YAKEEN NEET 2.0

2026

Vectors (Last)

PHYSICS | Lecture - 10

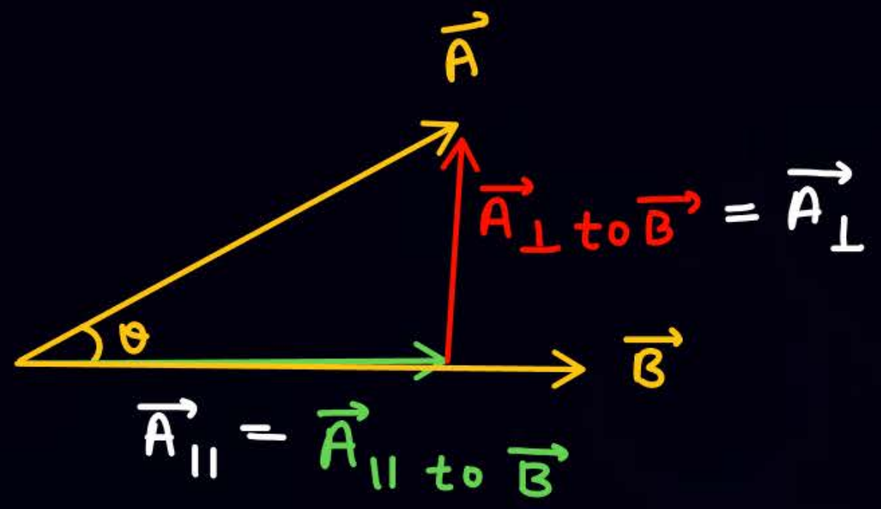
By - Saleem Ahmed Sir

Todays Goal

- Cross Product & Component of one vector perpendicular to another vector.

$$\vec{A}_{\parallel} + \vec{A}_{\perp} = \vec{A}$$

$$\boxed{\vec{A}_{\perp} = \vec{A} - \vec{A}_{\parallel}}$$



Note

Agar $\vec{A}_{\perp}$ wallah component nikalna hai to $\vec{A}$ me se $\vec{A}_{\parallel}$ Minus kar do

अगर $\vec{A}_{\perp}$ वाला Component निकालना हो तो $\vec{A}$ में से $\vec{A}_{\parallel}$ घटा दो

Q $\vec{A} = 3\hat{i} + 4\hat{j}$

$\vec{B} = \hat{i} + \hat{j}$

Component of $\vec{A}$ parallel to $\vec{B}$ $= A\cos\theta = \dfrac{\vec{A}\cdot\vec{B}}{B} = \dfrac{3+4}{\sqrt{2}} = \dfrac{7}{\sqrt{2}}$

Vector form $= \dfrac{7}{\sqrt{2}}\hat{B} = \dfrac{7}{\sqrt{2}}\dfrac{\hat{i}+\hat{j}}{\sqrt{2}} = \dfrac{7}{2}(\hat{i}+\hat{j}) = \vec{A}_{\parallel}$ to $\vec{B}$

Component of $\vec{A}$ perpendicular to $\vec{B}$ $= \vec{A} - \vec{A}_{\parallel} = (3\hat{i}+4\hat{j}) - \left(\dfrac{7}{2}\hat{i} + \dfrac{7}{2}\hat{j}\right)$

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

Q $\vec{A} = 4\hat{i} - 2\hat{j}$

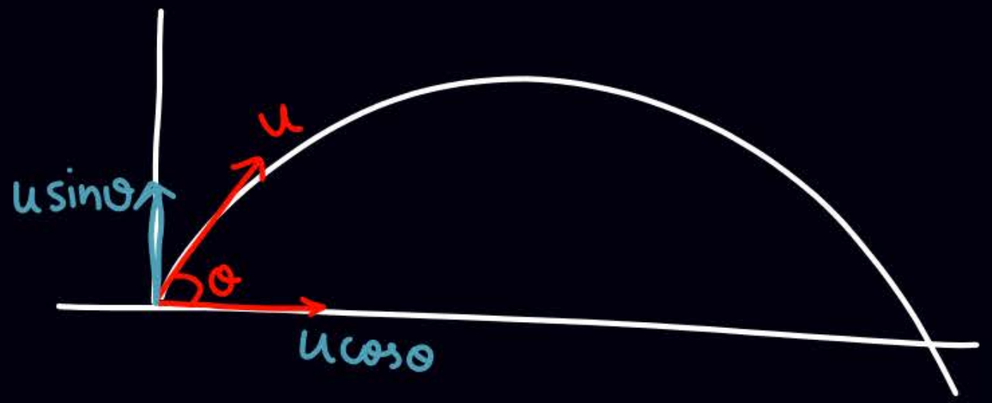
$\vec{B} = 3\hat{i} + 4\hat{j}$

Component of $\vec{A}$ parallel to $\vec{B}$ $= \frac{\vec{A}\cdot\vec{B}}{B} = \frac{4}{5}$

Vector $= \frac{4}{5}\left(\frac{3\hat{i}+4\hat{j}}{5}\right) = \frac{12\hat{i}+16\hat{j}}{25}$

Component of perpendicular to $\vec{B} = \vec{A} - \vec{A}_{||} = (4\hat{i} - 2\hat{j}) - \left(\frac{12\hat{i}+16\hat{j}}{25}\right)$

