# Class 12

## Chapter 10 - Vector Algebra

This is question 18 from exercise 10.5

1. The value of $\hat{i} \cdot (\hat{j} \times \hat{k}) + \hat{j} \cdot (\hat{i} \times \hat{k}) + \hat{k} \cdot (\hat{i} \times \hat{j})$ is

   a) 0 b) $-1$ c) 1 d) 3

**Solution:** The Directional vectors of $x, y$ and $z$ axes are given respectively

$$\vec{e_1} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \vec{e_2} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \vec{e_3} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \tag{1}$$

Here, $\vec{e_i} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1(i^{\text{th}}term) \\ 0 \\ 0 \\ 0... \end{pmatrix}$, $\vec{e_j} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1(j^{\text{th}}term) \\ 0 \\ 0 \\ 0... \end{pmatrix}$, $\vec{e_k} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1(k^{\text{th}}term) \\ 0 \\ 0 \\ 0... \end{pmatrix}$

$$\begin{array}{l|l} \vec{e_i} \times \vec{e_j} = \vec{e_k} & \vec{e_j} \times \vec{e_i} = -\vec{e_k} \\ \vec{e_j} \times \vec{e_k} = \vec{e_i} & \vec{e_k} \times \vec{e_j} = -\vec{e_i} \\ \vec{e_k} \times \vec{e_i} = \vec{e_j} & \vec{e_i} \times \vec{e_k} = -\vec{e_j} \end{array}$$

$\vec{e_i} \cdot \vec{e_i} = |\vec{e_i}||\vec{e_i}| \cos 0$
$= 1 \times 1 \times 1$
$= 1$
similarly, $\vec{e_j} \cdot \vec{e_j} = \vec{e_k} \cdot \vec{e_k} = 1$

Now,

$$\begin{aligned} &\vec{e_1} \cdot (\vec{e_2} \times \vec{e_3}) + \vec{e_2} \cdot (\vec{e_1} \times \vec{e_3}) + \vec{e_3} \cdot (\vec{e_1} \times \vec{e_2}) \\ &= 1 - 1 + 1 \\ &= 1 \end{aligned}$$

So, option (c) is correct.

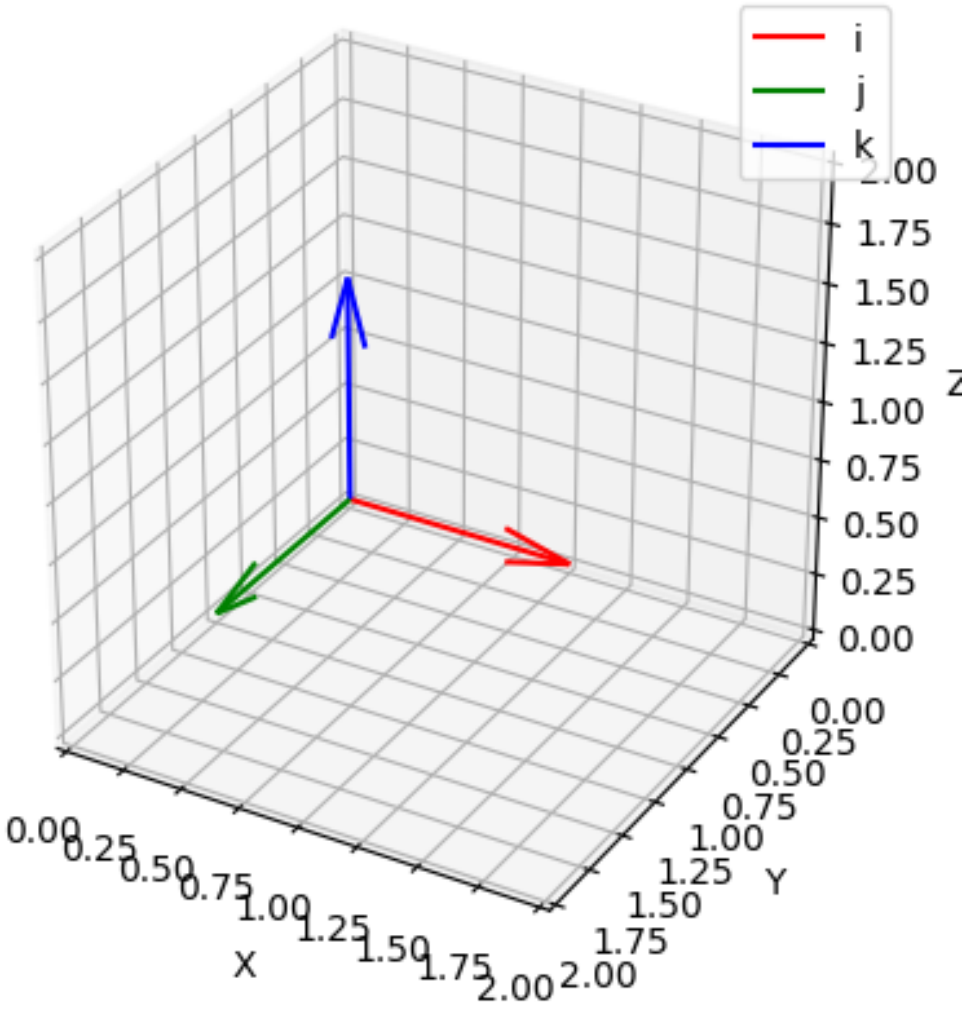


Figure 1: fig:1