

Ques-8. Cross Product 8th foundation +

Thank

①

Given  $|\vec{A}| = 80$  ;  $|\vec{B}| = 100$   $\theta = 30^\circ$

$$\therefore \vec{A} \times \vec{B} = |\vec{A}| |\vec{B}| \sin \theta$$

$$= 80 \times 100 \times \sin 30^\circ$$

$$= 80 \times 100 \times \frac{1}{2} \Rightarrow 4000$$

$\rightarrow A$

②

$\vec{j} \times \vec{k} = \vec{i}$  here Angle b/w  $\vec{j}$  and  $\vec{k}$  is  $90^\circ$   
 $\rightarrow A$

③

Given  $\vec{A} = 2\vec{i} + 3\vec{j} + \vec{k}$  &  $\vec{B} = \vec{i} - \vec{j} + \vec{k}$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 3 & 1 \\ 1 & -1 & 1 \end{vmatrix} = \vec{i} [3 \times 1 - (1)(-1)] - \vec{j} [2 \times 1 - (1)(1)] + \vec{k} [2(-1) - 3(1)]$$

$$= \vec{i} [3+1] - \vec{j} [2-1] + \vec{k} [-2-3]$$

$$= 4\vec{i} - \vec{j} - 5\vec{k}$$

$$|\vec{A} \times \vec{B}| = \sqrt{4^2 + (-1)^2 + (-5)^2} = \sqrt{16+1+25} = \sqrt{42}$$

$\therefore$  The unit vector perpendicular to  $\vec{A} \times \vec{B}$  is

$$= \frac{\vec{A} \times \vec{B}}{|\vec{A} \times \vec{B}|} = \frac{4\vec{i} - \vec{j} - 5\vec{k}}{\sqrt{42}} \rightarrow A$$

(4)

Given  $\vec{A} = 6\hat{i} + 8\hat{j}$  ;  $\vec{B} = 210\hat{i} + 250\hat{j}$

$\vec{C} = 50\hat{i} + 60\hat{j}$  ;  $\vec{D} = 30\hat{i} + 8\hat{j} + 48\hat{k}$

If  $\vec{A}$  and  $\vec{C}$  are parallel vectors

$$\vec{A} = m\vec{C}$$

$$\vec{C} = 1.7[3\hat{i} + 4\hat{j}] \quad \vec{A} = 2[3\hat{i} + 4\hat{j}]$$

$$\vec{C} = \frac{1.7}{2}[6\hat{i} + 8\hat{j}] \quad \vec{A} = 1.7$$

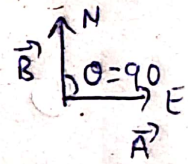
$$\vec{C} = \frac{1.7}{2} \vec{A} \quad \text{so } \vec{A} \text{ and } \vec{C} \text{ are parallel} \rightarrow B$$

(5)

Given  $|\vec{A}| = 3$  points towards east

$|\vec{B}| = 4$  points towards north

$$\frac{\vec{A} \cdot \vec{B}}{|\vec{A}| |\vec{B}|} = \frac{AB \cos \theta}{AB \sin \theta} = \cot \theta$$



$$= \cot 90^\circ = 0 \rightarrow C$$

(6)

Given  $r = 4\text{m}$  ;  $F = 20\text{N}$  ;  $\theta = 30^\circ$

$$\text{Torque} = Fr \sin \theta$$

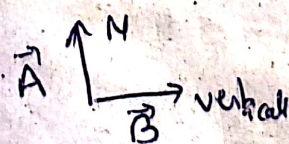
$$= 4 \times 20 \times \sin 30^\circ$$

$$= 4 \times 20 \times \frac{1}{2}$$

$$= 40\text{Nm} \rightarrow C$$

(9)

Given



The direction of  $\vec{A} \times \vec{B}$  is perpendicular to both  $\vec{A}$  and  $\vec{B}$

Direction of  $\vec{A}$  towards north  $\vec{A} = a\hat{j}$

Direction of  $\vec{B}$  along z-axis (upwards)  $\vec{B} = b\hat{k}$

$$\text{Now } \vec{A} \times \vec{B} = a\hat{j} \times b\hat{k} = ab(\hat{j} \times \hat{k}) \\ = ab(\hat{i})$$

$\therefore \vec{A} \times \vec{B}$  is ~~also~~ towards ~~East~~ <sup>West</sup>. [ $\hat{i}$  is unit

vector along west]  $\rightarrow C$ .

