

# Vectors

## 1 12<sup>th</sup> Maths - Chapter 10

This is Problem-6 from Exercise 10.5 (Miscellaneous Exercise)

1. Find a vector of magnitude 5 units, and parallel to the resultant of the vectors  $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$  and  $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$ .

## 2 Solution

Let us assume that required vector as  $\mathbf{x}$   
Given  $\mathbf{a}$  and  $\mathbf{b}$  are

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

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

now assume that

$$\mathbf{a} + \mathbf{b} = \mathbf{c} \quad (3)$$

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

$$\mathbf{c} = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} \quad (5)$$

so our resultant vector is  $\mathbf{c} = 3\hat{i} + \hat{j} + 0\hat{k}$

$$\frac{\mathbf{c}}{\|\mathbf{c}\|} = \frac{3\hat{i} + \hat{j}}{\sqrt{10}} \quad (6)$$

so  $\frac{3\hat{i} + \hat{j}}{\sqrt{10}}$  is a unit vector which is in the direction of resultant vector of  $\mathbf{a}$  and  $\mathbf{b}$  but we want the  $\mathbf{x}$  which magnitude is 5 so

$$\mathbf{x} = 5 \times \frac{3\hat{i} + \hat{j}}{\sqrt{10}} \quad (7)$$

$$\mathbf{x} = \frac{3\sqrt{10}\hat{i}}{2} + \frac{\sqrt{10}\hat{j}}{2} \quad (8)$$

Hence the required vector  $\mathbf{x}$  is  $\frac{3\sqrt{10}\hat{i}}{2} + \frac{\sqrt{10}\hat{j}}{2}$