

CHAPTER - 1

Vector Arithmetic

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1 1.8 LENGTH

1.8.9 Find the values of y for which the distance between the points $\mathbf{P}(2, -3)$ and $\mathbf{Q}(10, y)$ is 10 units.

Solution: Given points \mathbf{P} and \mathbf{Q} are represented as:

$$\mathbf{P} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} \quad (1)$$

$$\mathbf{Q} = \begin{pmatrix} 10 \\ y \end{pmatrix} \quad (2)$$

Let the distance between the two points be d . Given that the distance between the two points \mathbf{P} and \mathbf{Q} is 10 units:

$$d = 10 \quad (3)$$

We know that d is defined as:

$$d = \|\mathbf{P} - \mathbf{Q}\| \quad (4)$$

$$\Rightarrow d = \sqrt{(\mathbf{P} - \mathbf{Q})^\top (\mathbf{P} - \mathbf{Q})} \quad (5)$$

$$\mathbf{P} - \mathbf{Q} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} - \begin{pmatrix} 10 \\ y \end{pmatrix} = \begin{pmatrix} -8 \\ -3 - y \end{pmatrix} \quad (6)$$

$$(7)$$

From (3):

$$d = \|\mathbf{P} - \mathbf{Q}\| = 10 \quad (8)$$

$$\Rightarrow (\mathbf{P} - \mathbf{Q})^\top (\mathbf{P} - \mathbf{Q}) = 100 \quad (9)$$

Therefore:

$$y = 3 \text{ and } y = -9 \quad (10)$$