⑧

Given adjacent sides of a triangle

are  $\vec{A} = 4\hat{i} + 3\hat{j} + 4\hat{k}$  and  $\vec{B} = 5\hat{i}$ .

$$\text{Area} = \frac{1}{2} |\vec{A} \times \vec{B}| ; \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & 3 & 4 \\ 5 & 0 & 0 \end{vmatrix}$$

$$\vec{A} \times \vec{B} = \hat{i}(3 \times 0 - 4 \times 0) - \hat{j}(4 \times 0 - 5 \times 4) + \hat{k}(4 \times 0 - 3 \times 5) \\ = \hat{i}[0] - \hat{j}[-20] + \hat{k}[-15] \\ = 20\hat{j} - 15\hat{k}$$

$$|\vec{A} \times \vec{B}| = \sqrt{20^2 + (-15)^2} = 25$$

$$\text{Area} = \frac{1}{2} \times 25 = 12.5 \text{ sq cm}$$

⑩

$$\text{Here } \vec{A} \cdot \vec{B} = AB \cos \theta$$

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

~~So the~~ Here  $\cos$  and  $\sin$  are perpendicular

So angle b/w  $\vec{A} \cdot \vec{B}$  and  $\vec{A} \times \vec{B}$  is  $90^\circ = \frac{\pi}{2}$

(8) Given  $\vec{A} = 4\hat{i} - \hat{j} - \hat{k}$ ,  $\vec{B} = 4\hat{i} + \hat{j} - 4\hat{k}$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & -1 & -1 \\ 4 & 1 & -4 \end{vmatrix}$$

$$= \hat{i}[-1 \times -4 - 1 \times -1] - \hat{j}[4 \times -4 - 4 \times -1] + \hat{k}[4 \times 1 - 4 \times -1]$$

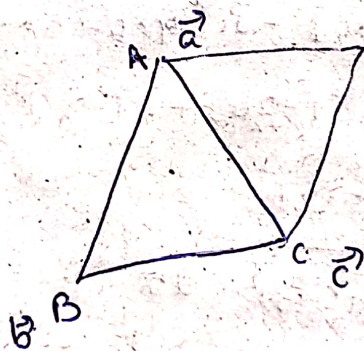
$$= \hat{i}[4+1] - \hat{j}[-16+4] + \hat{k}[4+4]$$

$$= 5\hat{i} + 12\hat{j} + 8\hat{k}$$

$$|\vec{A} \times \vec{B}| = \sqrt{5^2 + 12^2 + 8^2} = \sqrt{25 + 144 + 64} = \sqrt{233}$$

∴ The unit vector perpendicular to  $\vec{A}$  &  $\vec{B}$  is  $\frac{5\hat{i} + 12\hat{j} + 8\hat{k}}{\sqrt{233}}$

(11)



Area of Parallelogram  
 $= |\vec{BA} \times \vec{BC}|$

$$\text{Area of } \triangle ABC = \frac{|\vec{BA} \times \vec{BC}|}{2}$$

$$= \frac{(\vec{b} - \vec{a}) \times (\vec{c} - \vec{b})}{2}$$

$$= \frac{1}{2} |(\vec{b} - \vec{a}) \times \vec{c} - (\vec{b} - \vec{a}) \times \vec{b}|$$

$$= \frac{1}{2} | \vec{b} \times \vec{c} - \vec{a} \times \vec{c} - \vec{b} \times \vec{b} + \vec{a} \times \vec{b} |$$

$$= \frac{1}{2} | \vec{b} \times \vec{c} - \vec{a} \times \vec{c} - 0 + \vec{a} \times \vec{b} |$$

$$= \frac{1}{2} | \vec{b} \times \vec{c} - \vec{a} \times \vec{c} + \vec{a} \times \vec{b} |$$

$$= \frac{1}{2} | \vec{b} \times \vec{c} + \vec{c} \times \vec{a} + \vec{a} \times \vec{b} |$$

(12)

If a vector having zero magnitude it is a null vector, direction is not defined.

$$\text{If } \vec{A} \times \vec{B} = 0 \Rightarrow |\vec{A}| = 0 \text{ or } |\vec{B}| = 0$$

$$\text{or } \sin \theta = 0.$$

The component of a vector is a scalar  
all are false.