$= \frac{88\hat{i} - 66\hat{j}}{25}$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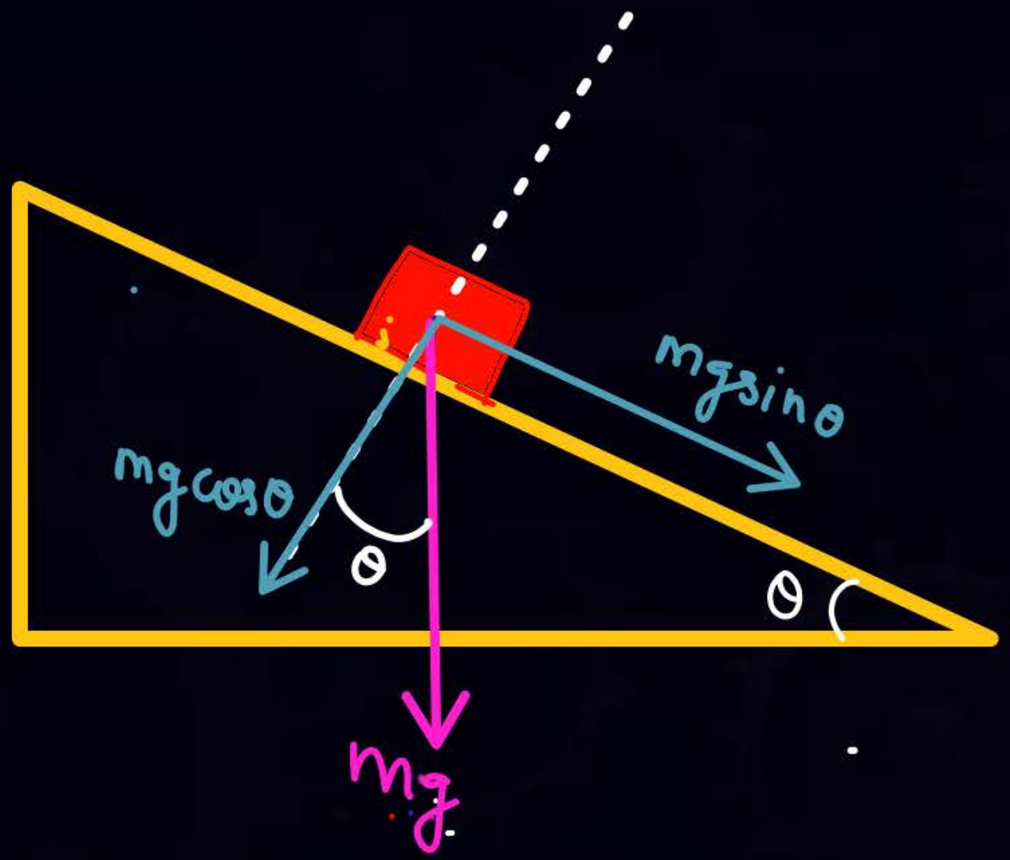

mgsinθ
mgcosθ
θ
θ
mg

$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$$

$$\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$$

If $\frac{A_x}{B_x} = \frac{A_y}{B_y} = \frac{A_z}{B_z} = n$

- If $n > 0 \Rightarrow \vec{A}$ parallel to $\vec{B}$
- If $n < 0 \Rightarrow \vec{A}$ antiparallel to $\vec{B}$

Q $\vec{A} = 3\hat{i} + b\hat{j} - a\hat{k}$

$\vec{B} = 9\hat{i} + 2\hat{j} + 5\hat{k}$

If $\vec{A}$ is parallel to $\vec{B}$

find Value of $(a+b)^2$

Sol^n $\frac{3}{9} = \frac{b}{2} = \frac{-a}{5}$

$\frac{3}{9} = \frac{b}{2}$

$b = \frac{2}{3}$

$\frac{3}{9} = \frac{-a}{5}$

$a = \frac{-5}{3}$

$(a+b)^2 = \left(\frac{-5}{3} + \frac{2}{3}\right)^2 = 1$

Cross Product

- Rotation (Feel)
- magnetic field, EMI

product
- Dot product
- Cross Product

$\frac{\vec{A}}{\vec{B}}$ X

$\vec{A}.\vec{B} = AB\cos\theta$ number scalar

Cross Product

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

- magnitude → $AB\sin\theta$
- Direction → $\vec{C} \perp \vec{A}$, $\vec{C} \perp \vec{B}$,

* Do Vector $\vec{A}$ & $\vec{B}$ Ka cross product ek teesra Vector $\vec{C}$ Hota hai...
* $\vec{A} \times \vec{B}$ = Khud me ek vector hai
* magnitude of $\vec{A} \times \vec{B} = AB\sin\theta$
* $\vec{A} \times \vec{B} = (AB\sin\theta).\hat{C}$
* $|\vec{A} \times \vec{B}| = AB\sin\theta$

** $\vec{A} \times \vec{B} = \overrightarrow{\text{कदद्दू}} = \vec{C}$

ye jo $\overrightarrow{\text{कदद्दू}}$ Hai ≡ $\vec{A}$ Ke bhi perpendicular hai or $\vec{B}$ Ke bhi perpendicular hai.

* $\vec{C}.\vec{A} = 0$
* $\vec{C}.\vec{B} = 0$

$\vec{A}$ & $\vec{B}$

Q If two vector of magnitude 10 Unit & 20 unit are angle between them θ. Find the magnitude of $\vec{A} \times \vec{B}$ if

① $\theta = 0 \Longrightarrow AB\sin\theta = 10 \times 20 \times \sin 0 = 0$

② $\theta = 30^\circ \Longrightarrow AB\sin\theta = 10 \times 20 \times \sin 30^\circ = 100$

③ $\theta = 90^\circ \Longrightarrow AB\sin\theta = 10 \times 20 \times \sin 90 = 200$

