Applications of determinants in finding the area of triangle.

SUBJECT : (Mathematics)
CHAPTER NUMBER: 04
CHAPTER NAME : Determinant

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Applications of determinants in finding the area of a triangle.

Area of a Triangle:-

Let $(x_1, y_1), (x_2, y_2)$ and (x_3, y_3) be the vertices of a triangle, then

Area of Triangle $= \frac{1}{2}\left[x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\right]$

$$\Delta = \frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

Note:-

- Area is a positive quantity, we always take the absolute value or the determinant.
- If area is given, use both positive and negative values of the determinant for calculation.

The area of the triangle formed by three collinear points is zero.

Example:-

Q1) Find the area of triangle with vertices $(3,8),(-4,2),(5,1)$

Answer:

The area of triangle is given by

$$\Delta = \frac{1}{2}\begin{vmatrix} 3 & 8 & 1 \\ -4 & 2 & 1 \\ 5 & 1 & 1 \end{vmatrix}$$

$$= \frac{1}{2}\left[3(2-1)-8(-4-5)+1(-4-10)\right]$$

$$= \frac{1}{2}\left(3+72-14\right) = \frac{61}{2}$$

2. Find the equation of line joining $A(1,3), B(0,0)$ and determinant find K if $C(K,0)$ is a point such that area of ΔABC is 3sq unit.

Answer:

Let P (x, y) be any point on AB. Then, area of triangle ABP is zero

$$\frac{1}{2}\begin{vmatrix} 0 & 0 & 1 \\ 1 & 3 & 1 \\ x & y & 1 \end{vmatrix} = 0$$

This gives $\frac{1}{2}(y-3x) = 0$ or $y = 3x$,

which is the equation of required line AB.

Also, since the area of the triangle ABD is 3 sq. units, we have

$$\frac{1}{2}\begin{vmatrix} 1 & 3 & 1 \\ 0 & 0 & 1 \\ k & 0 & 1 \end{vmatrix} = \pm 3$$

This gives, $\frac{-3k}{2} = \pm 3$, i.e., $k = \mp 2$.

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