \\ 0 & 0 \end{bmatrix}$, then A^{10} is:
   (A) $\begin{bmatrix} 0 & 20 \\ 0 & 0 \end{bmatrix}$
   (B) $\begin{bmatrix} 0 & 1024 \\ 0 & 0 \end{bmatrix}$
   (C) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$
   (D) $\begin{bmatrix} 0 & 2 \\ 0 & 0 \end{bmatrix}$

14. If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $adjA$ is:
   (A) $\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

(B) $\begin{bmatrix} d & -c \\ -b & a \end{bmatrix}$

(C) $\begin{bmatrix} a & -b \\ -c & d \end{bmatrix}$

(D) $\begin{bmatrix} -d & b \\ c & -a \end{bmatrix}$

15. Consider the system $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$. The system has infinite solutions if:
    (A) $\lambda = 3, \mu = 10$
    (B) $\lambda \neq 3, \mu = 10$
    (C) $\lambda = 3, \mu \neq 10$
    (D) $\lambda \neq 3, \mu \neq 10$

16. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ a & b & -1 \end{bmatrix}$, then A^2 is:
    (A) A
    (B) $-A$
    (C) I
    (D) O

17. If the points $(x, -2), (5, 2), (8, 8)$ are collinear, then x is:
    (A) 3
    (B) -3
    (C) 1
    (D) 4

18. For a square matrix A, $A(adjA)$ is equal to:
    (A) $|A|I$
    (B) $|A|^2 I$
    (C) I
    (D) A^{-1}

19. If $A = \begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$ and $A^{-1} = kA$, then k is:
    (A) 19
    (B) 1/19
    (C) -19
    (D) -1/19

20. If A is a square matrix such that $A^2 = A$, then $(I + A)^3 - 7A$ is:
    (A) A
    (B) $I - A$
    (C) I
    (D) $3A$

Solutions

1. **Correct Option: (B)**. $|adjA| = |A|^{n-1}$. For $n = 3$, $|adjA| = 5^{3-1} = 25$.

2. **Correct Option: (B)**. Non-invertible means $|A| = 0 \implies 8 - (-3\lambda) = 0 \implies 3\lambda = -8 \implies \lambda = -8/3$.

3. **Correct Option: (C)**. The condition $|A| = 0$ and $(adjA)B \neq 0$ defines an inconsistent system with no solution.

4. **Correct Option: (B)**. This is the Reversal Law of Inverses: $(AB)^{-1} = B^{-1}A^{-1}$.

5. **Correct Option: (A)**. Adding C_2 to C_3 makes C_3 a multiple of C_1 (all elements $a+b+c$), hence the determinant is 0.

6. **Correct Option: (C)**. $|3A| = 3^3|A| = 27|A|$. So $k = 27$.

7. **Correct Option: (A)**. Solving $\frac{1}{2}|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)| = 35$ yields $k = 12$ and $k = -2$.

8. **Correct Option: (A)**. Calculation of A^2 yields $\begin{bmatrix} 7 & 10 \\ 15 & 22 \end{bmatrix}$. Subtracting $5A$ results in $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} = 2I$.

9. **Correct Option: (C)**. $|A^2| = |I| \implies |A|^2 = 1 \implies |A| = \pm 1$.

10. **Correct Option: (A)**. The inverse of a diagonal matrix is a diagonal matrix with reciprocals of the original entries.

11. **Correct Option: (B)**. $A + A^T = \begin{bmatrix} 2\cos\alpha & 0 \\ 0 & 2\cos\alpha \end{bmatrix} = I$. $2\cos\alpha = 1 \implies \alpha = \pi/3$.

12. **Correct Option: (C)**. This is the standard expansion property of determinants.

13. **Correct Option: (C)**. Since A^2 is the zero matrix O, all powers A^n where $n \geq 2$ are also O.

14. **Correct Option: (A)**. To find $adjA$ for 2×2, swap a and d, and change the signs of b and c.

15. **Correct Option: (A)**. For infinite solutions, the planes must be dependent. $\lambda = 3$ and $\mu = 10$ makes the second and third equations identical.

16. **Correct Option: (C)**. Multiplying A by itself results in the Identity matrix I.

17. **Correct Option: (A)**. Area of triangle formed by collinear points is 0. Solving the determinant/slope equation gives $x = 3$.

18. **Correct Option: (A)**. By the definition of inverse, $A \cdot adjA = |A|I$.

19. **Correct Option: (B)**. $|A| = -19$. $A^{-1} = \frac{1}{-19}\begin{bmatrix} -2 & -3 \\ -5 & 2 \end{bmatrix} = \frac{1}{19}\begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix} = \frac{1}{19}A$. So $k = 1/19$.

20. **Correct Option: (C)**. $(I + A)^3 - 7A = I + 3A + 3A^2 + A^3 - 7A$. Since $A^2 = A$ and $A^3 = A$, this becomes $I + 7A - 7A = I$.

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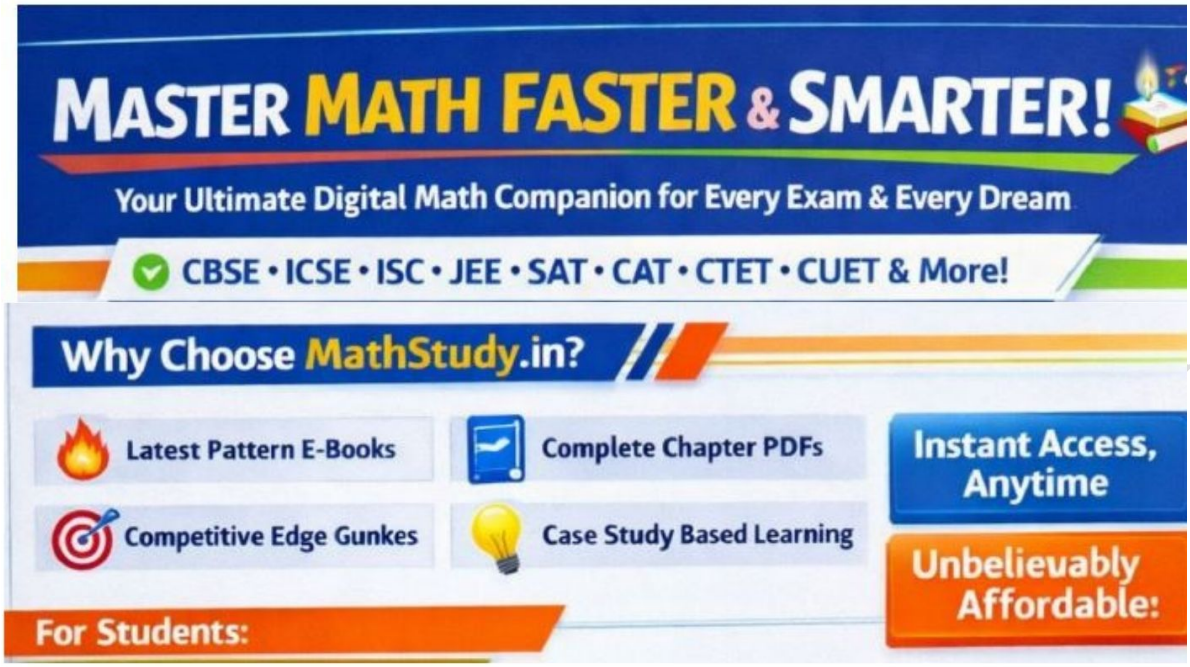

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