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Class - XIIth, Topic - Vector

Subject :- Mathematics

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<u>Problem 1.</u> Find the angle between $\vec{a} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$.

<u>Solution</u>: Given that

$$\vec{a} = 2\hat{i} + 3\hat{j} + 4\hat{k}$$

$$\& \ \vec{b} = \hat{i} + 2\hat{j} + \hat{k}$$

$$\therefore |\vec{a}| = \sqrt{(2)^2 + (3)^2 + (4)^2} = \sqrt{4+9+16} = \sqrt{29}$$

$$|\vec{b}| = \sqrt{(1)^2 + (2)^2 + (1)^2} = \sqrt{1+4+1} = \sqrt{6}$$

$$\vec{a} \cdot \vec{b} = 2 \times 1 + 3 \times 2 + 4 \times 1$$

$$= 2 + 6 + 4 = 12$$

$$\because \vec{a} \cdot \vec{b} = |\vec{a}| \, |\vec{b}| \cos\theta$$

$$\therefore \cos\theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|} = \frac{12}{\sqrt{29} \times \sqrt{6}}$$

$$= \frac{6 \times 2}{\sqrt{29} \times \sqrt{6}} = \frac{\sqrt{6} \times \sqrt{6} \times 2}{\sqrt{29} \times \sqrt{6}}$$

$$= \frac{2\sqrt{6}}{\sqrt{29}}$$

$$\therefore \theta = \cos^{-1}\left[\frac{2\sqrt{6}}{\sqrt{29}}\right] \text{ Ans}$$

Problem (2). If $\vec{a} = 3\hat{i} + 2\hat{j} + \hat{k}$
& $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$
Then find $|\vec{a} \times \vec{b}|$.

Solution: $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 2 & 1 \\ 1 & 2 & 3 \end{vmatrix}$

$$= \hat{i}\begin{vmatrix} 2 & 1 \\ 2 & 3 \end{vmatrix} - 3\begin{vmatrix} \hat{j} & \hat{k} \\ 2 & 3 \end{vmatrix} + 1\begin{vmatrix} \hat{j} & \hat{k} \\ 2 & 1 \end{vmatrix}$$

$$= \hat{i}(6-2) - 3(3\hat{j} - 2\hat{k}) + (\hat{j} - 2\hat{k})$$

$$= 4\hat{i} - 9\hat{j} + 6\hat{k} + \hat{j} - 2\hat{k}$$

$$= 4\hat{i} - 8\hat{j} + 4\hat{k}$$

$$\therefore |\vec{a} \times \vec{b}| = \sqrt{(4)^2 + (-8)^2 + (4)^2}$$

$$= \sqrt{16 + 64 + 16}$$

$$= \sqrt{96}$$

$$= \sqrt{16 \times 6} = 4\sqrt{6}.$$