

# 1.9.16

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**Question** Find the distance between the points  $(a, b)$  and  $(-a, -b)$ .

**Solution:**

Let us solve the given equation theoretically and then verify the solution computationally.

Let the given two points be P and Q, where,

$$\mathbf{P} = \begin{pmatrix} a \\ b \end{pmatrix} \text{ and } \mathbf{Q} = \begin{pmatrix} -a \\ -b \end{pmatrix} \quad (1)$$

Let D be a vector defined as:

$$\mathbf{D} = \mathbf{P} - \mathbf{Q} \quad (2)$$

Now,

$$\mathbf{D} = \begin{pmatrix} a \\ b \end{pmatrix} - \begin{pmatrix} -a \\ -b \end{pmatrix} \quad (3)$$

$$\mathbf{D} = \begin{pmatrix} 2a \\ 2b \end{pmatrix} \quad (4)$$

The distance between the point P and Q = Norm of the vector D

Norm of the vector D is defined as:

$$\|\mathbf{D}\| \triangleq \sqrt{\mathbf{D}^T \mathbf{D}} \quad (5)$$

$$\mathbf{D}^T \mathbf{D} = \begin{pmatrix} 2a & 2b \end{pmatrix} \begin{pmatrix} 2a \\ 2b \end{pmatrix} \quad (6)$$

$$\mathbf{D}^T \mathbf{D} = 4a^2 + 4b^2 \quad (7)$$

Now substitute in Eq.5:

$$\|\mathbf{D}\| = \sqrt{4a^2 + 4b^2} \quad (8)$$

$$\|\mathbf{D}\| = 2\sqrt{a^2 + b^2} \quad (9)$$

Therefore the distance between the two points is:  $2\sqrt{a^2 + b^2}$

For verification let us assume  $a = 4$  and  $b = 4$

From the figure it is clearly verified that the theoretical solution matches with the computational solution.

