PRACTICE PAPER 01 (2026-27) – ANSWER KEY WITH SOLUTIONS
CHAPTER 04 : DETERMINANTS

SUBJECT: MATHEMATICS	**MAX. MARKS:** 40
CLASS: XII	**DURATION:** 1½ hrs

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. $|3A|$ for 3×3 matrix A, $|A| = -2$

Ans: (b) −54

$|kA| = k^n|A|$ for a matrix of order n. So $|3A| = 3^3(-2) = -54$.

2. Equation in x

Ans: (c) ±5

$x^2 - 12 = 5(1) - (-2)(4) = 13 \Rightarrow x^2 = 25 \Rightarrow x = \pm 5$.

3. Cofactor of 4 (element a_{21})

Ans: (a) 4

Minor $M_{21} = \begin{vmatrix} -1 & 3 \\ 2 & -2 \end{vmatrix} = 2 - 6 = -4$.

Cofactor $A_{21} = (-1)^{2+1}(-4) = 4$.

4. $|ABA'|$

Ans: (d) −12

$|ABA'| = |A||B||A'| = |A||B||A| = 2(-3)(2) = -12$.

5. Skew-symmetric matrix of odd order

Ans: (b) 0

$A' = -A \Rightarrow |A'| = |-A| \Rightarrow |A| = (-1)^n|A| = -|A|$ for odd n. So $2|A| = 0$, i.e. $|A| = 0$.

6. Singular matrix

Ans: (c) k = 3 or k = −4

$|A| = k(k+1) - 12 = k^2 + k - 12 = (k-3)(k+4) = 0 \Rightarrow k = 3$ or $k = -4$.

7. adj $\begin{bmatrix} 2 & -3 \\ 5 & 1 \end{bmatrix}$

Ans: (b) $\begin{bmatrix} 1 & 3 \\ -5 & 2 \end{bmatrix}$

For a 2×2 matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, adj $= \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$. So adj A $= \begin{bmatrix} 1 & 3 \\ -5 & 2 \end{bmatrix}$.

8. Value of the determinant

Ans: (a) ½

Value $= \cos 75° \cos 15° + \sin 75° \sin 15° = \cos(75° - 15°) = \cos 60° = ½$.

9. Assertion–Reason

Ans: (c) A is true but R is false

A is true: $A^{-1} = \text{adj } A/|A|$ exists only if $|A| \neq 0$.

R is false: a singular matrix has no inverse.

10. Assertion–Reason

Ans: (b) Both A and R are true but R is not the correct explanation of A

Area = ½ $\begin{vmatrix} 1 & 2 & 1 \\ 2 & 4 & 1 \\ 3 & 6 & 1 \end{vmatrix}$ = 0 because the points are collinear ($C_2 = 2C_1$), so A is true.

R is a true property, but the area vanishes because the points are collinear, not because a row is zero. So R does not explain A.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. Show that $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix} = 0$

Apply $C_3 \to C_3 + C_2$: each entry of the new third column becomes a + b + c. (1)

$\Delta = (a+b+c)\begin{vmatrix} 1 & a & 1 \\ 1 & b & 1 \\ 1 & c & 1 \end{vmatrix}$ = 0, because C_1 and C_3 are identical. (1)

12. Area of the triangle

Area = ½|Δ|, where Δ = $\begin{vmatrix} 2 & -1 & 1 \\ 5 & 3 & 1 \\ -1 & 4 & 1 \end{vmatrix}$. (1)

Δ = 2(3 − 4) + 1(5 + 1) + 1(20 + 3) = −2 + 6 + 23 = 27. Area = **27/2 square units**. (1)

13. |A| = −4, order 3

|adj A| = $|A|^{n-1} = (-4)^2$ = **16**. (1)

$|A^{-1}| = 1/|A| = -¼$, so $|2A^{-1}| = 2^3 \cdot (-¼)$ = **−2**. (1)

14. Area = 4 sq. units

Area = ½ $\begin{vmatrix} k & 0 & 1 \\ 4 & 0 & 1 \\ 0 & 2 & 1 \end{vmatrix}$ = ½[k(0 − 2) − 0 + 1(8 − 0)] = ½(8 − 2k). (1)