④ $\theta = 150 \Longrightarrow 10 \times 20 \times \sin 150^\circ = 100$

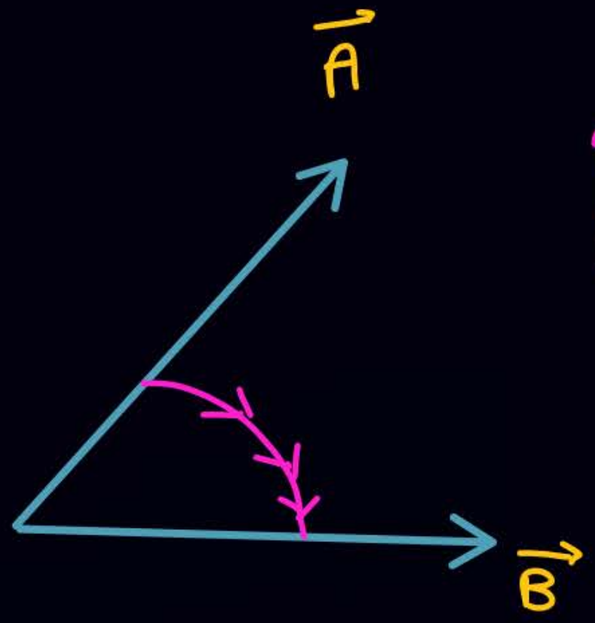
⑤ $\theta = 180 \Longrightarrow 10 \times 20 \times \sin 180 = 0$

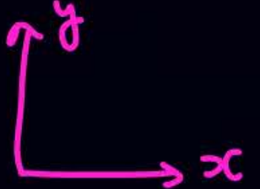
If $\theta = 0, 180^\circ$.
$\vec{A} \times \vec{B} = 0$
parallel/Antiparallel

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

$\theta = 90^\circ$

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





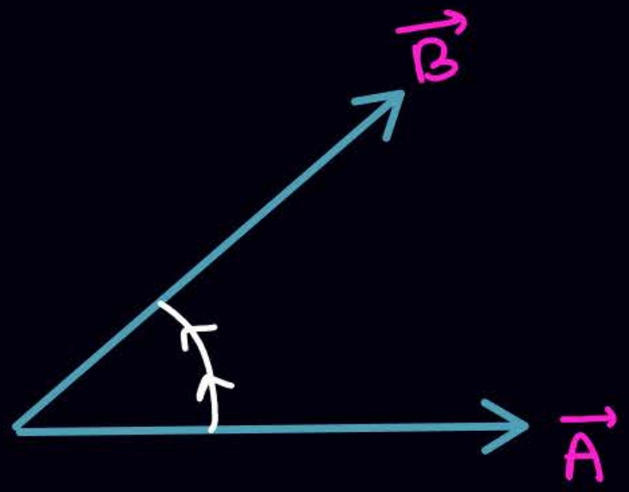
* Right hand thumb rule.

$\vec{A} \times \vec{B}$ ⇒ Direction ⇒ perpendicularly inside.

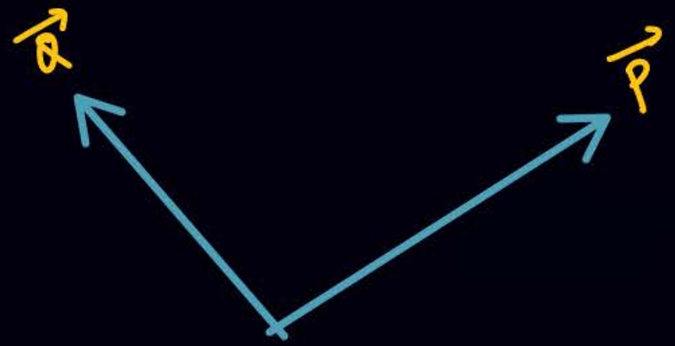
$= -\hat{k}$

$\vec{A}$ से $\vec{B}$ की तरफ अंगुलियां घुमाना है

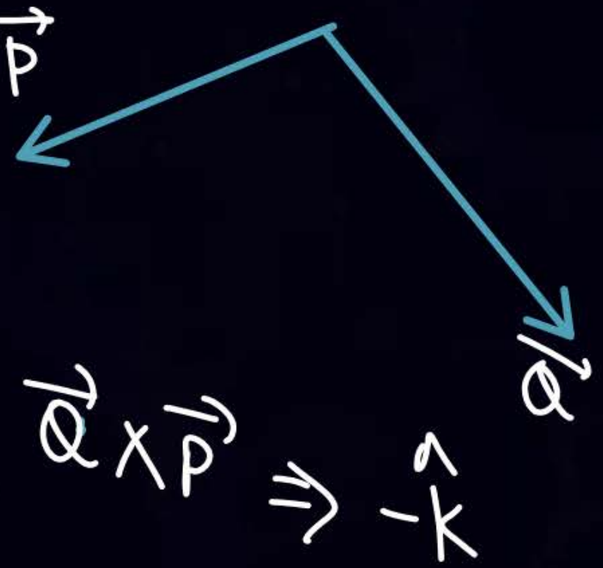
thumb ⇒ will give us dir^n of $\vec{A} \times \vec{B}$



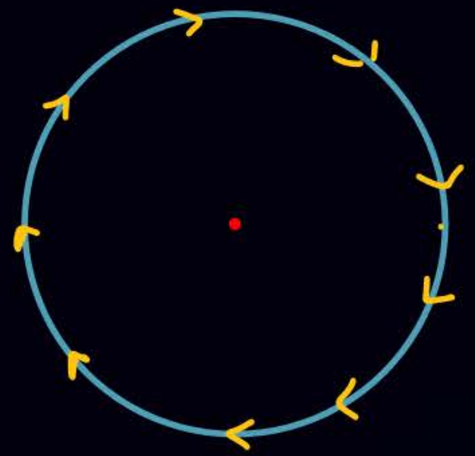
Dir^{n} of $\vec{A} \times \vec{B}$ $\Rightarrow$ perpendicularly outside $\hat{k}$



