YAKEEN NEET 2.0

2026

Vectors

Physics | Lecture - 8

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Topics to be covered

1. # * H/W & Revision of Dot Product
2. # Cross-Product
3. # Lamis theorem.
4.

Question

If $\vec{A} = 0.5\hat{\imath} + 0.4\hat{\jmath} - \alpha\hat{k}$ then find α if $\vec{A}$ is unit vector.

$$|\vec{A}| = 1 = \sqrt{(0.5)^2 + (0.4)^2 + (-\alpha)^2}$$

$$1^2 = 0.25 + 0.16 + \alpha^2$$

$$1 - 0.41 = \alpha^2$$

$$\sqrt{0.59} = \alpha$$

$$\vec{A} \cdot \vec{A} = 1$$

$$(0.5\hat{i} + 0.4\hat{j} - \alpha\hat{k}) \cdot (0.5\hat{i} + 0.4\hat{j} - \alpha\hat{k}) = 1$$

$$\boxed{0.25 + 0.16 + \alpha^2 = 1}$$

Question

If $\vec{A} = \sin\theta\,\hat{\imath} + \cos\theta\,\hat{\jmath}$ then prove that $\vec{A}$ is a unit vector.

done

$|\vec{A}| = 1$

Question

If $\vec{A} = 2\hat{\imath} + 3\hat{\jmath} + \alpha\hat{k}$ and $\vec{B} = \hat{\imath} - 2\hat{\jmath} + 4\hat{k}$ find α. If $\vec{A}$ is perpendicular to $\vec{B}$.

$$\vec{A} \cdot \vec{B} = 0$$

$$2 - 6 + 4\alpha = 0$$

$$-4 + 4\alpha = 0$$

$$\cancel{4}\alpha = +\cancel{4}$$

$$\alpha = +1$$

$$\vec{A} \cdot \vec{B} = AB\cos\theta = AB\cos 90^\circ = 0$$

$$A \perp_r B$$

Question

If $\vec{A} = 2\hat{\imath} + 6\hat{\jmath} + 3\hat{k}$ and $\vec{B} = 4\hat{\imath}$. Find angle between $\vec{A}$ and $\vec{B}$.

$|\vec{A}| = \sqrt{4+36+9} = \sqrt{45} = 7$

$\vec{A} \cdot \vec{B} = (2\hat{i} + 6\hat{j} + 3\hat{k}) \cdot (4\hat{i})$

$= 8$

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

$8 = 7 \times 4 \cos\theta$

$\cos\theta = \frac{\cancel{8}\,2}{7 \times \cancel{4}} = \frac{2}{7}$

$\theta = \cos^{-1}(2/7)$

Question

done

If a vector $\underbrace{2\hat{\imath} + 3\hat{\jmath} + 8\hat{k}}$ is perpendicular to the vector $3\hat{\jmath} - 4\hat{\imath} + \alpha\hat{k}$, then the value of α is [2005]

1. 1/2
2. –1/2
3. 1
4. –1/8

Question

The angle between the two vectors $\vec{A} = 3\hat{\imath} + 4\hat{\jmath} + 5\hat{k}$ and $\vec{B} = 3\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$ will be

[1994]

(1) $90°$

(2) $180°$

(3) zero

(4) $45°$

$\vec{A} \cdot \vec{B} = 9 + 16 - 25 = 0$

$\vec{A} \perp \vec{B}$

Question

A particle moves with velocity $\vec{v} = 5\hat{\imath} + 2\hat{\jmath} - \hat{k}$ under the influence of the constant force $\vec{f} = 2\hat{\imath} + 5\hat{\jmath} - 10\hat{k}$ of the instantaneous power applied is $(P = \vec{F}\cdot\vec{v})$