(13)

According to law of conservation of  
linear momentum  $\vec{L} = \text{constant}$

$$\text{i.e. } \vec{L} \cdot \vec{L} = \text{constant}$$

$$\Rightarrow \frac{d}{dt} (\vec{L} \cdot \vec{L}) = 0$$

$$\Rightarrow \frac{d}{dt} L^2 = 0 \Rightarrow 2\vec{L} \frac{d\vec{L}}{dt} = 0$$

i.e.  $\vec{L}$  and  $\frac{d\vec{L}}{dt}$  are perpendicular.

$$\text{Since } \vec{\tau} = \vec{A} \times \vec{L}$$

$$\therefore \frac{d\vec{L}}{dt} = \vec{A} \times \vec{L} \text{ so } \frac{d\vec{L}}{dt} \text{ must be}$$

perpendicular to  $\vec{A}$  as well as  $\vec{L}$ .

Further the component of  $\vec{L}$  along  $\vec{A} = \frac{\vec{A} \cdot \vec{L}}{A}$

$$\text{Also } \frac{d}{dt} (\vec{A} \cdot \vec{L}) = \vec{A} \cdot \frac{d\vec{L}}{dt} + \vec{L} \cdot \frac{d\vec{A}}{dt} = 0$$

$$\vec{A} \cdot \vec{L} = \text{constant}$$

$\therefore \frac{d\vec{L}}{dt} \perp \vec{L}$ , it cannot change  $L$ , but surely direction changed.

(15)

A) let  $\vec{A} = 3\hat{i} + 4\hat{j}$   
 $|\vec{A}| = \sqrt{3^2 + 4^2} = 5$

B)  $F = 3\hat{i} + 4\hat{j} \text{ N}$ ;  $\vec{s} = 6\hat{j} \text{ m}$

$$\text{work} = \vec{F} \cdot \vec{s} = (3\hat{i} + 4\hat{j}) \cdot 6\hat{j}$$

$$= 4 \times 6 = 24 \text{ J}$$

C) Given  $F = 20 \text{ N}$ ;  $\theta = 60^\circ$

Component of force  $= F \cos \theta$   
 $= 20 \cos 60^\circ$   
 $= 20 \times \frac{1}{2}$   
 $= 10 \text{ N}$

(17), (18)

Let  $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}$ ;  $\vec{B} = \hat{i} + 2\hat{j} + 3\hat{k}$

$$|\vec{A} \times \vec{B}| = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -2 & 1 \\ 1 & 2 & 3 \end{vmatrix} = \hat{i}[-2 \times 3 - 2] - \hat{j}[9 - 1] + \hat{k}[6 + 2]$$

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

$$|\vec{A} \times \vec{B}| = \sqrt{(-8)^2 + (-8)^2 + 8^2} = 8\sqrt{3}$$

Area of triangle  $= \frac{1}{2} |\vec{A} \times \vec{B}| = \frac{1}{2} \times 8\sqrt{3} = 4\sqrt{3} \text{ sq unit}$

Area of Parallelogram  $= |\vec{A} \times \vec{B}| = 8\sqrt{3} \text{ sq unit}$

(19)

Given  $r = 4\text{ m}$ ;  $F = 20\text{ N}$ ;  $\theta = 30^\circ$

$$\text{Torque} = rF \sin \theta$$

$$= 4 \times 20 \sin 30 = 4 \times 20 \times \frac{1}{2} = 40\text{ Nm}$$

$$= \underline{40\text{ Nm}}$$

(20)

The value of  $\hat{i} \cdot (\hat{j} + \hat{k}) + \hat{j} \cdot (\hat{k} + \hat{i}) + \hat{k} \cdot (\hat{i} + \hat{j})$

$$= \hat{i} \cdot \hat{j} + \hat{i} \cdot \hat{k} + \hat{j} \cdot \hat{k} + \hat{j} \cdot \hat{i} + \hat{k} \cdot \hat{i} + \hat{k} \cdot \hat{j}$$

$$= 1 + 1 + 1 = 3$$

Here  $\hat{j} + \hat{k} = \hat{i}$ ;  $\hat{k} + \hat{i} = \hat{j}$ ;  $\hat{i} + \hat{j} = \hat{k}$ .

Task CUA

(21)

Given  $A \cdot B = 0$  i.e. A is perpendicular to B

$A \cdot C = 0$  i.e. A is perpendicular to C

$\therefore$  A is perpendicular to that the plane formed by B and C.

$\Rightarrow B \times C$  gives a vector perpendicular to both B and C.