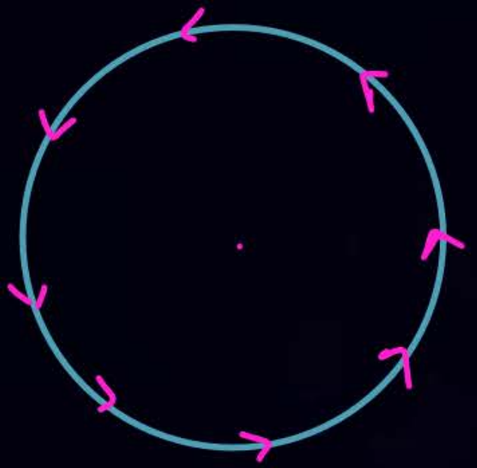
dir^{n} of $\vec{P} \times \vec{Q} \Rightarrow \hat{k}$



Dir^{n} of $\vec{Q} \times \vec{P} \Rightarrow -\hat{k}$



Clockwise sense ≡ C.W.



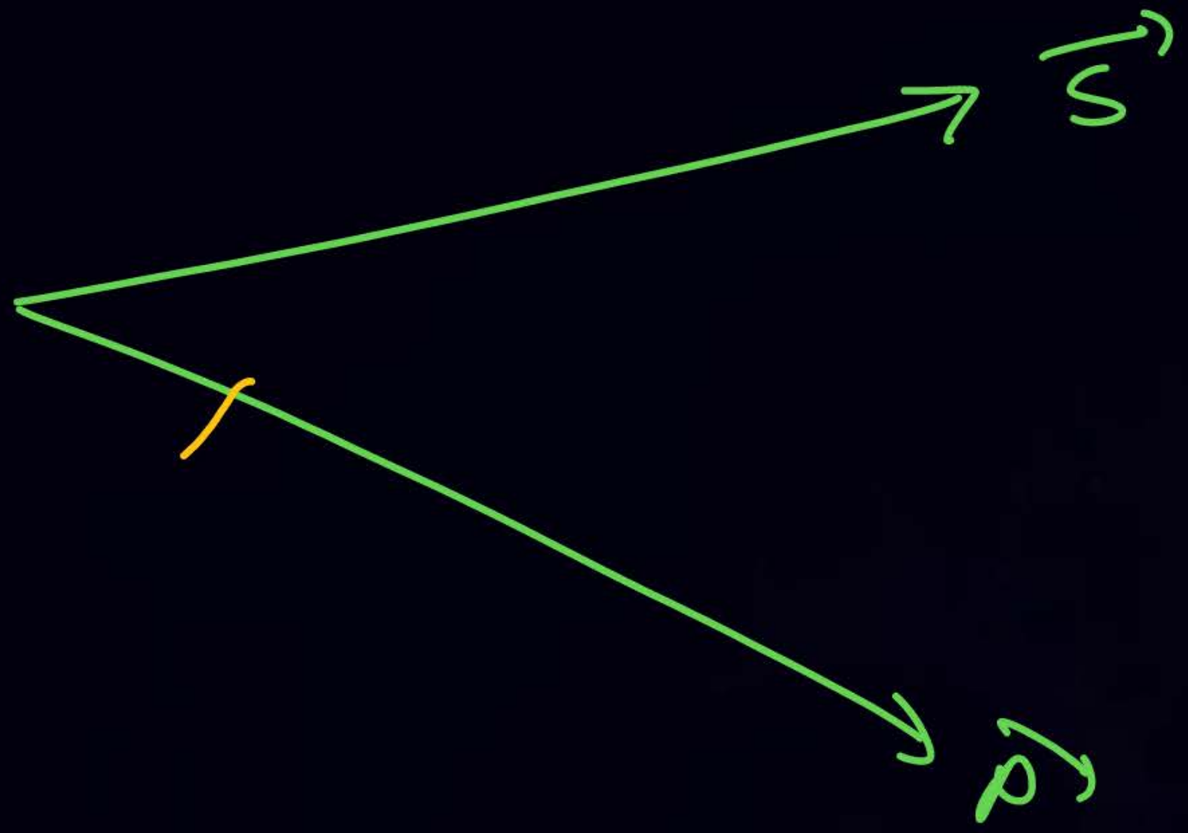
Anticlockwise sense (ACW)

* Perpendicularly Inside ($-\hat{k}$)

Perpendicularly outside ($+\hat{k}$)

