5.3.37

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Question

Draw the graphs of the following equations

$$3x - 4y + 6 = 0$$
$$3x + y - 9 = 0$$

Also, determine the co-ordinates of the vertices of the triangle formed by these lines and the X-axis.

Theoretical Solution

The triangle is formed by the intersection of three lines:
The two given lines. The X-axis, which has the equation $y = 0$.

In vector normal form, the lines are:

$$L_1 : \begin{pmatrix} 3 \\ -4 \end{pmatrix}^\top \begin{pmatrix} x \\ y \end{pmatrix} = -6 \tag{1}$$

$$L_2 : \begin{pmatrix} 3 \\ 1 \end{pmatrix}^\top \begin{pmatrix} x \\ y \end{pmatrix} = 9 \tag{2}$$

$$L_3 : \begin{pmatrix} 0 \\ 1 \end{pmatrix}^\top \begin{pmatrix} x \\ y \end{pmatrix} = 0 \quad \text{(X-axis)} \tag{3}$$

The vertices, **A**, **B**, and **C**, are the intersection points of these lines.

Theoretical Solution

We solve the system: $3x - 4y = -6$ and $3x + y = 9$. The augmented matrix is:

$$\left(\begin{array}{cc|c} 3 & -4 & -6 \\ 3 & 1 & 9 \end{array}\right) \xrightarrow{R_2 \to R_2 - R_1} \left(\begin{array}{cc|c} 3 & -4 & -6 \\ 0 & 5 & 15 \end{array}\right) \tag{4}$$

From R_2: $5y = 15 \implies y = 3$.

Substituting into R_1: $3x - 4(3) = -6 \implies 3x = 6 \implies x = 2$.

$$\mathbf{A} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \tag{5}$$

Theoretical Solution

We solve the system: $3x - 4y = -6$ and $y = 0$. Substituting $y = 0$ into the first equation:

$$3x - 4(0) = -6 \tag{6}$$
$$3x = -6 \tag{7}$$
$$x = -2 \tag{8}$$

$$\mathbf{B} = \begin{pmatrix} -2 \\ 0 \end{pmatrix} \tag{9}$$

Theoretical Solution

We solve the system: $3x + y = 9$ and $y = 0$. Substituting $y = 0$ into the first equation:

$$3x + 0 = 9 \tag{10}$$

$$3x = 9 \tag{11}$$

$$x = 3 \tag{12}$$

$$\mathbf{C} = \begin{pmatrix} 3 \\ 0 \end{pmatrix} \tag{13}$$

Theoretical Solution

The coordinates of the vertices of the triangle are:

Vertex A: $(2, 3)$

Vertex B: $(-2, 0)$

Vertex C: $(3, 0)$

Plot

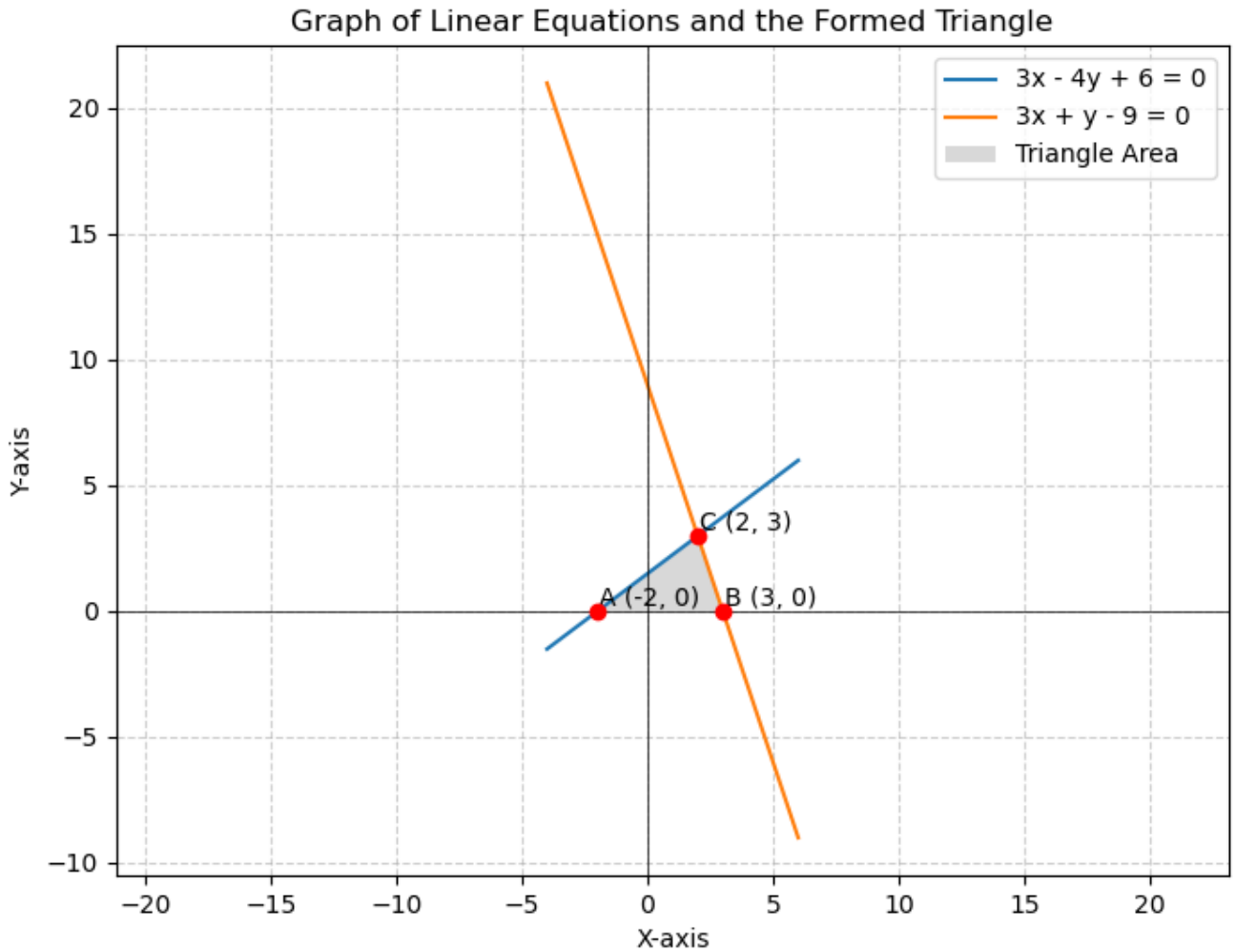

Figure: figure for 5.3.37