$\therefore$  A is parallel to  $B \times C \rightarrow C$

④

we know that  $\vec{\tau} = \vec{r} \times \vec{F} = rF \sin \theta \cdot \hat{n}$   
 $\hat{n}$  is the unit vector which shows direction of torque which is perpendicular to both  $\vec{r}$  &  $\vec{F}$ .

$$\Rightarrow \vec{F} \perp \vec{\tau} \text{ and } \vec{r} \perp \vec{\tau}$$

$$\text{For } \vec{r} \perp \vec{\tau} \Rightarrow \vec{r} \cdot \vec{\tau} = 0$$

$$\text{if } \vec{F} \perp \vec{\tau} \Rightarrow \vec{F} \cdot \vec{\tau} = 0 \rightarrow 0$$

⑤

$$\text{we know } \vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$$

$$\therefore (\vec{A} + \vec{B}) \times (\vec{B} \times \vec{A}) = -(\vec{B} \times \vec{A}) \times (\vec{B} \times \vec{A}) \\ = 0 \text{ Null vector} \rightarrow 0$$

⑥

According to right hand thumb rule

$\vec{C}$  is perpendicular to both  $\vec{A}$  and  $\vec{B}$   
 $\rightarrow D$

⑦

$$\vec{A} \times \vec{B} = AB \sin \theta \quad \therefore \vec{B} \times \vec{A} = -\vec{A} \times \vec{B}$$

$$\text{i.e.} \quad = -AB \sin \theta \\ \text{angle between} \quad = AB \sin(180^\circ + \theta)$$

$$\vec{A} \times \vec{B} \text{ and } \vec{B} \times \vec{A} \text{ is } 180^\circ = \pi \\ \rightarrow B$$

(9)

Given  $\vec{A} \times \vec{B} = 0$  and  $\vec{B} \times \vec{C} = 0$

$\Rightarrow \hat{n} \sin \theta_1 = 0$

$\hat{n} \sin \theta_2 = 0$

(i.e.)  $\vec{A}$  and  $\vec{B}$  are Parallel  $\vec{B}$  and  $\vec{C}$  also Parallel

From here  $\vec{A}$  and  $\vec{C}$  also Parallel

$$\vec{A} \times \vec{C} = |\vec{A}| |\vec{C}| \sin 0 \hat{n} = 0$$

(10)

If  $\vec{A}, \vec{B}, \vec{C}$  are coplanar

$\vec{C}$  must be perpendicular to  $\vec{A} \times \vec{B}$ .

$$\therefore \vec{C} = \vec{A} \times \vec{B}$$

$$\begin{aligned} \therefore (\vec{A} \times \vec{B}) \cdot \vec{C} &= (|\vec{A} \times \vec{B}| |\vec{C}| \cos \theta) \\ &= |\vec{A} \times \vec{B}| |\vec{C}| \cos 90^\circ \\ &= 0 \rightarrow B \end{aligned}$$

(11)

We know Angular momentum  $\vec{L} = \vec{r} \times \vec{p}$ .

$\therefore$  The direction of  $\vec{L}$  is  $\perp$  to both  $\vec{r}$  and  $\vec{p}$

Given  $\vec{r} = \hat{i} \rightarrow$  Direction is along x-axis

$\vec{p} = 4\hat{j} \rightarrow$  Direction is along y-axis

$\therefore$  Direction of  $\vec{L}$  is z-axis (perpendicular to both x and y-axis)

# SQA

①

Given  $(\hat{i} + \hat{j} + \hat{k}) \times (2\hat{i} + 3\hat{j} + \hat{k})$

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

$$= \hat{i} [1 - 3] - \hat{j} [1 - 2] + \hat{k} [3 - 2]$$

$$= -2\hat{i} + \hat{j} + \hat{k} \rightarrow B$$

②

Given  $F = 2\hat{i} + 3\hat{j} + 4\hat{k}$  N.

$$r_1 = 3\hat{i} + 4\hat{j} + 5\hat{k} \text{ and } r_2 = \hat{i} + 2\hat{j} + 3\hat{k}$$

$$\vec{r} = \vec{r}_1 - \vec{r}_2 = 3\hat{i} + 4\hat{j} + 5\hat{k} - (\hat{i} + 2\hat{j} + 3\hat{k})$$

$$= 3\hat{i} + 4\hat{j} + 5\hat{k} - \hat{i} - 2\hat{j} - 3\hat{k}$$

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

$$\therefore \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 2 & 2 \\ 2 & 3 & 4 \end{vmatrix} = \hat{i} [8 - 6] - \hat{j} [8 - 6] + \hat{k} [6 - 4]$$