Saleem Bhaia ke kamre ke Andar ghadi hai

$-\hat{k}$ CW

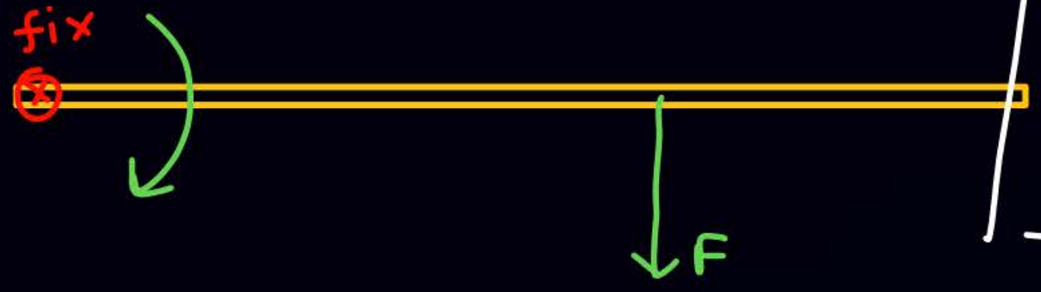


$\vec{S} \times \vec{P} \equiv C\omega$

$-\hat{k}$

$\vec{P} \times \vec{S} \equiv AC\omega$

$+\hat{k}$



$\vec{\tau} = \vec{r} \times \vec{F}$

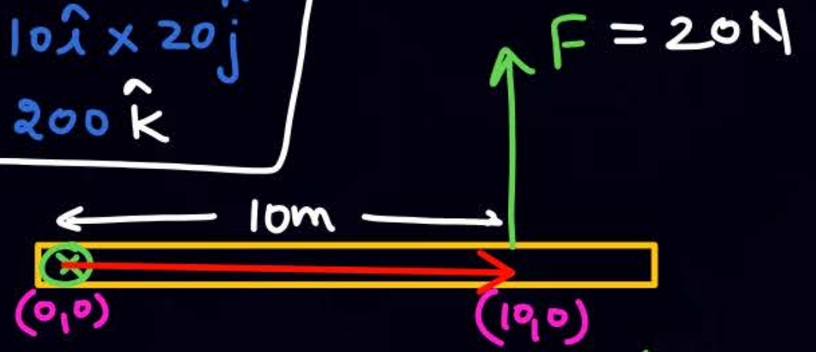
$\vec{r} = 10\hat{i}$

$\vec{F} = 20\hat{j}$

$\vec{\tau} = 10\hat{i} \times 20\hat{j}$

$\vec{\tau} = 200\,\hat{k}$

$\vec{\tau} \equiv (-\omega) \Rightarrow -\hat{k}$



$\vec{\tau} \equiv A(\omega) \Rightarrow$ outside $\Rightarrow \hat{k}$

$\tau = r_{\perp} F = 10 \times 20 = 200$

$\vec{\tau} = 200\,\hat{k}$

Q $\hat{i} \times \hat{i} = 0$

$\theta = 0$

$\Rightarrow \hat{i} \times \hat{i} = 0 \iff \hat{i} \cdot \hat{i} = 1$

$\hat{j} \times \hat{j} = 0 \iff \hat{j} \cdot \hat{j} = 1$

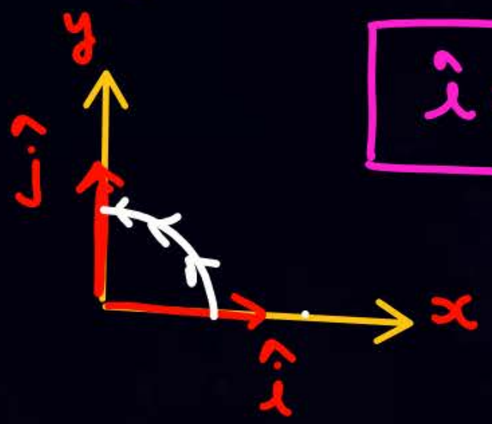
$\hat{k} \times \hat{k} = 0 \iff \hat{k} \cdot \hat{k} = 1$

$\vec{A} \times \vec{A} = 0 \iff \vec{A} \cdot \vec{A} = A^2$

x $\hat{i} \times \hat{j}$

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

$\hat{i} \times \hat{j} = 1 \times 1 \times \sin 90^\circ \cdot \hat{k}$

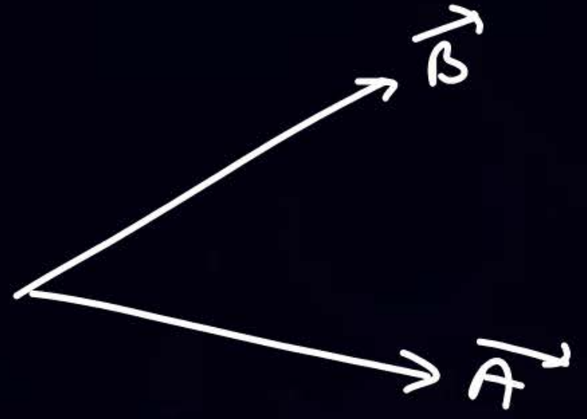


$\hat{i} \times \hat{j} = \hat{k}$

* $\vec{A} \times \vec{B} \neq \vec{B} \times \vec{A}$

$\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$

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



* $A(B+C) = AB + AC$
* $\vec{A} \cdot (\vec{B}+\vec{C}) = \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{C}$
* $\vec{A} \times (\vec{B}+\vec{C}) = \vec{A} \times \vec{B} + \vec{A} \times \vec{C}$

Q $\vec{A} = 3\hat{i} + 4\hat{j}$

$\vec{B} = 5\hat{i} + 3\hat{j}$

$(a+b)(c+d) = ac + ad + bc + bd$

$\vec{A} \times \vec{B} = (3\hat{i} + 4\hat{j}) \times (5\hat{i} + 3\hat{j})$

$= 15\,\hat{i} \times \hat{i} + 9\,\hat{i} \times \hat{j} + 20\,\hat{j} \times \hat{i} + 12\,\hat{j} \times \hat{j}$

$= 0 + 9\hat{k} - 20\hat{k} + 0$

$= \underline{-11\hat{k}}$

Q $\vec{A} = 2\hat{i} - 3\hat{j}$

$\vec{B} = 5\hat{i} + 10\hat{j}$

$\vec{A} \times \vec{B} = (2\hat{i} - 3\hat{j}) \times (5\hat{i} + 10\hat{j})$

$= 0 + 20\hat{k} - 15(-\hat{k}) + 0$

$= \underline{35\hat{k}}$

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

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

1 $\hat{i}\,\hat{j}\,\hat{k}\,\hat{i}\,\hat{j}\,\hat{k}$

$\vec{A} \times \vec{B} = (\hat{i} + \hat{j} + 2\hat{k}) \times (3\hat{i} + 4\hat{j} + 5\hat{k})$