So |8 − 2k|/2 = 4 ⇒ 8 − 2k = ±8 ⇒ **k = 0 or k = 8**. (1)

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Prove $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix} = (a-b)(b-c)(c-a)(a+b+c)$

Apply $C_1 \to C_1 - C_2$ and $C_2 \to C_2 - C_3$:

$\Delta = \begin{vmatrix} 0 & 0 & 1 \\ a-b & b-c & c \\ a^3-b^3 & b^3-c^3 & c^3 \end{vmatrix}$. (1)

Expand along R_1: Δ = $\begin{vmatrix} a-b & b-c \\ a^3-b^3 & b^3-c^3 \end{vmatrix}$.

Taking $(a - b)$ and $(b - c)$ common: $\Delta = (a - b)(b - c)\begin{vmatrix} 1 & 1 \\ a^2 + ab + b^2 & b^2 + bc + c^2 \end{vmatrix}$.

(1)

$= (a - b)(b - c)[(b^2 + bc + c^2) - (a^2 + ab + b^2)] = (a - b)(b - c)[(c^2 - a^2) + b(c - a)]$
$= (a - b)(b - c)(c - a)(a + b + c)$. Hence proved. (1)

16. $A = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -1 \\ 1 & 0 & 1 \end{bmatrix}$; adjoint and inverse

Cofactors: $A_{11} = 2$, $A_{12} = -(0 + 1) = -1$, $A_{13} = 0 - 2 = -2$,
$A_{21} = -(-1 - 0) = 1$, $A_{22} = 1 - 2 = -1$, $A_{23} = -(0 + 1) = -1$,
$A_{31} = (1 - 4) = -3$, $A_{32} = -(-1 - 0) = 1$, $A_{33} = 2 - 0 = 2$. (1)
adj A = (cofactor matrix)′ $= \begin{bmatrix} 2 & 1 & -3 \\ -1 & -1 & 1 \\ -2 & -1 & 2 \end{bmatrix}$. (1)

$|A| = 1(2) + (-1)(-1) + 2(-2) = 2 + 1 - 4 = -1 \neq 0$, so A^{-1} exists and A^{-1} = adj A/|A| =

$\begin{bmatrix} -2 & -1 & 3 \\ 1 & 1 & -1 \\ 2 & 1 & -2 \end{bmatrix}$. (1)

17. Line through (1, 2) and (3, −4)

Let (x, y) be any point on the line. The three points are collinear, so $\begin{vmatrix} x & y & 1 \\ 1 & 2 & 1 \\ 3 & -4 & 1 \end{vmatrix} = 0$. (1)

$x(2 + 4) - y(1 - 3) + 1(-4 - 6) = 0 \Rightarrow 6x + 2y - 10 = 0$. (1)
So the equation of the line is **3x + y = 5**. (Check: (1, 2) gives 5 and (3, −4) gives 5.) (1)

SECTION – D

Question 18 carries 5 marks.

18. $2x + y = 3$, $x + 3y + z = 2$, $y + z = 2$

$AX = B$, where $A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 3 & 1 \\ 0 & 1 & 1 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, $B = \begin{bmatrix} 3 \\ 2 \\ 2 \end{bmatrix}$. (1)

$|A| = 2(3 - 1) - 1(1 - 0) + 0 = 4 - 1 = 3 \neq 0$, so A^{-1} exists and the solution is unique. (1)
Cofactors: $A_{11} = 2$, $A_{12} = -1$, $A_{13} = 1$, $A_{21} = -1$, $A_{22} = 2$, $A_{23} = -2$, $A_{31} = 1$, $A_{32} = -2$, $A_{33} = 5$. (1)

adj $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -2 \\ 1 & -2 & 5 \end{bmatrix}$, so $A^{-1} = \frac{1}{3}\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -2 \\ 1 & -2 & 5 \end{bmatrix}$. (1)

$X = A^{-1}B = \frac{1}{3}\begin{bmatrix} 2(3) - 2 + 2 \\ -3 + 2(2) - 2(2) \\ 3 - 2(2) + 5(2) \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 6 \\ -3 \\ 9 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}$.

x = 2, y = −1, z = 3. (1)