NEET-2016/2012

Use of dot Product

$W = \vec{F}\cdot\vec{S}$

Power $= \vec{F}\cdot\vec{v}$

$U = -\vec{P}\cdot\vec{E}$

$P = \vec{F}\cdot\vec{v}$

$= (2\hat{i} + 5\hat{j} - 10\hat{k})\cdot(5\hat{i} + 2\hat{j} - \hat{k})$

$= 10 + 10 + 10 = 30$ Watt

Question

A body, constrained to move in y-direction, is subjected to a force given by $\vec{F} = (-2\hat{\imath} + 15\hat{\jmath} + 6\hat{k})$ N. The work done by this force in moving the body through a distance of along $10\hat{\jmath}$ m y-axis, is

many times in NEET/JEE

(1) 150 J

(2) 20 J

(3) 190 J

(4) 160 J

$S = 10\hat{j}$

$F = -2i + 15j + 6k$

$$\boxed{W = \vec{F} \cdot \vec{S}}$$

$= 0 + 150 + 0$

$= 150\,J$ ✓

Question

Two forces $\vec{F}_1 = \hat{\imath} + 2\hat{\jmath} - 2\hat{k}$ and $\vec{F}_2 = 2\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ are acting on a particle and it's displacement is $\underline{-\hat{\imath} + 2\hat{\jmath} + \hat{k}}$. Find work done on the particle

NEET

(1) 2J

(2) 6J

(3) –3J

(4) zero

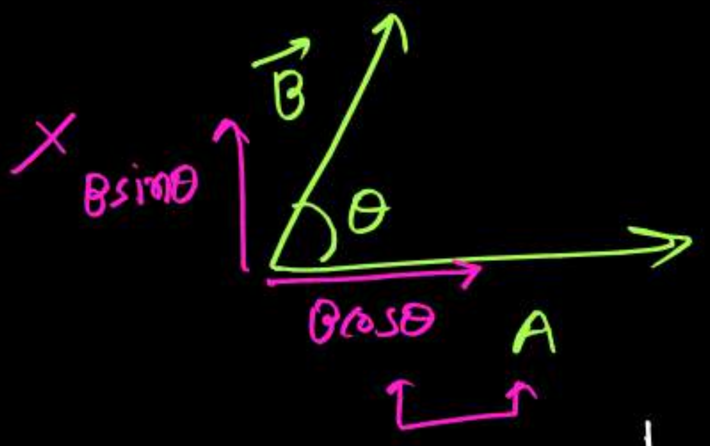
$\vec{F_1} + \vec{F_2} = 3\hat{i} + 4\hat{j} + \hat{k}$

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

dot Produc = $-3 + 8 + 1$

$= \underline{\underline{6}}$

Revision Dot Product



magnitu of $\vec{A} = A$

" of $\vec{B} = B$

Angle b/w $\vec{A}$ & $\vec{B} = \theta$

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

$$\vec{A}\cdot\vec{B} = A\,(B\cos\theta) = A\,(\text{Comp}^n \text{ of } B \text{ along } A)$$

$$\text{Comp}^n \text{ of } \vec{B} \text{ along } A = \frac{\vec{A}\cdot\vec{B}}{A} = \frac{\vec{A}\cdot\vec{B}}{A} \text{ (scalar)}$$

$$\text{Compon of } \vec{A} \text{ along } B = \frac{\vec{A}\cdot\vec{B}}{B} = \vec{A}\cdot\hat{B}$$

$$\text{Projection of } \vec{B} \text{ along } A = \frac{\vec{A}\cdot\vec{B}}{A}$$

$$\text{Projection of } \vec{A} \text{ along } \vec{B} = \frac{\vec{A}\cdot\vec{B}}{B}$$

~~DTH~~ ka nahi hai

Component of $\vec{B}$ along $\hat{A}$ in vector form =

$$= \frac{\vec{A}\cdot\vec{B}}{A} * (\hat{A})$$

Kisi bhi vector ke magnitude ko unit vector se multiply kiya (Not dot Product) to Net magnitude same Rahega but ush magnitude ka diretin Unit vector ki tarf aayga

$5\hat{A}$

$5\hat{B}$

$5\hat{C}$

$\vec{A}$ & $\vec{B}$ iska Product Karo

Scalar × vector

$5 \times \vec{A} = 5\vec{A}$

⇒ Kisi vector ka Scalar ke sath dot Product and cross product Nahi ho sakta.

