**CBSE Class–12 Mathematics**

**NCERT solution**

**Chapter - 4**

**Determinants - Exercise 4.3**

**1. Find the area of the triangle with vertices at the points given in each of the following:**

**(i) (1, 0), (6, 0), (4, 3)**

**(ii) (2, 7), (1, 1), (10, 8)**

**(iii)** $(-2,-3),(3,2),(-1,-8)$

**Ans. (i)** Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$

= $\left|\frac{1}{2}\begin{bmatrix} 1 & 0 & 1 \\ 6 & 0 & 1 \\ 4 & 3 & 1 \end{bmatrix}\right|$

= $\left|\frac{1}{2}\left[1(0-3)-0(6-4)+1(18-0)\right]\right|$

= $\left|\frac{1}{2}(-3+18)\right|$

= $\left|\frac{15}{2}\right|$ = $\frac{15}{2}$ sq. units

**(ii)** Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$

$$= \left|\frac{1}{2}\begin{bmatrix} 2 & 7 & 1 \\ 1 & 1 & 1 \\ 10 & 8 & 1 \end{bmatrix}\right|$$

$$= \left|\frac{1}{2}\left[2(1-8)-7(1-10)+1(8-10)\right]\right|$$

$$= \left|\frac{1}{2}\left[2(-7)-7(-9)-2\right]\right|$$

$$= \left|\frac{1}{2}(-14+63-2)\right|$$

$$= \left|\frac{1}{2}(63-16)\right|$$

$$= \left|\frac{47}{2}\right| = \frac{47}{2} \text{ sq. units}$$

**(iii)** Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$

$$= \left|\frac{1}{2}\begin{bmatrix} -2 & -3 & 1 \\ 3 & 2 & 1 \\ -1 & -8 & 1 \end{bmatrix}\right|$$

$$= \left|\frac{1}{2}\left[-2(2+8)-(-3)(3+1)+1(-24+2)\right]\right|$$

$$= \left|\frac{1}{2}\left[-2(10)+3(4)-22\right]\right|$$

= $\left|\frac{1}{2}(-20+12-22)\right|$

= $\left|\frac{1}{2}\times(-30)\right|$

= $\left|\frac{1}{2}\times 30\right|$ = 15 sq. units

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**2. Show that the points A$(a, b+c)$, B$(b, c+a)$, C$(c, a+b)$ are collinear.**

**Ans.** Area of triangle ABC = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ = $\left|\frac{1}{2}\begin{bmatrix} a & b+c & 1 \\ b & c+a & 1 \\ c & a+b & 1 \end{bmatrix}\right|$

= $\left|\frac{1}{2}\left[a(c+a-a-b)-(b+c)(b-c)+1\{b(a+b)-c(c+a)\}\right]\right|$

= $\left|\frac{1}{2}\left[a(c-b)-(b^2-c^2)+(ab+b^2-c^2-ac)\right]\right|$

= $\left|\frac{1}{2}(ac-ab-b^2+c^2+ab+b^2-c^2-ac)\right|$

= $\left|\frac{1}{2}\times 0\right|$ = 0

Therefore, points A, B and C are collinear.

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**3. Find values of $k$ if area of triangle is 4 sq. units and vertices are:**

**(i)** $(k, 0), (4, 0), (0, 2)$

**(ii)** $(-2, 0), (0, 4), (0, k)$

**Ans. (i)** Given: Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ = 4

$\Rightarrow$ Modulus of $\frac{1}{2}\begin{vmatrix} k & 0 & 1 \\ 4 & 0 & 1 \\ 0 & 2 & 1 \end{vmatrix}$ = 4

$\Rightarrow \left|\frac{1}{2}\left[k(0-2)-0+1(8-0)\right]\right| = 4$

$\Rightarrow \left|\frac{1}{2}(-2k+8)\right| = 4$

$\Rightarrow |-k+4| = 4$

$\Rightarrow -k+4 = \pm 4$

Taking positive sign, $-k+4=4$

$\Rightarrow k=0$

Taking negative sign, $-k+4=-4$

$\Rightarrow k=8$

**(ii)** Given: Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ = 4

$\Rightarrow \frac{1}{2}\begin{vmatrix} -2 & 0 & 1 \\ 0 & 4 & 1 \\ 0 & k & 1 \end{vmatrix}$ = 4

$\Rightarrow \left|\frac{1}{2}\left[-2(4-k)-0+1(0-0)\right]\right|=4$

$\Rightarrow \left|\frac{1}{2}(-8+2k)\right|=4$

$\Rightarrow |-k+4|=4$

$\Rightarrow -k+4=\pm 4$

Taking positive sign, $-k+4=4$

$\Rightarrow k=0$

Taking negative sign, $-k+4=-4$

$\Rightarrow k=8$

**4. (i) Find the equation of the line joining (1, 2) and (3, 6) using determinants.**

**(ii) Find the equation of the line joining (3, 1) and (9, 3) using determinants.**

**Ans. (i)** Let P$(x, y)$ be any point on the line joining the points (1, 2) and (3, 6).

Then, Area of triangle that could be formed by these points is zero.

$\therefore$ Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ = 0

$\Rightarrow$ Modulus of $\frac{1}{2}\begin{vmatrix} x & y & 1 \\ 1 & 2 & 1 \\ 3 & 6 & 1 \end{vmatrix}$ = 0

$\Rightarrow \frac{1}{2}\left[x(2-6)-y(1-3)+1(6-6)\right]=0$

$\Rightarrow -4x+2y=0$

$\Rightarrow -2x+y=0$

$\Rightarrow y=2x$ which is required line.

**(ii)** Let P$(x, y)$ be any point on the line joining the points (3, 1) and (9, 3).

Then, Area of triangle that could be formed by these points is zero.

$\therefore$ Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ = 0

$\Rightarrow$ Modulus of $\frac{1}{2}\begin{vmatrix} x & y & 1 \\ 3 & 1 & 1 \\ 9 & 3 & 1 \end{vmatrix}$ = 0

$\Rightarrow \frac{1}{2}\left[x(1-3)-y(3-9)+1(9-9)\right]=0$

$\Rightarrow -2x+6y=0$

$\Rightarrow -x+3y=0$

$\Rightarrow x-3y=0$ which is required line.

**5. If area of triangle is 35 sq. units with vertices $(2,-6),(5,4)$ and $(k,4)$. Then $k$ is:**

**(A)** 12

**(B)** $-2$

**(C)** $-12,-2$

**(D)** $12,-2$

**Ans.** Given: Area of triangle = Modulus of $\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ = 35

$\Rightarrow$ Modulus of $\frac{1}{2}\begin{vmatrix} 2 & -6 & 1 \\ 5 & 4 & 1 \\ k & 4 & 1 \end{vmatrix}$ = 35

$\Rightarrow \left|\frac{1}{2}\left[2(4-4)-(-6)(5-k)+1(20-4k)\right]\right|=35$

$\Rightarrow \left|\frac{1}{2}\left[0+30-6k+20-4k\right]\right|=35$

$\Rightarrow \left|\frac{1}{2}\left[50-10k\right]\right|=35$

$\Rightarrow |25-5k|=35$

$\Rightarrow 25-5k=\pm 35$

Taking positive sign, $25-5k=35$

$\Rightarrow k=-2$

Taking negative sign, $25-5k=-35$

$\Rightarrow k=12$

Therefore, option (D) is correct.