1 NCERT 12.10.5.9

Find the position vector of a point R which divides the line joining two points P and Q whose Position Vectors are $2\overrightarrow{a} + \overrightarrow{b}$ and $\overrightarrow{a} - 3\overrightarrow{b}$ externally in the ratio $1 : 2$. Also, Show that P is the mid point of the line segment QR

Solution: let us assume a and b and the given ratio is

Symbol	Value
a	$\begin{pmatrix} 1 \\ -3 \end{pmatrix}$
b	$\begin{pmatrix} 0 \\ 2 \end{pmatrix}$
k	2

Table 1: vectors a,b and Ratio k

using section formula

$$\mathbf{R} = \frac{\mathbf{Q} - k.\mathbf{P}}{1 - k} \tag{1}$$

where P and Q depends on a and b then,

$$\mathbf{P} = (2\mathbf{a} + \mathbf{b}) = 2\begin{pmatrix} 1 \\ -3 \end{pmatrix} + \begin{pmatrix} 0 \\ 2 \end{pmatrix} = \begin{pmatrix} 2 \\ -4 \end{pmatrix} \tag{2}$$

$$\mathbf{Q} = (\mathbf{a} - 3\mathbf{b}) = \begin{pmatrix} 1 \\ -3 \end{pmatrix} - 3\begin{pmatrix} 0 \\ 2 \end{pmatrix} = \begin{pmatrix} 1 \\ -9 \end{pmatrix} \tag{3}$$

where R can be calculated as

$$\mathbf{R} = \frac{(\mathbf{a} - 3\mathbf{b}) - k.(2\mathbf{a} + \mathbf{b})}{1 - k} \tag{4}$$

by substituting a and b values we get R as

$$\mathbf{R} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} \tag{5}$$

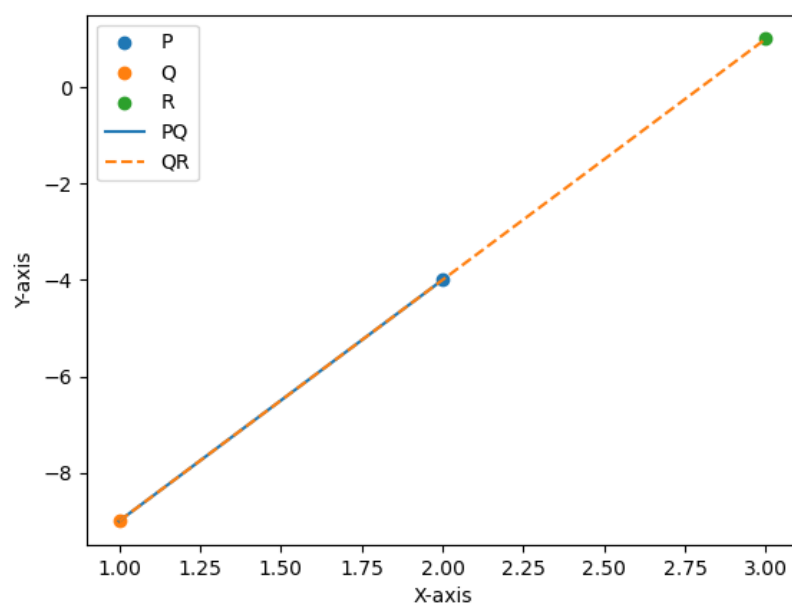| Symbol	Value
P	$(2\mathbf{a} + \mathbf{b})$
Q	$(\mathbf{a} - 3\mathbf{b})$
R	$\frac{\mathbf{Q} - k.(\mathbf{P})}{1 - k}$

Table 2: vectors P,Q,R

Figure 1: point vectors P,Q,R