• Dot Product [Scalar Product]

$$\underbrace{\vec{A}\cdot\vec{B}}_{\text{Scalar}} = AB\cos\theta$$

(No dirⁿ)

$\vec{A}\cdot B$ ✗

• Cross Product (vector Product)

$$\underbrace{\vec{A}\times\vec{B}}_{\text{Vector}} = AB\sin\theta\,\hat{n}$$

dirⁿ of $\vec{A}\times\vec{B}$

आगे पढ़ेंगे

Question

If velocity $\vec{V} = \hat{\imath} - 2\hat{\jmath} + \hat{k}$ and acceleration $\vec{a} = 2\hat{\imath} + \hat{\jmath} + 2\hat{k}$ then find component of velocity along acceleration?

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

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

$$\text{comp}^n\ \vec{v}\ \text{along}\ \vec{a} = \frac{\vec{v} \cdot \vec{a}}{a}$$

$$= \frac{(\hat{i} - 2\hat{j} + \hat{k}) \cdot (2\hat{i} + \hat{j} + 2\hat{k})}{3} = \frac{2 - 2 + 2}{3} = \frac{2}{3}$$

Ans

$$|\vec{a}| = \sqrt{4 + 1 + 4}$$

$$= \sqrt{9} = 3$$

Question

Find the projection of $\vec{A} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$ along the vector $\vec{B} = \hat{\imath} + \hat{\jmath} + \hat{k}$.

(1) $\frac{1}{\sqrt{3}}$

(2) $\frac{2}{\sqrt{3}}$ ✓ Ans

(3) $\frac{4}{\sqrt{3}}$

(4) 0

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

$\Rightarrow A\cos\theta = \frac{\vec{A} \cdot \vec{B}}{B} = \frac{2-1+1}{B} = \frac{2}{\sqrt{3}}$

Question

A vector perpendicular to $\boxed{\hat{\imath}+\hat{\jmath}-\hat{k}}$ and $\boxed{\hat{\imath}-\hat{\jmath}-\hat{k}}$ is:

1. $\hat{\imath}+\hat{\jmath}+\hat{k}$ ✗
2. $\hat{\imath}+\hat{k}$ ✓
3. $-\hat{\imath}+\hat{\jmath}+\hat{k}$
4. $\hat{\jmath}+\hat{k}-2\hat{\imath}$ ✗

Perpendicular $\vec{A} \perp \vec{B}$

$\vec{A}\cdot\vec{B}=0$

Question Level up

$\vec{A}\cdot\vec{A} = AA\cos 0^\circ$

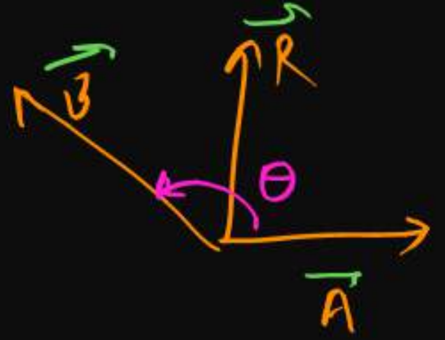
If resultant of $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ then angle between $\vec{A}$ and $\vec{B}$ will be:

(1) $\cos^{-1}(A/B)$

(2) $\cos^{-1}(-A/B)$

(3) $\sin^{-1}(A/B)$

(4) $\sin^{-1}(-A/B)$



$$\boxed{\vec{R} = \vec{A} + \vec{B}}$$

$\vec{R} \perp_r \vec{A}$

$\vec{R}\cdot\vec{A} = 0$

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

$\vec{A}\cdot\vec{A} + \vec{B}\cdot\vec{A} = 0$

$AA\cos 0^\circ + BA\cos\theta = 0$

$A^2 + BA\cos\theta = 0$

$B\cancel{A}\cos\theta = -\cancel{A^2}A$

$\cos\theta = -\dfrac{A}{B}$

$$\boxed{\theta = \cos^{-1}(-A/B)}$$

$$\left\{\begin{aligned}\vec{A} &= 2i + 3\hat{j} + 5\hat{k} \\ \vec{B} &= 4i + 6\hat{j} + 10\hat{k}\end{aligned}\right.$$

