4.11.11

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Question

Find the ratio in which the line $x - 3y = 0$ divides the line segment joining the points $(-2, -5)$ and $(6, 3)$. Find the coordinates of the point of intersection.

Theoretical Solution

Given the points,

$$\mathbf{A} = \begin{pmatrix} -2 \\ -5 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} 6 \\ 3 \end{pmatrix} \tag{1}$$

and the line L_1,

$$L_1 : \begin{pmatrix} 1 & -3 \end{pmatrix} \mathbf{x} = 0 \tag{2}$$

$$\implies \mathbf{n}^\top \mathbf{x} = 0 \tag{3}$$

Let the vector $\mathbf{P}$ be a point on the line $x - 3y = 0$ wihch divides the line segment joining the points $\mathbf{A}$ and $\mathbf{B}$.

Formulae

Section formula for a vector P which divides the line formed by vectors A and B in the ratio $k:1$ is given by

$$\mathbf{P} = \frac{k\mathbf{B} + \mathbf{A}}{k+1} \tag{4}$$

Theoretical Solution

$$\mathbf{P} = \begin{pmatrix} \mathbf{A} & \mathbf{B} \end{pmatrix} \begin{pmatrix} \frac{1}{k+1} \\ \frac{k}{k+1} \end{pmatrix} \tag{5}$$

Since $\mathbf{P}$ lies on line L_1,

$$\mathbf{n}^\top \mathbf{P} = 0 \tag{6}$$

$$\implies \begin{pmatrix} 1 & -3 \end{pmatrix} \begin{pmatrix} \mathbf{A} & \mathbf{B} \end{pmatrix} \begin{pmatrix} \frac{1}{k+1} \\ \frac{k}{k+1} \end{pmatrix} = 0 \tag{7}$$

$$\implies \begin{pmatrix} 1 & -3 \end{pmatrix} \begin{pmatrix} -2 & 6 \\ -5 & 3 \end{pmatrix} \begin{pmatrix} \frac{1}{k+1} \\ \frac{k}{k+1} \end{pmatrix} = 0 \tag{8}$$

$$\implies \begin{pmatrix} 13 & -3 \end{pmatrix} \begin{pmatrix} \frac{1}{k+1} \\ \frac{k}{k+1} \end{pmatrix} = 0 \tag{9}$$

Theoretical Solution

$$\implies \frac{13-3k}{k+1} = 0 \tag{10}$$

$$\implies k = \frac{13}{3} \tag{11}$$

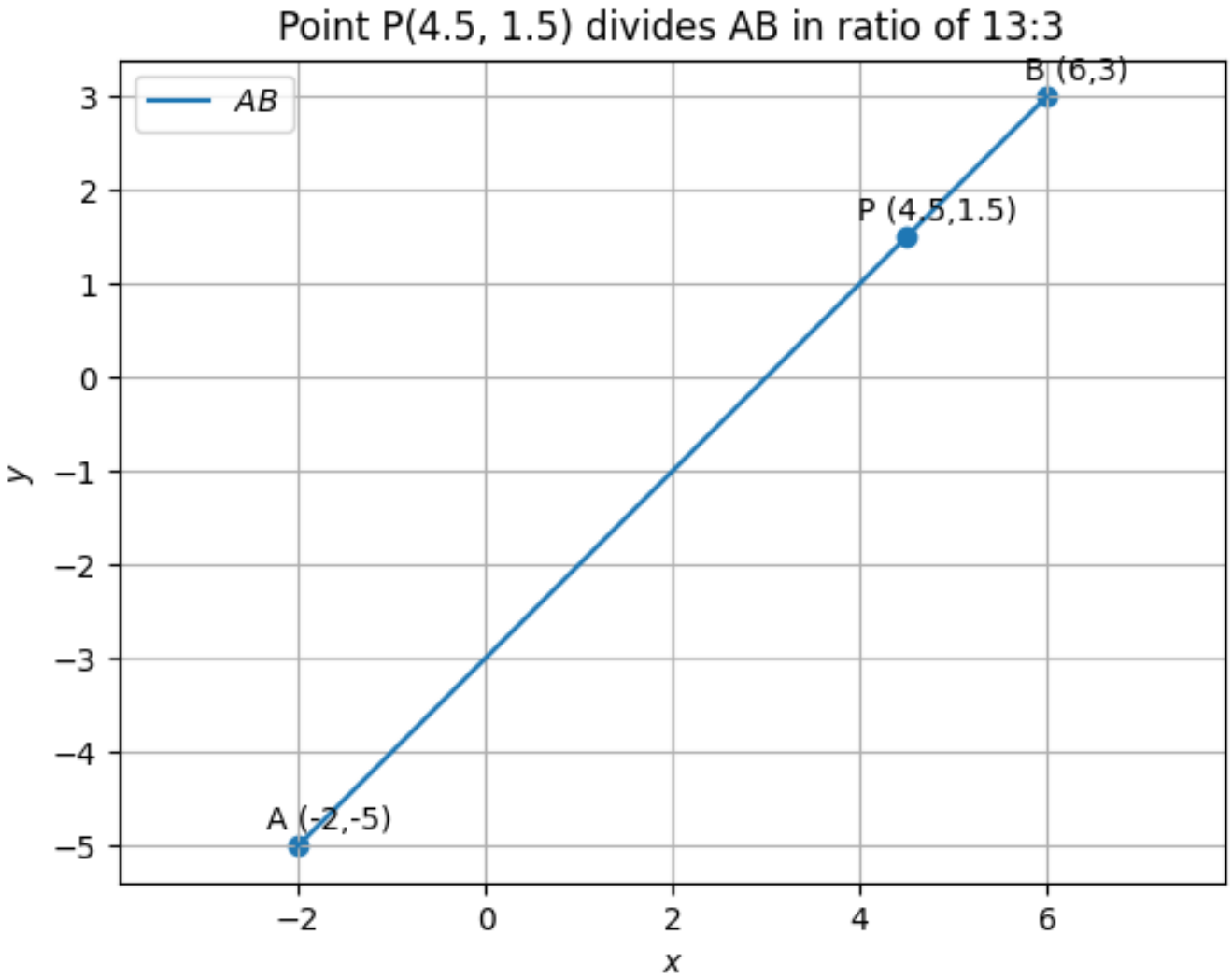
Therefore the ratio in which **P** divides the line segment joining the points **A** and **B** is $13:3$

On substituting the value of k in equation (5) we will get,

$$\mathbf{P} = \begin{pmatrix} -2 & 6 \\ -5 & 3 \end{pmatrix} \begin{pmatrix} 3/16 \\ 13/16 \end{pmatrix} \tag{12}$$

$$\implies \mathbf{P} = \begin{pmatrix} 9/2 \\ 3/2 \end{pmatrix} \tag{13}$$

Plot


Point P(4.5, 1.5) divides AB in ratio of 13:3
AB
B (6,3)
P (4.5,1.5)
A (-2,-5)
3
2
1
0
−1
−2
−3
−4
−5
y
−2
0
2
4
6
x