

## 1.4.21

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### Question

Find the coordinates of the point which divides the line segment joining the points  $(1, -2, 3)$  and  $(3, 4, -5)$  in the ratio

- (a)  $2 : 3$  internally,
- (b)  $2 : 3$  externally.

### Solution

Let the two points be

$$A = \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}, \quad B = \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix} \quad (1)$$

**(a) Internal Division:** If  $P$  divides  $AB$  in the ratio  $m : n$  internally, then

$$P = \frac{mB + nA}{m + n} \quad (2)$$

Substituting  $m = 2, n = 3$ :

$$P = \frac{2 \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix} + 3 \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}}{5} \quad (3)$$

$$P = \frac{\begin{pmatrix} 6 \\ 8 \\ -10 \end{pmatrix} + \begin{pmatrix} 3 \\ -6 \\ 9 \end{pmatrix}}{5} = \frac{\begin{pmatrix} 9 \\ 2 \\ -1 \end{pmatrix}}{5} = \begin{pmatrix} \frac{9}{5} \\ \frac{2}{5} \\ \frac{-1}{5} \end{pmatrix} \quad (4)$$

**(b) External Division:** If  $Q$  divides  $AB$  in the ratio  $m : n$  externally, then

$$Q = \frac{mB - nA}{m - n} \quad (5)$$

Substituting  $m = 2, n = 3$ :

$$Q = \frac{2 \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix} - 3 \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}}{5} \quad (6)$$

$$Q = \frac{\begin{pmatrix} 6 \\ 8 \\ -10 \end{pmatrix} - \begin{pmatrix} 3 \\ -6 \\ 9 \end{pmatrix}}{-1} = \frac{\begin{pmatrix} 3 \\ 14 \\ -19 \end{pmatrix}}{-1} = \begin{pmatrix} -3 \\ -14 \\ 19 \end{pmatrix} \quad (7)$$

Internal point: $\begin{pmatrix} -1.8 \\ 0.40 \\ 0.20 \end{pmatrix},$	External point: $\begin{pmatrix} -3 \\ -14 \\ 19 \end{pmatrix}$
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(8)

### 3D Division of Line Segment

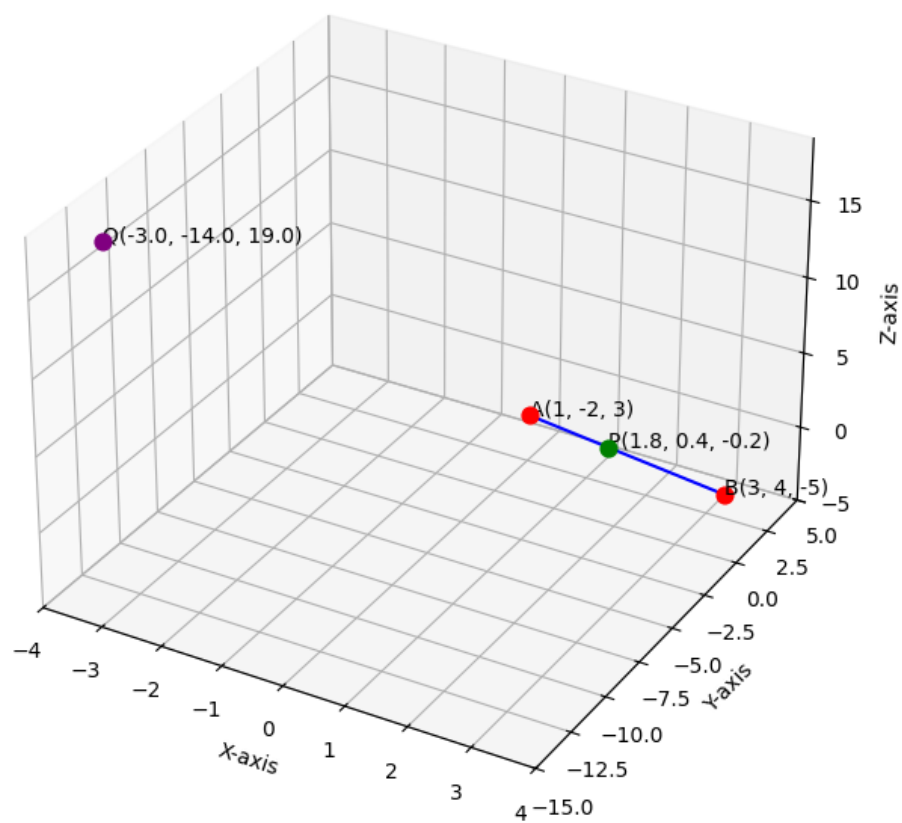


Figure 1: 3D Plot