Problem 1.4.25

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Question

Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $2\mathbf{a}+\mathbf{b}$ and $\mathbf{a}-3\mathbf{b}$ externally in the ratio $1:2$.

Solution

Step 1: Represent points in coordinates

$$P = 2\mathbf{a} + \mathbf{b} = \begin{pmatrix} 2 \\ 1 \end{pmatrix},$$

$$Q = \mathbf{a} - 3\mathbf{b} = \begin{pmatrix} 1 \\ -3 \end{pmatrix}.$$

Solution

Step 2: Apply section formula (external division)

$$R = \frac{1 \cdot Q - 2 \cdot P}{1 - 2}$$

$$= \frac{1}{-1}\left(\begin{pmatrix} 1 \\ -3 \end{pmatrix} - 2\begin{pmatrix} 2 \\ 1 \end{pmatrix}\right)$$

$$= -\begin{pmatrix} 1-4 \\ -3-2 \end{pmatrix}$$

$$= -\begin{pmatrix} -3 \\ -5 \end{pmatrix}$$

$$= \begin{pmatrix} 3 \\ 5 \end{pmatrix}.$$

So, the position vector is

$$\boxed{R = 3\mathbf{a} + 5\mathbf{b}}$$

Graphical Representation

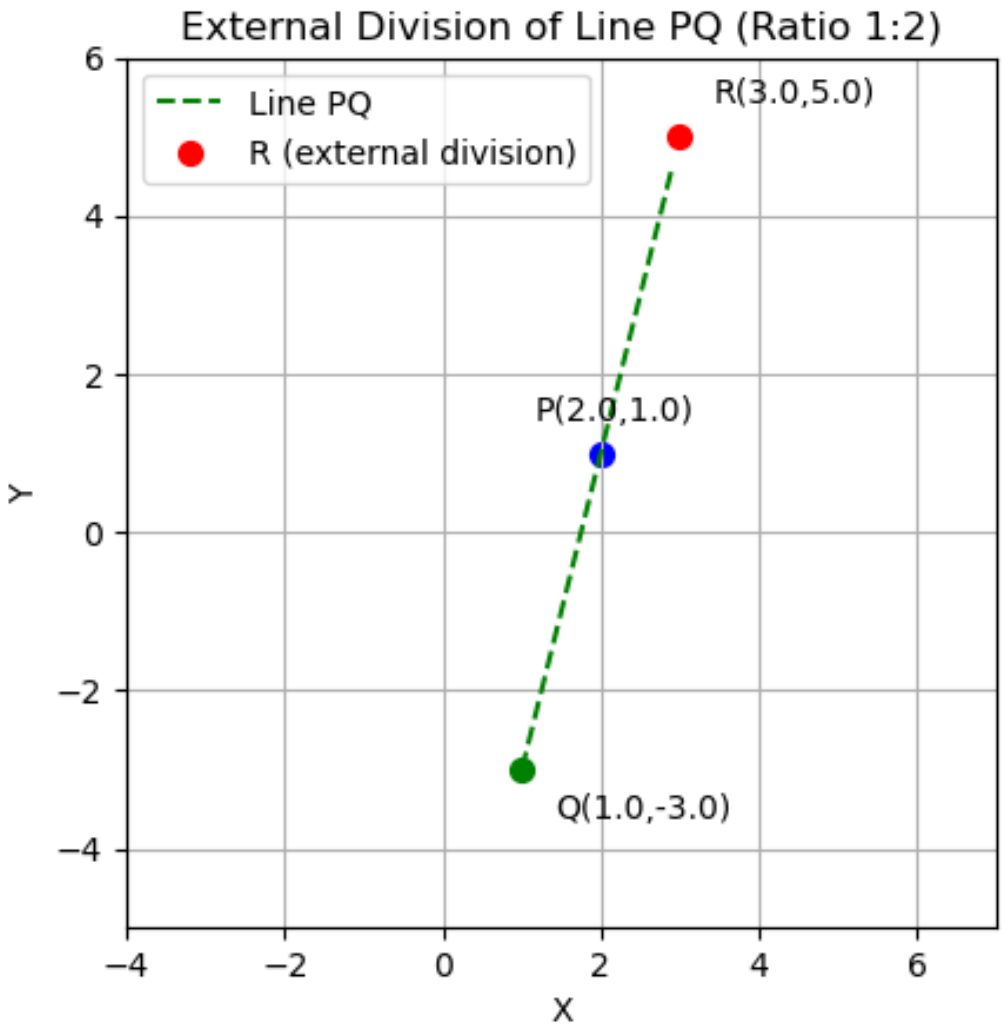

Figure: Graph for Question 2