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ELECTRICAL ENGINEERING
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Line Assignment

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0.1 Problem

The area of triangle is 5. Two of its vertices are A(2,1) and B(3,-2). The third vertex lies on y=x+3. Find C.

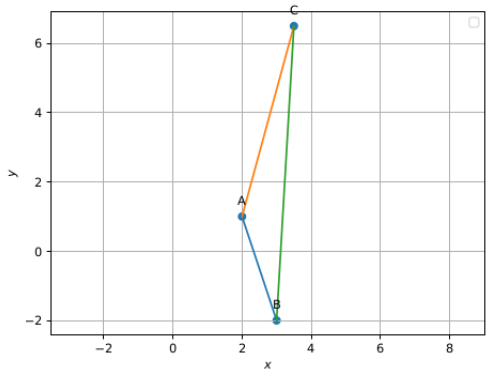

Figure of Construction
The following python code is used for finding third vertex of triangle

Githublink : https : //github.com/RupaSaiSreshta/FWC

0.2 Solution

Construction:
Input parameters for this construction

Symbol	Value
A	(2,1)
B	(3,-2)
Area	5
C lies on	y=x+3

Solution:
Let us assume C(x,y)
Area of triangle is

$$Ar = \frac{1}{2}\,|\mathbf{AB}X\mathbf{AC}|$$

By solving we get
3x+y=17.....(1)
The vertex C lies on y=x+3.....(2)
By solving (1) and (2) equations using matrix reduction method

$$3x + y = 17 \tag{1}$$
$$x - y = -3 \tag{2}$$
$$\implies \begin{pmatrix} 3 & 1 \\ 1 & -1 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 17 \\ -3 \end{pmatrix} \tag{3}$$

The above matrix is in the form of Ax=B
The augmented matrix for the above matrix equation is

$$\left(\begin{array}{cc|c} 3 & 1 & 17 \\ 1 & -1 & -3 \end{array}\right) \tag{4}$$
$$\xleftrightarrow{R_2 \leftarrow 3R_2 - R_1} \left(\begin{array}{cc|c} 3 & 1 & 17 \\ 0 & -4 & -20 \end{array}\right) \tag{5}$$
$$\xleftrightarrow{R_1 \leftarrow 4R_1 + R_2} \left(\begin{array}{cc|c} 12 & 0 & 42 \\ 0 & -4 & -26 \end{array}\right) \tag{6}$$
$$\xleftrightarrow{R_1 \leftarrow R_1 * 1/12} \left(\begin{array}{cc|c} 1 & 0 & 3.5 \\ 0 & -4 & -20 \end{array}\right) \tag{7}$$
$$\xleftrightarrow{R_2 \leftarrow R_2 * 1/4} \left(\begin{array}{cc|c} 1 & 0 & 3.5 \\ 0 & 1 & 6.5 \end{array}\right) \implies \mathbf{x} = \begin{pmatrix} 3.5 \\ 6.5 \end{pmatrix} \tag{8}$$

Now the vertex of C is

$$\boxed{C(3.5, 6.5)}$$

0.3 Proof

Proof: Here The area of triangle is given as 5.Now we have to calculate the area of triangle using three vertices A,B and C. We need to prove that the area of triangle is 5.
Area of triangle is

$$Ar = \frac{1}{2}\,|\mathbf{AB}X\mathbf{AC}|$$

By substituting the values of A,B and C

$$Ar = \frac{1}{2}[2(-8.5) + 3(5.5) + 3.5(3)]$$

$$Ar = \frac{1}{2}[-17 + 16.5 + 10.5]$$

$$Ar = \frac{1}{2}[10.5 - 0.5]$$

$$\boxed{Ar = 5}$$

Hence verified.