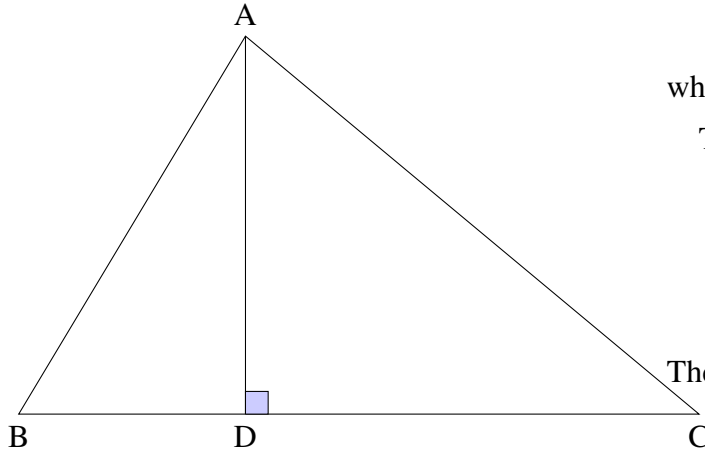


L^AT_EX ASSIGNMENT 1

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Question 1.3.3 D_1 is a point on BC such that $AD_1 \perp BC$ and AD_1 is defined to be the altitude. Find the equations of the altitude BE_1 and CF_1 to the sides AC and AB respectively.



Solutions: Let

$$\mathbf{A} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \mathbf{B} = \begin{pmatrix} -4 \\ 6 \end{pmatrix} \mathbf{C} = \begin{pmatrix} -3 \\ -5 \end{pmatrix} \quad (1)$$

We know that equation of slope is represented by

$$\mathbf{m} = \mathbf{vector}_1 - \mathbf{vector}_2 \quad (2)$$

Slope of line $AB = \mathbf{B} - \mathbf{A}$

$$\mathbf{m}_{AB} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} - \begin{pmatrix} -4 \\ 6 \end{pmatrix} = \begin{pmatrix} 5 \\ -7 \end{pmatrix} \quad (3)$$

Similarly,

slope of line $AC = \mathbf{C} - \mathbf{A}$

$$\mathbf{m}_{AC} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} - \begin{pmatrix} -3 \\ -5 \end{pmatrix} = \begin{pmatrix} 4 \\ 4 \end{pmatrix} \quad (4)$$

We need slope perpendicular to line AB, and slope perpendicular to line AC We know $m_{\perp} m = -1$

Therefore

$$\mathbf{m}_{AB_{\perp}} = \mathbf{m}_{CF} = \begin{pmatrix} -7 \\ 5 \end{pmatrix} \quad (5)$$

$$\mathbf{m}_{AC_{\perp}} = \mathbf{m}_{BE} = \begin{pmatrix} 4 \\ 4 \end{pmatrix} \quad (6)$$

Equation of line is represented by:

$$\mathbf{m}^T (\mathbf{X} - \mathbf{p}) = 0 \quad (7)$$

$$\text{where } \mathbf{X} = \begin{pmatrix} x \\ y \end{pmatrix} \mathbf{p} = \begin{pmatrix} x_1 \\ y_1 \end{pmatrix}$$

Therefore, the equation of line CF

$$\mathbf{m}_{CF}^T (\mathbf{X} - \mathbf{A}) = 0 \quad (8)$$

$$\begin{pmatrix} 4 & 4 \end{pmatrix} \begin{pmatrix} x+4 \\ y+6 \end{pmatrix} = 0 \quad (9)$$

Therefore, the equation of line BE

$$\mathbf{m}_{BE}^T (\mathbf{X} - \mathbf{A}) = 0 \quad (10)$$

$$\begin{pmatrix} -7 & 5 \end{pmatrix} \begin{pmatrix} x+3 \\ y+5 \end{pmatrix} = 0 \quad (11)$$