$= 0 + 4\hat{k} - 5\hat{j} - 3\hat{k} + 0 + 5\hat{i} + 6\hat{j} - 8\hat{i} + 0$

50% ① Kinematics

31% ② Unit & measurment

65% ③ Sir jaisaap bolo

3% ④ Hum to Spammer hai

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

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

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

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

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

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

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

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

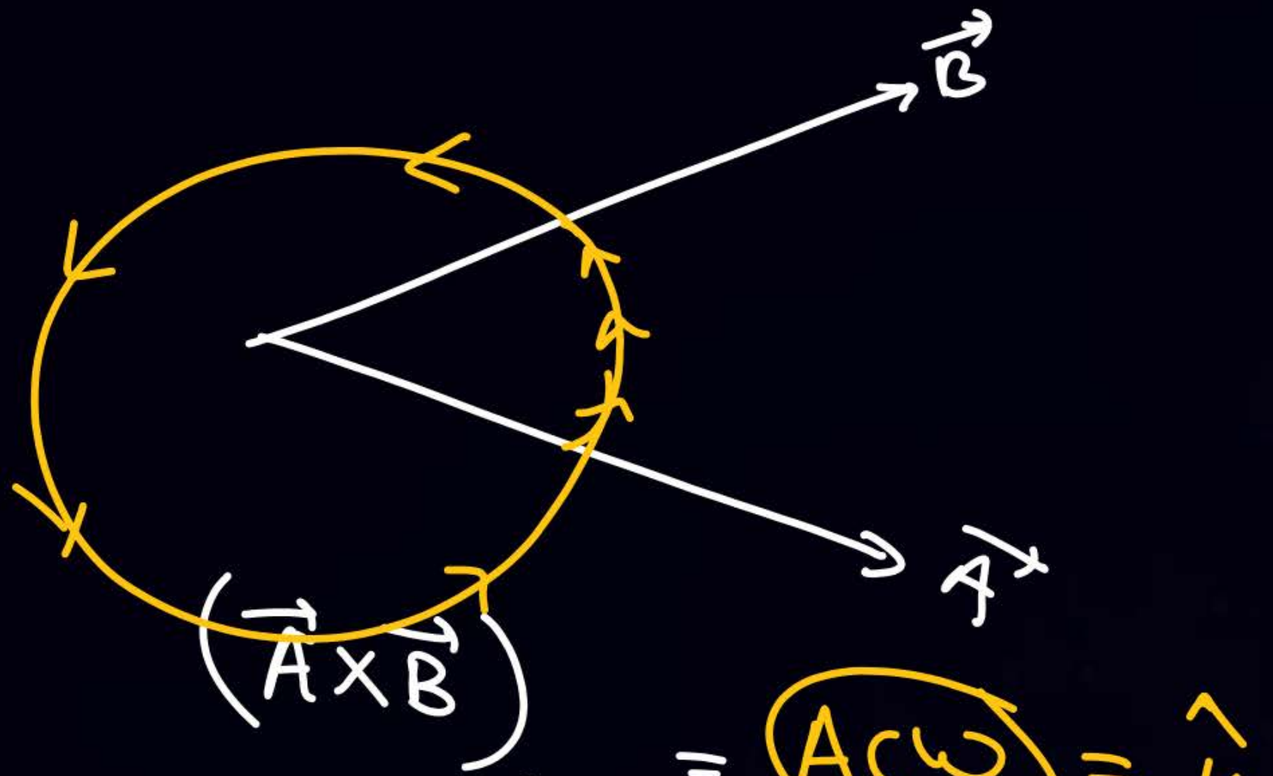
$\hat{k} \times \hat{i} = +\hat{j}$

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

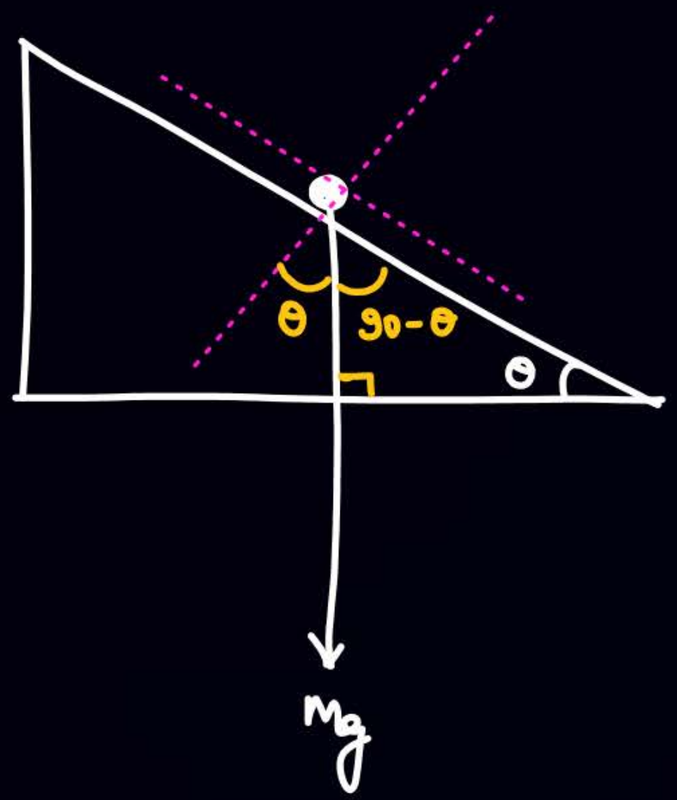
$\hat{k} \times \hat{j} = -\hat{i}$

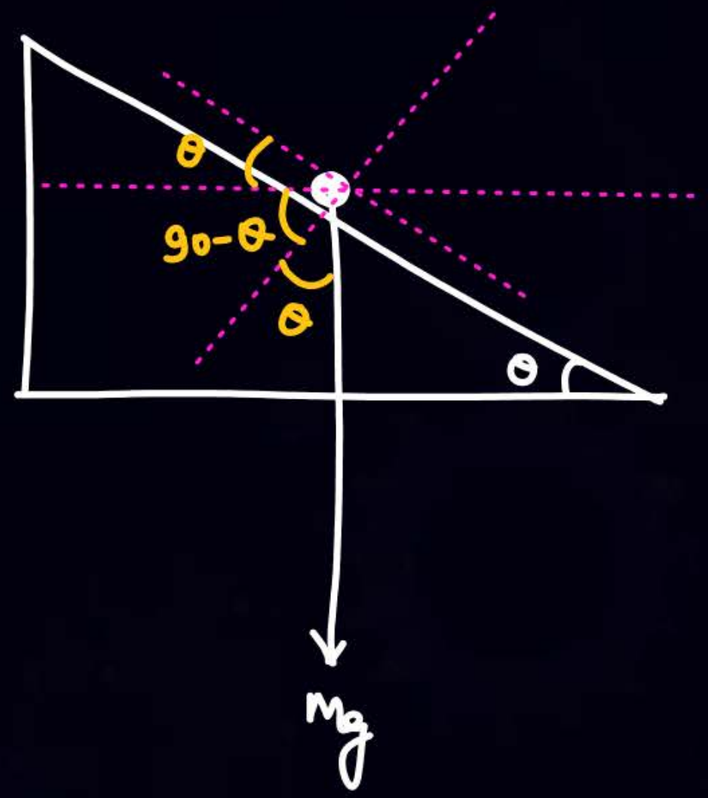
$\hat{i} \times \hat{k} = -\hat{j}$

$\hat{i}\,\hat{j}\,\hat{k}\;\hat{i}\,\hat{j}\,\hat{k}\;\hat{i}\,\hat{j}\,\hat{k}$