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

③

Given  $|\vec{a} \cdot \vec{b}|^2 + |\vec{a} \times \vec{b}|^2 = (ab \cos \theta)^2 + (ab \sin \theta)^2$

$$= a^2 b^2 \cos^2 \theta + a^2 b^2 \sin^2 \theta$$

$$= a^2 b^2 (\cos^2 \theta + \sin^2 \theta)$$

$$= a^2 b^2 \rightarrow D$$



(4)

Since  $A \cdot B = 0$ ,  $A \cdot C = 0$  $\therefore$  A is perpendicular to both  $\vec{B}$  and  $\vec{C}$ .

$$\Rightarrow \vec{A} \parallel (\vec{B} \times \vec{C})$$

$$\Rightarrow \vec{A} = \pm \frac{\vec{B} \times \vec{C}}{|\vec{B} \times \vec{C}|}$$

$$\vec{A} = \frac{\vec{B} \times \vec{C}}{|\vec{B}| |\vec{C}| \sin \theta} = \frac{\vec{B} \times \vec{C}}{1 \times 1 \times \sin 30^\circ}$$

$$\vec{A} = 2(\vec{B} \times \vec{C}) \quad \text{Given angle between } \vec{B} \text{ and } \vec{C} \text{ is } \frac{\pi}{3} \rightarrow C$$

(5)

Given  $\vec{F}_1$  is acting along +x-axis. so

$$\vec{F}_1 = x \hat{i}$$

also given that  $\vec{F}_1 \times \vec{F}_2 = 0$ . i.e.  $\vec{F}_1$  is parallel to  $\vec{F}_2$ so  $\vec{F}_2$  also acts along x-direction.

$$\text{This is also shown } \vec{F}_2 = -5\hat{i}$$

$$\vec{F}_1 \times \vec{F}_2 = x \hat{i} \times (-5) \hat{i} = -5x (\hat{i} \times \hat{i}) = -5x(0) = 0$$

C.

(7)

$$\text{Given } (\vec{a} \cdot \vec{b})^2 - (\vec{a} \times \vec{b})^2$$

$$\Rightarrow (ab \cos \theta)^2 - (ab \sin \theta)^2$$

$$\Rightarrow a^2 b^2 \cos^2 \theta - a^2 b^2 \sin^2 \theta$$

$$\Rightarrow a^2 b^2 (\cos^2 \theta - \sin^2 \theta)$$

$$\Rightarrow a^2 b^2 \cos 2\theta \quad [\cos 2\theta = \cos^2 \theta - \sin^2 \theta]$$



(8)

$$\text{let } \vec{r} = 2\hat{i} + 3\hat{j} - 3\hat{k}$$

$$\text{or } \vec{\omega} = 4\hat{i} + \hat{j} - 2\hat{k}$$

$$\vec{r} \times \vec{\omega} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & -3 \\ 4 & 1 & -2 \end{vmatrix}$$

$$= \hat{i} (3 \times -2 - 1 \times (-3)) - \hat{j} (2 \times -2 - 4 \times -3) + \hat{k} (2 \times 1 - 3 \times 4)$$

$$= \hat{i} [-6 + 3] - \hat{j} [-4 + 12] + \hat{k} [2 - 12]$$

$$= -3\hat{i} - 8\hat{j} - 10\hat{k}$$

$$\begin{aligned} \vec{v} &= -\vec{\omega} \times \vec{r} = -[-3\hat{i} - 8\hat{j} - 10\hat{k}] \\ &= 3\hat{i} + 8\hat{j} + 10\hat{k} \rightarrow B \end{aligned}$$

(9)

$$\text{Given } \vec{v} = 3\hat{i} + 2\hat{j} \text{ m/s} ; \vec{B} = 2\hat{i} + 3\hat{k} \text{ T}$$

Force acting on a charged particle

$$\vec{F} = q(\vec{v} \times \vec{B})$$

$$\Rightarrow m\vec{a} = \frac{q}{m}(\vec{v} \times \vec{B})$$

$$\Rightarrow \vec{a} = \frac{q}{m}(\vec{v} \times \vec{B}) \rightarrow (1)$$

$$\begin{aligned} \vec{v} \times \vec{B} &= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 2 & 0 \\ 2 & 0 & 3 \end{vmatrix} = \hat{i} (2 \times 3 - 0) - \hat{j} (3 \times 3 - 0) + \hat{k} (0 - 6) \\ &= 6\hat{i} - 9\hat{j} - 6\hat{k} \end{aligned}$$

