Assignment 5

Mirha Sidheek

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1 QUESTION No. 1.77 - MATRICES

If the area of the triangle is 35 sq.units with vertices $\begin{pmatrix} 2 & -6 \end{pmatrix}, \begin{pmatrix} 5 & 4 \end{pmatrix}, \begin{pmatrix} k & 4 \end{pmatrix}$, then k is,

2 SOLUTION

Given the vertices of triangle,

$$\mathbf{A} = \begin{pmatrix} 2 \\ -6 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 5 \\ 4 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} k \\ 4 \end{pmatrix} \qquad (2.0.1)$$

Area of the triangle = 35 sq.units

Area matrix is,

$$\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix} \qquad (2.0.2)$$

$$= \begin{pmatrix} 1 & 1 & 1 \\ 2 & 5 & k \\ -6 & 4 & 4 \end{pmatrix} \qquad (2.0.3)$$

Area of Triangle $= \frac{1}{2} \times \left| AreaMatrix \right|$

$$\implies \frac{1}{2} \times \begin{vmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{vmatrix} \qquad (2.0.4)$$

$$= \frac{1}{2} \times \begin{vmatrix} 1 & 1 & 1 \\ 2 & 5 & k \\ -6 & 4 & 4 \end{vmatrix} \qquad (2.0.5)$$

By using coloumn operation,

$$\begin{vmatrix} 1 & 1 & 1 \\ 2 & 5 & k \\ -6 & 4 & 4 \end{vmatrix} \xrightleftharpoons[C_2-C_3 \to C_2]{C_1-C_3 \to C_1} \begin{vmatrix} 0 & 0 & 1 \\ 2-k & 5-k & k \\ 10 & 0 & 4 \end{vmatrix} \qquad (2.0.6)$$

From cofactor,

$$\begin{vmatrix} 2-k & 5-k \\ 10 & 0 \end{vmatrix} = 10(5-k) \qquad (2.0.7)$$

Since area of triangle is half of the determinant of area matrix,

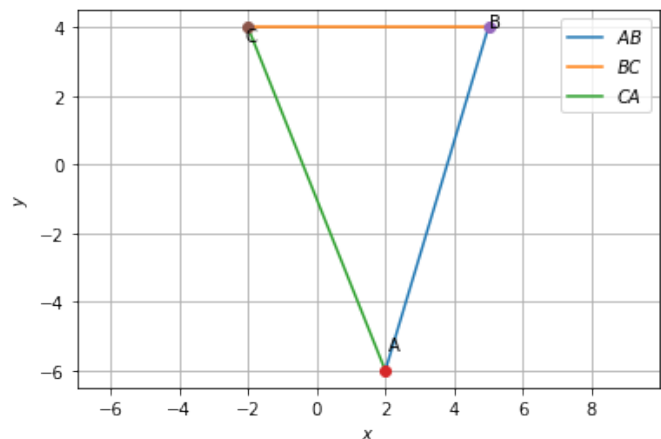$$\frac{1}{2}10(5-k) = 35 \qquad (2.0.8)$$

$$\implies 50 - 10k = 70 \qquad (2.0.9)$$

$$\implies k = -2 \qquad (2.0.10)$$

Fig. 0: Plot of the triangle