$$\text{Dir}^{n} \equiv \boxed{\text{ACW}} \equiv \hat{k}$$


θ
90-θ
θ
mg


θ
90-θ
θ
θ
mg

Q $\vec{A} = 3\hat{\imath} - 4\hat{\jmath}$

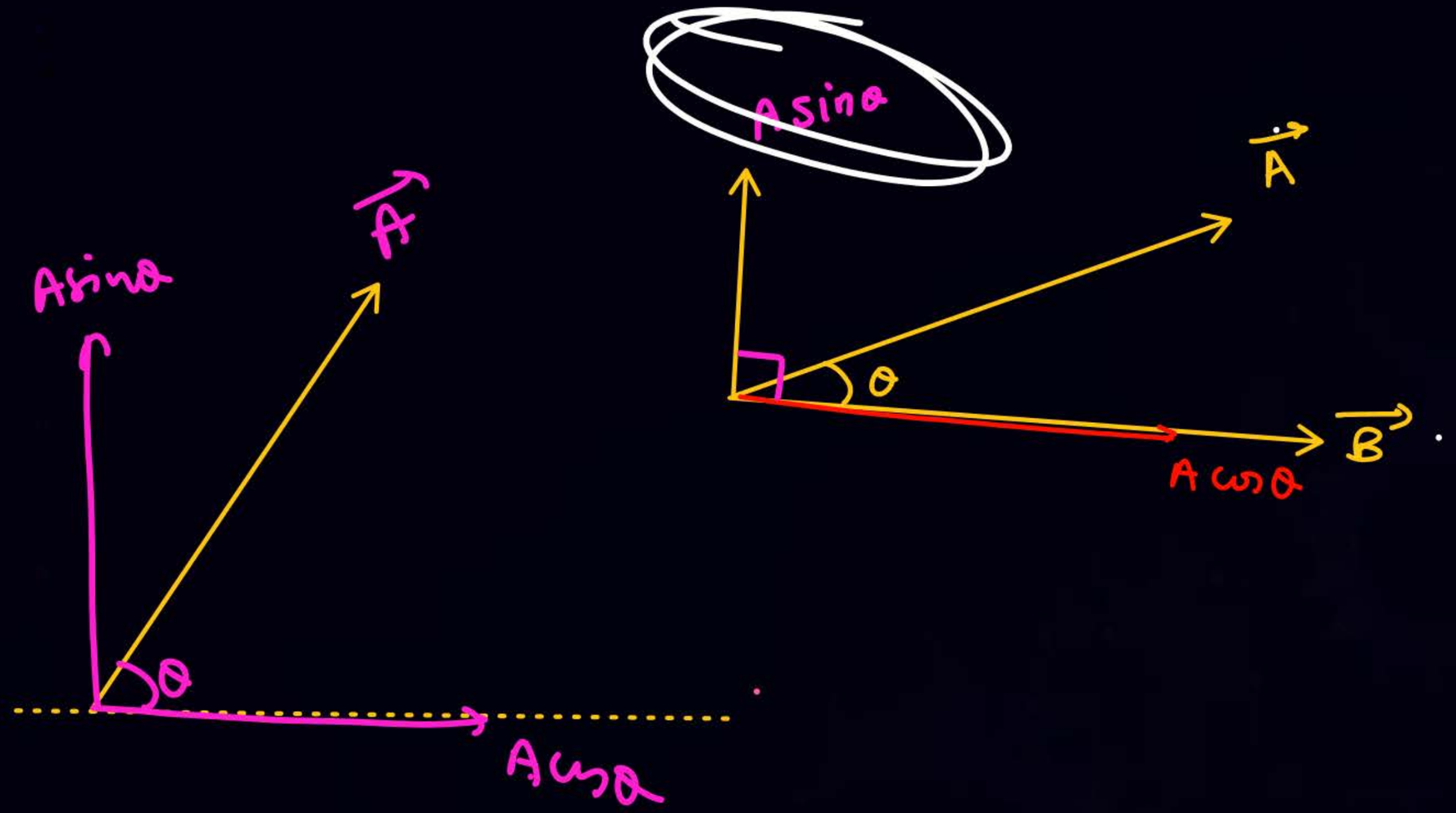
$\vec{B} = \hat{\imath} - \hat{\jmath}$

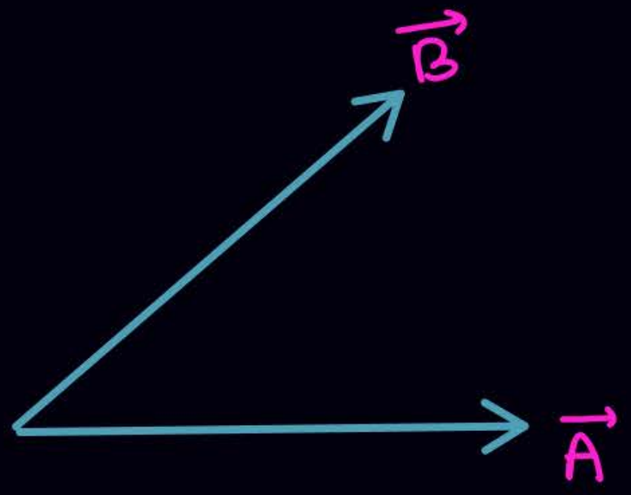
Component of $\vec{A}$ along $\vec{B}$ (parallel to $\vec{B}$) $= \frac{\vec{A}\cdot\vec{B}}{B} = \frac{7}{\sqrt{2}}$

" " " vector $= \frac{7}{\sqrt{2}} \cdot \frac{\hat{\imath}-\hat{\jmath}}{\sqrt{2}} = \frac{7}{2}(\hat{\imath}-\hat{\jmath}) = \vec{A}_{\parallel}$

Component of $\vec{A}$ perpendicular to $\vec{B}$ $= \vec{A} - \vec{A}_{\parallel} = (3\hat{\imath} - 4\hat{\jmath}) - \frac{7}{2}(\hat{\imath}-\hat{\jmath})$

