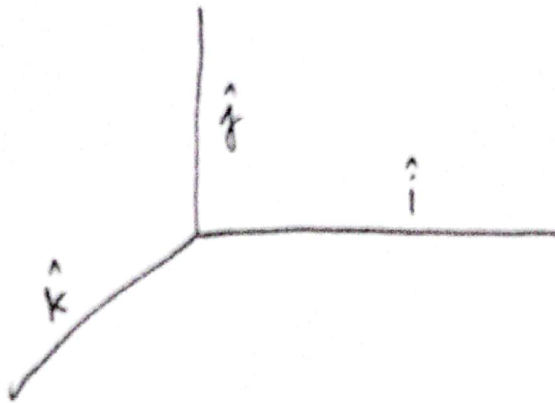


Role of mathematics in physics

$$\vec{r} = x_1 \hat{i} + x_2 \hat{j} + x_3 \hat{k}$$

$$\vec{v} = v_1 \hat{i} + v_2 \hat{j} + v_3 \hat{k}$$



$$\hat{r} = \frac{\vec{r}}{|\vec{r}|} = \frac{x\hat{i} + y\hat{j} + z\hat{k}}{\sqrt{x^2 + y^2 + z^2}}$$

$$\hat{i} \cdot \hat{i} = 1$$

$$\hat{i} \cdot \hat{j} = 0$$

$$\hat{i} \times \hat{j} = \hat{k}$$

$$\hat{j} \cdot \hat{j} = 1$$

$$\hat{j} \cdot \hat{k} = 0$$

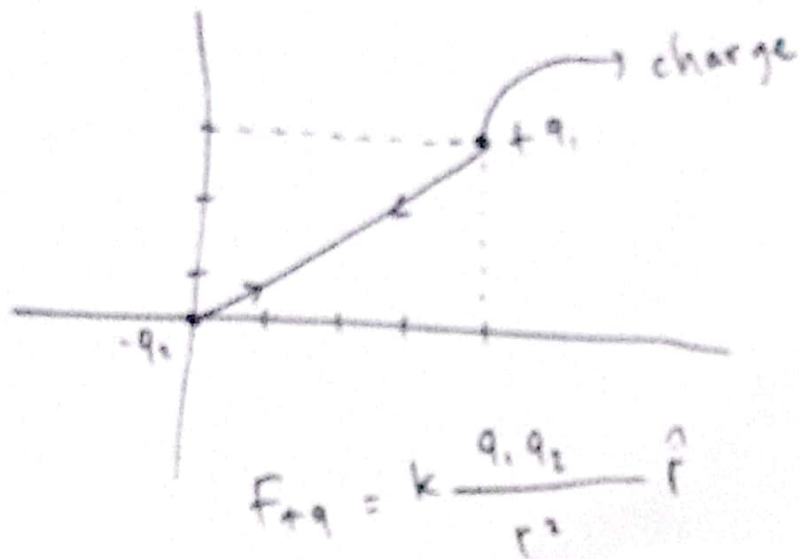
$$\hat{j} \times \hat{j} = 0$$

$$\hat{k} \cdot \hat{k} = 1$$

$$\hat{i} \times \hat{k} = -\hat{j}$$

$$\hat{j} \times \hat{k} = \hat{i}$$

Example 1



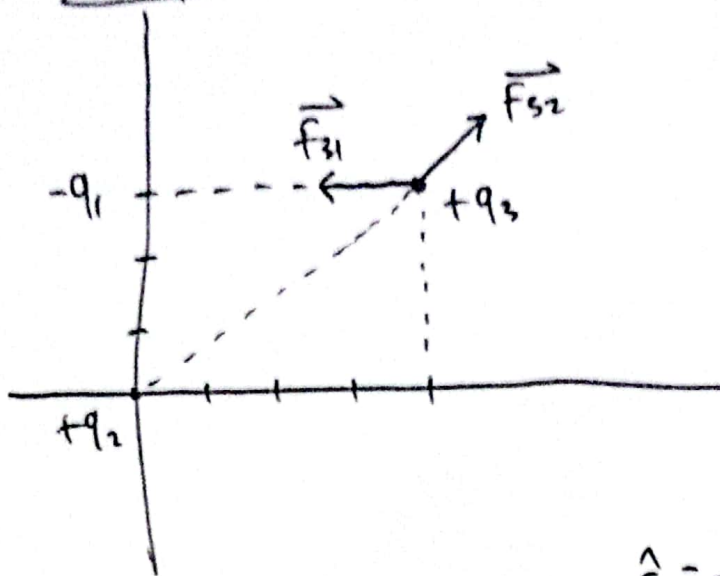
$$\vec{F}_{+q} = k \frac{q_1 q_2}{r^2} \hat{r}$$

$$= k \frac{q_1 q_2}{\sqrt{3^2 + 4^2}} \frac{(-4\hat{i} + 3\hat{j})}{5}$$

$$\vec{F}_{-q_1} = k \frac{q_1 q_2}{r^2} \hat{r}$$

$$= k \frac{q_1 q_2}{5^2} \frac{(4\hat{i} + 3\hat{j})}{5}$$

example 2



$$F_{q3} = \vec{F}_{31} + \vec{F}_{32}$$

$$\hat{r} = \frac{-q_1 \hat{i} + 0 + 0}{\sqrt{q_1^2 + 0^2 + 0^2}} = -\hat{i}$$

$$= kq_3 \left[\frac{q_1(-\hat{i})}{q_1^2} + \frac{q_2(4\hat{i} + 3\hat{j})}{5^2 \cdot 5} \right]$$

Perkalian Vektor

$$\vec{v}_1 = 4\hat{i} + 2\hat{j} + \hat{k}$$

