

$$1) \vec{a} = \hat{i} + 4\hat{j} + 3\hat{k}$$

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

a) sum of \vec{a} & \vec{b} ,

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

$$= 3\hat{i} + 5\hat{j} + 4\hat{k}$$

$$|\vec{a} + \vec{b}| = \sqrt{3^2 + 5^2 + 4^2} = \sqrt{9 + 25 + 16}$$

$$|\vec{a} + \vec{b}| = \sqrt{50}$$

direction:

$$\cos\alpha = \frac{3}{\sqrt{50}}, \cos\beta = \frac{5}{\sqrt{50}}, \cos\gamma = \frac{4}{\sqrt{50}}$$

b) dot product:

$$\vec{a} \cdot \vec{b} = (\hat{i} + 4\hat{j} + 3\hat{k}) \cdot (2\hat{i} + \hat{j} + \hat{k})$$

$$= 1 \cdot 2 + 4 \cdot 1 + 3 \cdot 1$$

$$= 2 + 4 + 3 = 9$$

$$\vec{a} \cdot \vec{b} = 9$$

$$c) \vec{a} \cdot \vec{a} = (1 \cdot 1 + 4 \cdot 4 + 3 \cdot 3)$$

$$= 1 + 16 + 9 = 26$$

$$\vec{a} \cdot \vec{a} = 26$$

$$|\vec{a}|^2 = (\sqrt{1^2 + 4^2 + 3^2})^2 = 1^2 + 4^2 + 3^2 = 26$$

$$\therefore \vec{a} \cdot \vec{a} = |\vec{a}|^2$$

$$d) \vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 4 & 3 \\ 2 & 1 & 1 \end{vmatrix}$$

$$= (4-3)\hat{i} - (1-6)\hat{j} + (1-8)\hat{k}$$

$$\boxed{\vec{a} \times \vec{b} = \hat{i} + 5\hat{j} - 7\hat{k}}$$

$$(\vec{a} \times \vec{b}) \cdot \vec{a} = (\hat{i} + 5\hat{j} - 7\hat{k}) \cdot (\hat{i} + 4\hat{j} + 3\hat{k})$$

$$= 1 + 20 - 21 = 0$$

$$(\vec{a} \times \vec{b}) \cdot \vec{b} = (\hat{i} + 5\hat{j} - 7\hat{k}) \cdot (2\hat{i} + \hat{j} + \hat{k})$$

$$= 2 + 5 - 7 = 0$$

$$\boxed{\therefore (\vec{a} \times \vec{b}) \cdot \vec{a} = (\vec{a} \times \vec{b}) \cdot \vec{b} = 0}$$

$$2) \quad a) \quad 1 \frac{m}{s} = \frac{1}{1000} \times 3600 \frac{km}{h} = \frac{1}{1000} \times 3600 \times \frac{1}{1.609} \text{ miles/hr}$$

$$\boxed{1 \text{ m/s} = 2.237 \text{ miles/hr}}$$

$$b) \quad 1 \text{ slug} = 1 \frac{\text{lb} \cdot \text{s}^2}{\text{ft}} = \frac{1 \times 4.452 \text{ N} \cdot \text{s}^2}{0.3048 \text{ m}}$$

$$\boxed{1 \text{ slug} = 14.584 \text{ kg}}$$

c) Slug is unit of mass in US units
SI unit of mass is kg

d) Pound is unit of force in US units
SI unit of force is N.