$$\text{From (1)} \quad \vec{a} = \frac{q}{m} (6\hat{i} - 9\hat{j} - 6\hat{k})$$

$$= 0.96 \times 10^8 (6\hat{i} - 9\hat{j} - 6\hat{k}) \rightarrow B$$

$\frac{q}{m} \rightarrow$  specific charge

(10)

$$(a) \vec{A} \times \vec{B} = AB \sin 0 = AB \sin 0 = 0.$$

$$(b) \vec{A} \times \vec{B} = AB \sin 0 = AB \sin 30 = \frac{AB}{2}$$

$$(c) \vec{A} \times \vec{B} = AB \sin 0 = AB \sin 120 = \frac{\sqrt{3}}{2} AB$$

$$C, b, a \rightarrow D$$

(13)

work done in the dot product of  $\vec{F}$  and  $\vec{s}$

$$W = \vec{F} \cdot \vec{s} \quad \text{so work is a scalar}$$

because the dot product of any two vectors is always scalar.

(14)

Given  $\vec{A} = 3\hat{i} + \hat{j} + 6\hat{k} ; \vec{B} = 3\hat{i} - 6\hat{j} + 4\hat{k}$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & 6 \\ 3 & -6 & 4 \end{vmatrix} = \hat{i}(1 \times 4 - 6 \times (-6)) - \hat{j}(3 \times 4 - 6 \times 3) + \hat{k}(3 \times (-6) - 1 \times 3)$$

$$= \hat{i}(4 + 36) - \hat{j}(12 - 18) + \hat{k}(-18 - 3)$$

$$= 40\hat{i} + 6\hat{j} - 21\hat{k}$$

$$|\vec{A} \times \vec{B}| = \sqrt{40^2 + 6^2 + (-21)^2} = \sqrt{2077}$$

The unit vector perpendicular to  $\vec{A} \times \vec{B} = \frac{40\hat{i} + 6\hat{j} - 21\hat{k}}{\sqrt{2077}}$

(16)

Given  $(\hat{i} \cdot \hat{i}) + (\hat{i} \times \hat{i})$

$$\Rightarrow 1 + 0$$

$$\Rightarrow 1$$

(17)

Given

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

$$= AB \cos \theta \cdot AB \sin \theta + BA \cos \theta (-BA \sin \theta)$$

$$= AB^2 \cos \theta \sin \theta - A^2 B^2 \cos \theta \sin \theta$$

$$= 0$$

(18)

Given

$$(\hat{i} + \hat{j}) \cdot (2\hat{i} + 2\hat{k})$$

$$= 2\hat{i} \cdot \hat{i} + 2\hat{i} \cdot \hat{j} + 2\hat{i} \cdot \hat{k} + 2\hat{j} \cdot \hat{k}$$

$$= 2 + 2(0) + 2(0) + 2(0)$$

$$\hat{i} \cdot \hat{j} = |\hat{i}| |\hat{j}| \cos \theta = 2$$

$$= 1 \times 1 \times \cos 90^\circ$$

$$= 0$$

ii.  $\hat{j} \cdot \hat{k}$  are perpendicular  
 $\hat{j} \cdot \hat{k} = 0$

(19)

Given

$$\vec{A} = 2\hat{i} + 3\hat{j} + 6\hat{k} \quad \& \quad \vec{B} = 3\hat{i} - 6\hat{j} + 2\hat{k}$$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 6 \\ 3 & -6 & 2 \end{vmatrix} = \hat{i} [2 \times 3 - 6 \times 6] - \hat{j} [2 \times 2 - 3 \times 6] + \hat{k} [-6 \times 2 - 3 \times 3]$$

$$= \hat{i} [6 - 36] - \hat{j} [4 - 18] + \hat{k} [-12 - 9]$$

$$= -30\hat{i} + 14\hat{j} - 21\hat{k}$$

$$= 7(6\hat{i} + 2\hat{j} - 3\hat{k})$$

Given The vector  $\vec{r}$  (let it be) Perpendicular to both  $\vec{A}$  and  $\vec{B}$

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

$$\therefore k = 7$$

(19)

$$(a) \hat{j} \cdot \hat{j} = |\hat{j}| |\hat{j}| \cos 0 = 1 \times 1 \times \cos 0 = 1$$

$$(b) |\hat{j} + \hat{i}| = \sqrt{1^2 + 1^2} = \sqrt{2}$$

$$(c) |\hat{i} + \hat{k}| = |\hat{k}| = 1$$

$$(d) \hat{j} \times \hat{k} = \hat{i}$$

Q3.

13.