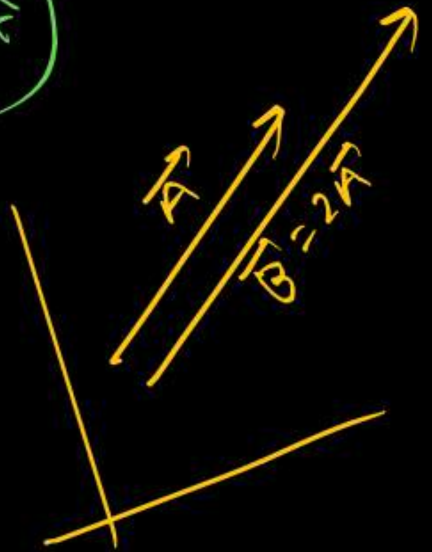
$$\vec{C} = -4i - 6\hat{j} - 10\hat{k}$$

$\vec{A}$ is Parallel to $\vec{B}$ ✓

$$\vec{A} = 2i + 3j + 5\hat{k}$$

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

If $\vec{B} = 2\vec{A}$



$$\left.\begin{aligned}\vec{A} &= 2i + 3\hat{j} + 5\hat{k} \\ \vec{B} &= 4i + 6\hat{j} + 15\hat{k}\end{aligned}\right\} \rightarrow \text{Not Parallel.}$$

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

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

If: $\dfrac{A_x}{B_x} = \left(\dfrac{A_y}{B_y}\right) = \dfrac{A_z}{B_z} = n$

\# If $n \rightarrow +ve$ then $\vec{A}$ & $\vec{B}$ is parallel

\# If $n \rightarrow -ve$ then $\vec{A}$ & $\vec{B}$ is antiparallel

Example-1

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

$\vec{B} = 6\hat{i} - 12\hat{j} + 9\hat{k}$

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

Examp-2

$\vec{A} = 2i - 4j - 3\hat{k}$

$\vec{B} = -6\hat{i} + 12\hat{j} + 9\hat{k}$

$\vec{A}$ is Anti Parallel to $\vec{B}$

$\frac{\cancel{2}}{-\cancel{6}} = \frac{-\cancel{4}}{\cancel{12}_{3}} = \frac{-3}{9}$

