

Vector Algebra

12th Maths - Chapter 10

Exercise 10.2 Problem-13

1. Find the direction cosines of the vector joining the points A (1, 2, 3) and B(1, 2, 1), directed from A to B.

Solution: The direction cosines are the cosines of the angles formed by the given vector with the respective axes, given vectors are **A** and **B**

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

The direction vector **m** of the line joining two points A, B is given by

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

$$\mathbf{m} = \mathbf{A} - \mathbf{B} = \begin{pmatrix} -2 \\ -4 \\ 4 \end{pmatrix} \quad (3)$$

$$\|\mathbf{m}\| = \sqrt{(-2)^2 + (-4)^2 + 4^2} = 6 \quad (4)$$

The unit vector in the direction of **m** is calculated as

$$\frac{\mathbf{m}}{\|\mathbf{m}\|} = \frac{1}{6} \begin{pmatrix} -2 \\ -4 \\ 4 \end{pmatrix} \quad (5)$$

The direction cosines are the elements of direction vector \mathbf{m} .

$$\cos \theta_i = 1, 2, 3 \quad (6)$$

So for different values of $\cos \theta_i$ the direction cosines of vector \mathbf{A} and \mathbf{B} are

$$\cos \theta_1 = \frac{-2}{6} = \frac{-1}{3} \quad (7)$$

$$\cos \theta_2 = \frac{-4}{6} = \frac{-2}{3} \quad (8)$$

$$\cos \theta_3 = \frac{4}{6} = \frac{2}{3} \quad (9)$$

Hence, the direction cosines for the given vectors are $(\frac{-1}{3}, \frac{-2}{3}, \frac{2}{3})$