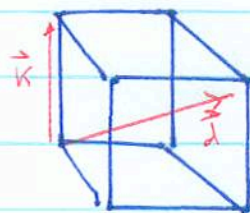


2-1 Diagonal $\hat{A} = \frac{(\hat{i} + \hat{j} + \hat{k})}{\sqrt{3}}$

$$\cos \theta = \hat{k} \cdot \hat{A}$$

$$= \frac{1}{\sqrt{3}} ; \quad \theta = \cos^{-1} \left(\frac{1}{\sqrt{3}} \right) = 54.7^\circ$$



2-2 a) Prove $|\vec{A} \times \vec{B}|$ is the area of their parallelogram.

Area is base \times height = $A \cdot (B \sin \theta)$

$$\text{Area} = AB \sin \theta = |\vec{A} \times \vec{B}|$$

b) $\vec{A} \times \vec{B}$ is a vector, $AB \sin \theta$ is not.

c) Prove $\vec{A} \cdot (\vec{B} \times \vec{C})$ is the determinant:

$$\begin{aligned} \vec{A} \cdot (\vec{B} \times \vec{C}) &= A_x (B_y C_z - B_z C_y) \\ &\quad + A_y (B_z C_x - B_x C_z) \\ &\quad + A_z (B_x C_y - B_y C_x) \end{aligned}$$

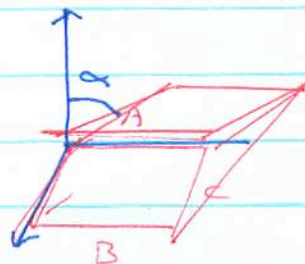
= Determinant.

d) Show the parallelepiped defined by $\vec{A}, \vec{B}, \vec{C}$ has volume $\vec{A} \cdot (\vec{B} \times \vec{C})$.

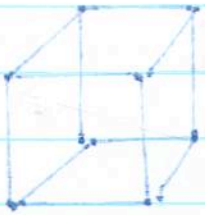
$$\vec{A} \cdot (\vec{B} \times \vec{C}) = A \cos \alpha (\vec{B} \times \vec{C})$$

$(\vec{B} \times \vec{C})$ has area of base,

height is $A \cos \alpha$



Volume is $\vec{A} \cdot (\vec{B} \times \vec{C})$



$$\frac{(\hat{i} + \hat{j} + \hat{k})}{\sqrt{3}} = \hat{n} \quad \text{Diagonal}$$

1-5

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

$$F \cdot A = \left(\frac{1}{\sqrt{3}}\right) \cdot \cos \theta = 0 \quad ; \quad \frac{1}{\sqrt{3}} =$$

with \hat{n} area with \hat{n} is the area of the face

5-5

$$(\sin \theta) \cdot A = \text{height} \cdot \text{area} \quad \text{if area is perpendicular}$$

$$|\vec{B} \times \vec{A}| = \sin \theta \cdot |\vec{B} \cdot \vec{A}| = \text{area}$$

then \hat{n} is perpendicular to $\vec{B} \times \vec{A}$ is a vector

(c) $\vec{B} \cdot (\vec{B} \times \vec{A})$ is the determinant

$$\begin{aligned} \vec{B} \cdot (\vec{B} \times \vec{A}) &= \det \begin{pmatrix} B_x & B_y & B_z \\ B_x & B_y & B_z \\ A_x & A_y & A_z \end{pmatrix} \\ &= B_x(B_y A_z - B_z A_y) + B_y(B_z A_x - A_z B_x) + B_z(A_x B_y - B_y A_x) \\ &= 0 \end{aligned}$$

Determinant =

(d) Show the perpendicularity of $\vec{B} \times \vec{A}$ and \vec{B}

$$(\vec{B} \times \vec{A}) \cdot \vec{B} = 0$$



$$(\vec{B} \times \vec{A}) \cdot \vec{B} = (\vec{B} \times \vec{A}) \cdot \vec{B}$$

$$= B_x(A_y B_z - A_z B_y) + B_y(A_z B_x - A_x B_z) + B_z(A_x B_y - A_y B_x)$$

$$= 0 \quad \text{if } \vec{B} \perp \vec{A}$$

$$(\vec{B} \times \vec{A}) \cdot \vec{A} = 0$$