$$\vec{v}_2 = 2\hat{i} + 3\hat{k}$$

$$\begin{aligned} \vec{v}_1 \cdot \vec{v}_2 &= 8\hat{i}^2 + 0\hat{j}^2 + 3\hat{k}^2 = 11 \\ &= 8(1) + 3(1) = 11 \end{aligned}$$

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

$$\vec{b} = 2\hat{i} - 3\hat{j} + 2\hat{k}$$

$$\begin{aligned} 1) \vec{a} \cdot \vec{a} &= (3\hat{i} + 4\hat{j} - 3\hat{k}) \cdot (3\hat{i} + 4\hat{j} - 3\hat{k}) \\ &= 9\hat{i}^2 + 16\hat{j}^2 + 9\hat{k}^2 \\ &= 9 + 16 + 9 = 34 \end{aligned}$$

$$2) \vec{a} \times \vec{b} =$$

$$\begin{aligned} 3) \vec{a} \cdot \vec{b} &= (3\hat{i} + 4\hat{j} - 3\hat{k}) \cdot (2\hat{i} - 3\hat{j} + 2\hat{k}) \\ &= 6 - 12 - 6 = -12 \end{aligned}$$

$$\begin{aligned} \rightarrow \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 4 & -3 \\ 2 & -3 & 2 \end{vmatrix} &= \begin{bmatrix} \hat{i}(4 \cdot 2 - (-3 \cdot -3)) + \\ \hat{j}(3 \cdot 2 - (-3 \cdot 2)) + \\ \hat{k}(3 \cdot -3 - (4 \cdot 2)) \end{bmatrix} \\ &= -\hat{i} + 12\hat{j} - 17\hat{k} \end{aligned}$$

$$\vec{a} = 9\hat{i} - 5\hat{j} + \hat{k}$$

$$\vec{b} = 2\hat{i} + 3\hat{j} - 2\hat{k}$$

$$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 9 & -5 & 1 \\ 2 & 3 & -2 \end{vmatrix} = i(10 - 3) + j(-8 - 2) + k(12 - (-10))$$
$$= 7\hat{i} - 10\hat{j} + 22\hat{k}$$