VECTORS

1 10th Maths - Chapter 10

This is Problem-3 from Exercise 10.3

1. Find the projection of the vector $\hat{i} - \hat{j}$ on the vector $\hat{i} + \hat{j}$

2 SOLUTION

Given points are

$$\mathbf{A} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \tag{1}$$

The formula of the projection vector :

$$\frac{\mathbf{A}^{\top}.\mathbf{B}}{\|\mathbf{B}\|^2}\mathbf{B} \tag{2}$$

Find the projection vector $\mathbf{C}$:

$$\mathbf{A}^{\top}\mathbf{B} = \begin{pmatrix} 1 & -1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \times 1 \end{pmatrix} + \begin{pmatrix} -1 \times 1 \end{pmatrix} = 0 \tag{3}$$

$$\|\mathbf{B}\|^2 = (\mathbf{B}^{\top}\mathbf{B}) = \begin{pmatrix} 1 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = (1 \times 1) + (1 \times 1) = 2 \tag{4}$$

$$\mathbf{C} = \frac{\mathbf{A}^{\top}\mathbf{B}^2}{\|\mathbf{B}\|}\mathbf{B} = \frac{0}{2}\begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{5}$$
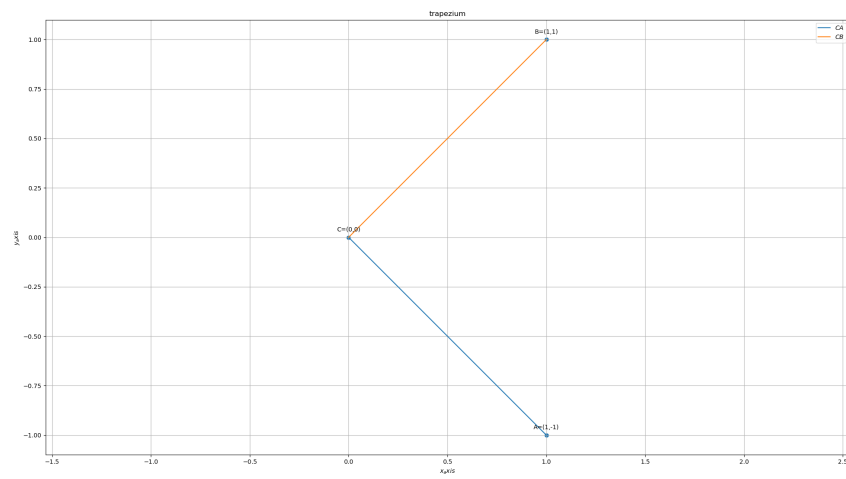
$$\mathbf{C} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{6}$$

3 Figure

Figure 1: projection vector