OR

AX = B, where $A = \begin{bmatrix} 1 & 4 & 3 \\ 2 & 3 & 2 \\ 1 & 2 & 1 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, $B = \begin{bmatrix} 3 \\ 3 \\ 1 \end{bmatrix}$. (1)

$|A| = 1(3 - 4) - 4(2 - 2) + 3(4 - 3) = -1 - 0 + 3 = 2 \neq 0$. (1)

Cofactors: $A_{11} = -1$, $A_{12} = 0$, $A_{13} = 1$, $A_{21} = 2$, $A_{22} = -2$, $A_{23} = 2$, $A_{31} = -1$, $A_{32} = 4$, $A_{33} = -5$. (1)

adj $A = \begin{bmatrix} -1 & 2 & -1 \\ 0 & -2 & 4 \\ 1 & 2 & -5 \end{bmatrix}$, so $A^{-1} = \frac{1}{2} \begin{bmatrix} -1 & 2 & -1 \\ 0 & -2 & 4 \\ 1 & 2 & -5 \end{bmatrix}$. (1)

$X = A^{-1}B = \frac{1}{2} \begin{bmatrix} -3 + 6 - 1 \\ -6 + 4 \\ 3 + 6 - 5 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 2 \\ -2 \\ 4 \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$. **x = 1, y = −1, z = 2.** (1)

SECTION – E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. Triangular garden A(−2, 1), B(5, −1), C(2, 5)

(i) Area = ½|Δ|, where $\Delta = \begin{vmatrix} -2 & 1 & 1 \\ 5 & -1 & 1 \\ 2 & 5 & 1 \end{vmatrix}$. (1)

(ii) $\Delta = -2(-1 - 5) - 1(5 - 2) + 1(25 + 2) = 12 - 3 + 27 = 36$. Area = ½(36) = 18 grid units² = 18 × (10 m)² = **1800 m²**. (1)

(iii) For (x, y) on line BC: $\begin{vmatrix} x & y & 1 \\ 5 & -1 & 1 \\ 2 & 5 & 1 \end{vmatrix} = 0$. (1)

$x(-1 - 5) - y(5 - 2) + 1(25 + 2) = 0 \Rightarrow -6x - 3y + 27 = 0 \Rightarrow$ **2x + y = 9**. (1)

OR

(iii) B, C and D are collinear, so $\begin{vmatrix} k & 3 & 1 \\ 5 & -1 & 1 \\ 2 & 5 & 1 \end{vmatrix} = 0$. (1)

$k(-1 - 5) - 3(5 - 2) + 1(25 + 2) = 0 \Rightarrow -6k - 9 + 27 = 0 \Rightarrow$ **k = 3**. (Check: 2(3) + 3 = 9.) (1)

20. Pens, notebooks and files

(i) $\begin{bmatrix} 2 & 3 & 2 \\ 1 & 2 & 1 \\ 2 & 2 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 32 \\ 19 \\ 32 \end{bmatrix}$, i.e. AX = B. (1)

(ii) $|A| = 2(8 - 2) - 3(4 - 2) + 2(2 - 4) = 12 - 6 - 4 = 2$. Since $|A| \neq 0$, the system has a unique solution. (1)

(iii) $X = A^{-1}B = \frac{1}{2} \begin{bmatrix} 6(32) - 8(19) - 32 \\ -2(32) + 4(19) \\ -2(32) + 2(19) + 32 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 8 \\ 12 \\ 6 \end{bmatrix} = \begin{bmatrix} 4 \\ 6 \\ 3 \end{bmatrix}$. (1)

So a pen costs **₹4**, a notebook **₹6** and a file **₹3**. (1)

OR

(iii) Now $B = \begin{bmatrix} 22 \\ 13 \\ 22 \end{bmatrix}$ and $X = A^{-1}B = \frac{1}{2}\begin{bmatrix} 6(22) - 8(13) - 22 \\ -2(22) + 4(13) \\ -2(22) + 2(13) + 22 \end{bmatrix}$. (1)

$= \frac{1}{2}\begin{bmatrix} 6 \\ 8 \\ 4 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \\ 2 \end{bmatrix}$. New prices: pen **₹3**, notebook **₹4**, file **₹2**. (1)

— End of Solutions —