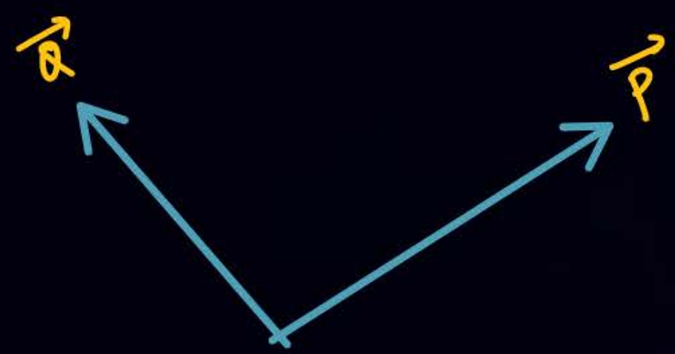
$= -\frac{\hat{\imath}}{2} - \frac{\hat{\jmath}}{2}$


Asinθ
A
Asinθ
A
θ
B
A cosθ
θ
A cosθ

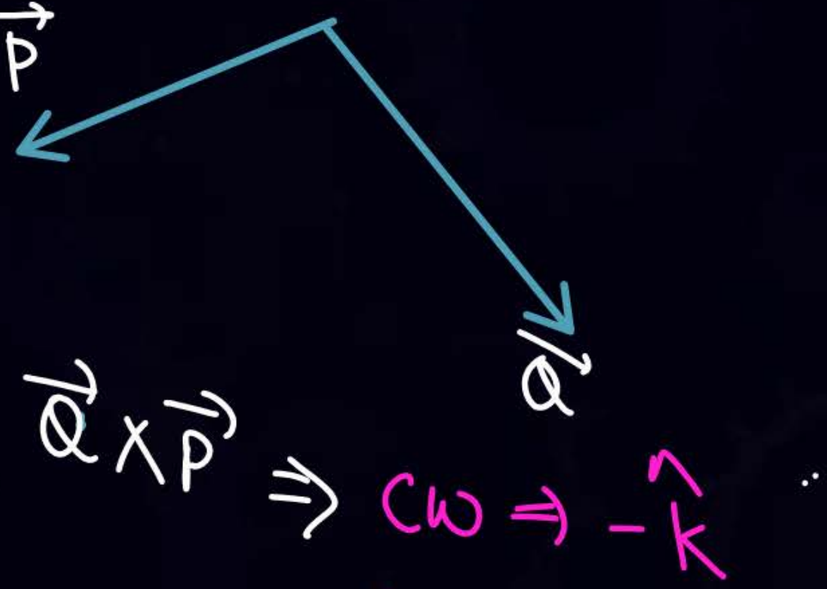


Dir^{n} of $\vec{A} \times \vec{B} \Rightarrow$ Acw $\Rightarrow +\hat{k}$

$\vec{A}$ से $\vec{B}$ की तरफ़ डंडा/pen घुमा दो



dir^{n} of $\vec{P} \times \vec{Q} \Rightarrow$ Acw $\Rightarrow +\hat{k}$



Dir^{n} of $\vec{Q} \times \vec{P} \Rightarrow$ Cw $\Rightarrow -\hat{k}$

$\therefore$

Homework

- Complete module . (Vector)
- KPP
- DPP

THANK YOU