

Mathematics

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(Chapter - 4) (Determinants)

(Class 12)

Exercise 4.1

Evaluate the determinants in Exercises 1 and 2.

Question 1:

$$\begin{vmatrix} 2 & 4 \\ -5 & -1 \end{vmatrix}$$

Answer 1:

$$\begin{vmatrix} 2 & 4 \\ -5 & -1 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get} \\ = 2 \times (-1) - 4 \times (-5) = -2 + 20 = 18$$

Question 2:

$$(i) \begin{vmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{vmatrix} \quad (ii) \begin{vmatrix} x^2 - x + 1 & x - 1 \\ x + 1 & x + 1 \end{vmatrix}$$

Answer 2:

$$(i) \begin{vmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{vmatrix} = \cos \theta \times \cos \theta - \sin \theta \times (-\sin \theta) = \cos^2 \theta + \sin^2 \theta = 1$$

$$(ii) \begin{vmatrix} x^2 - x + 1 & x - 1 \\ x + 1 & x + 1 \end{vmatrix} = (x^2 - x + 1) \times (x + 1) - (x - 1) \times (x + 1) \\ = x^3 + x^2 - x^2 - x + x + 1 - (x^2 + x - x - 1) \\ = x^3 - x^2 + 2$$

Question 3:

If $A = \begin{bmatrix} 1 & 2 \\ 4 & 2 \end{bmatrix}$, then show that $|2A| = 4|A|$

Answer 3:

$$|2A| = \begin{vmatrix} 2 & 4 \\ 8 & 4 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get} \\ = 2 \times 4 - 4 \times 8 = 8 - 32 = -24 \quad \dots (1)$$

$$4|A| = 4 \begin{vmatrix} 1 & 2 \\ 4 & 2 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get} \\ = 4(1 \times 2 - 2 \times 4) = 4(-6) = -24 \quad \dots (2)$$

From the equation (1) and (2), we get, $|2A| = 4|A|$

Question 4:

If $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{bmatrix}$, then show that $|3A| = 27|A|$

Answer 4:

$$|3A| = \begin{vmatrix} 3 & 0 & 3 \\ 0 & 3 & 6 \\ 0 & 0 & 12 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get} \\ = 3(36 - 0) - 0(0 - 0) + 1(0 - 0) = 108 \quad \dots (1)$$

$$27|A| = 27 \begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get} \\ = 27\{1(4 - 0) - 0(0 - 0) + 1(0 - 0)\} = 27(4) = 108 \quad \dots (2)$$

From the equation (1) and (2), we get, $|3A| = 27|A|$

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Question 5:

Evaluate the determinants:

$$(i) \begin{vmatrix} 3 & -1 & -2 \\ 0 & 0 & -1 \\ 3 & -5 & 0 \end{vmatrix} \quad (ii) \begin{vmatrix} 3 & -4 & 5 \\ 1 & 1 & -2 \\ 2 & 3 & 1 \end{vmatrix} \quad (iii) \begin{vmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{vmatrix} \quad (iv) \begin{vmatrix} 2 & -1 & -2 \\ 0 & 2 & -1 \\ 3 & -5 & 0 \end{vmatrix}$$

Answer 5:

$$(i) \begin{vmatrix} 3 & -1 & -2 \\ 0 & 0 & -1 \\ 3 & -5 & 0 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get}$$
$$= 3(0 - 5) + 1(0 + 3) - 2(0 - 0) = -15 + 3 - 0 = -12$$

$$(ii) \begin{vmatrix} 3 & -4 & 5 \\ 1 & 1 & -2 \\ 2 & 3 & 1 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get}$$
$$= 3(1 + 6) + 4(1 + 4) + 5(3 - 2) = 21 + 20 + 5 = 46$$

$$(iii) \begin{vmatrix} 0 & 1 & 2 \\ -1 & 0 & -3 \\ -2 & 3 & 0 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get}$$
$$= 0(0 + 9) - 1(0 - 6) + 2(-3 - 0) = 0 + 6 - 6 = 0$$

$$(iv) \begin{vmatrix} 2 & -1 & -2 \\ 0 & 2 & -1 \\ 3 & -5 & 0 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get}$$
$$= 2(0 - 5) + 1(0 + 3) - 2(0 - 6) = -10 + 3 + 12 = 5$$

Question 6:

If $A = \begin{bmatrix} 1 & 1 & -2 \\ 2 & 1 & -3 \\ 5 & 4 & -9 \end{bmatrix}$, find $|A|$.

Answer 6:

$$|A| = \begin{vmatrix} 1 & 1 & -2 \\ 2 & 1 & -3 \\ 5 & 4 & -9 \end{vmatrix} \quad \text{Expanding along } R_1, \text{ we get}$$
$$= 1(-9 + 12) - 1(-18 + 15) - 2(8 - 5) = 3 + 3 - 6 = 0$$

Question 7:

Find values of x , if

$$(i) \begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix} \quad (ii) \begin{vmatrix} 2 & 3 \\ 4 & 5 \end{vmatrix} = \begin{vmatrix} x & 3 \\ 2x & 5 \end{vmatrix}$$

Answer 7:

$$(i) \begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix}$$
$$\Rightarrow 2 - 20 = 2x^2 - 24 \quad \Rightarrow x^2 = 3 \quad \Rightarrow x = \pm\sqrt{3}$$

$$(ii) \begin{vmatrix} 2 & 3 \\ 4 & 5 \end{vmatrix} = \begin{vmatrix} x & 3 \\ 2x & 5 \end{vmatrix}$$
$$\Rightarrow 10 - 12 = 5x - 6x \quad \Rightarrow -2 = -x \quad \Rightarrow x = 2$$

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Question 8:

If $\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$, then x is equal to:

(A) 6

(B) ± 6

(C) -6

(D) 0

Answer 8:

$$\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$$

$$\Rightarrow x^2 - 36 = 36 - 36$$

$$\Rightarrow x^2 = 36$$

$$\Rightarrow x = \pm 6$$

Hence, the option (B) is correct.