$-\frac{1}{3} = -\frac{1}{3} = -1/3$

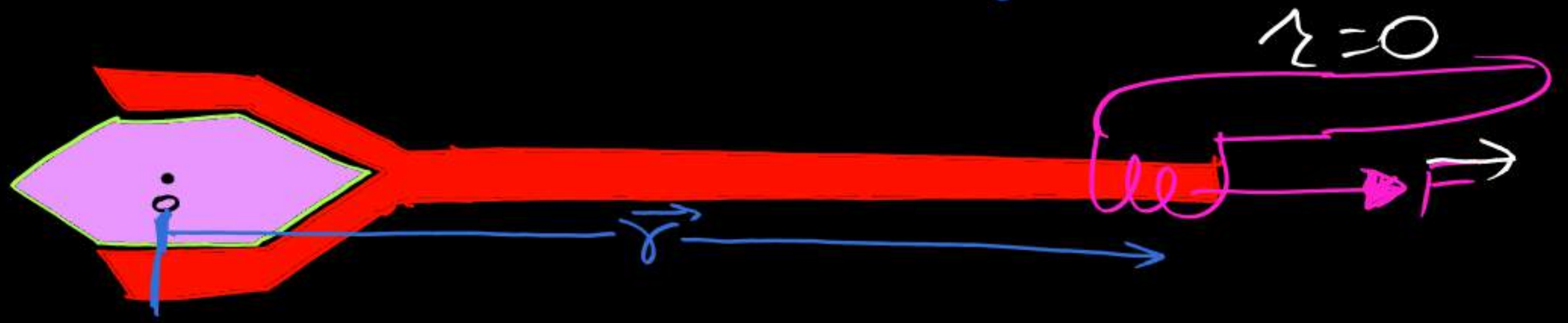
Explem-3

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

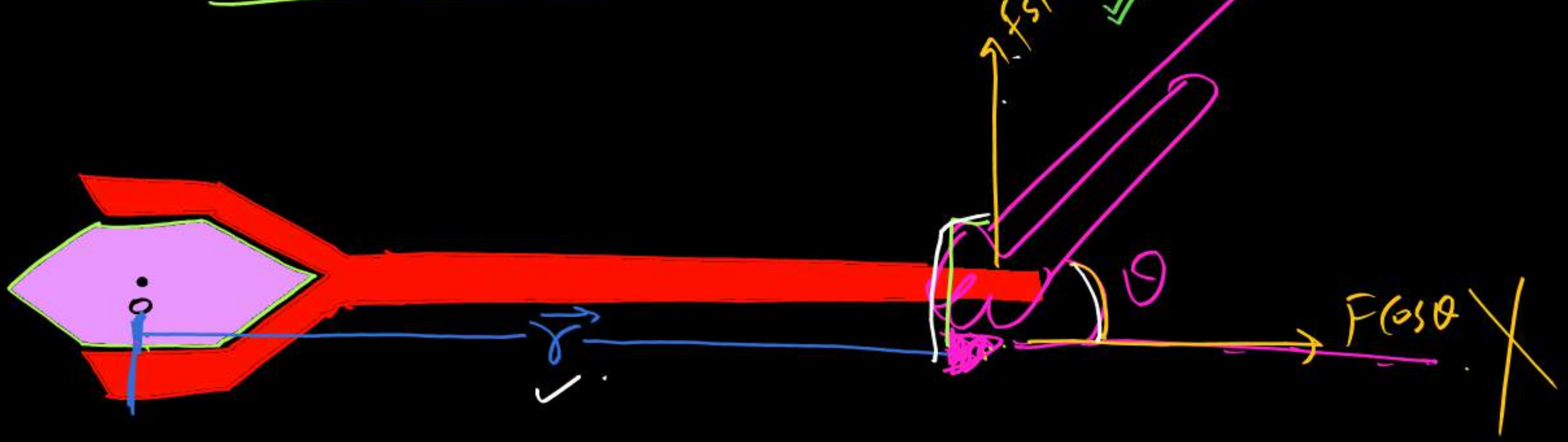
$\vec{B} = 8i + 12\hat{j} - 16\hat{k}$

$\vec{A}$ is not parallel &
Not anti-parallel

$\vec{r}$ = Position vector of force



Cross Product



$\vec{\tau} = r F \sin\theta$

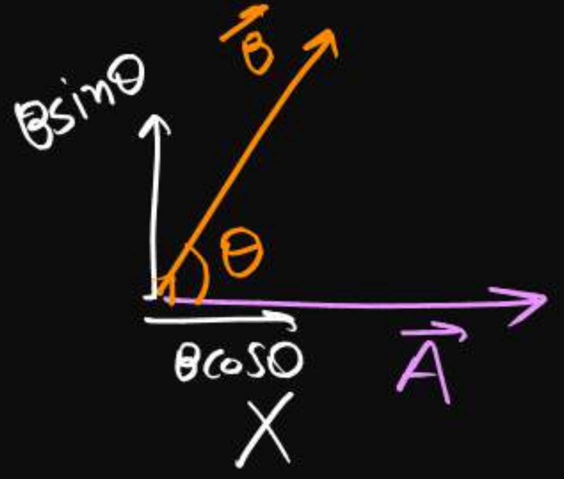
rotational effect $= r\,(F_{\perp r})$

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

vector product

$$\boxed{\vec{\tau} = r F \sin\theta\, \hat{n}}$$

Cross Vector (Vector Product)



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

$= A$ (comp^n of B Perpendicu to $\vec{A}$)

$\vec{A} \times \vec{B} = B$ (comp^n of A $\perp$r to $\vec{B}$)

$\underbrace{\vec{A} \times \vec{B}}_{\text{Vector}} = AB\sin\theta\,\hat{n} \longrightarrow$ dir^n of $\vec{A} \times \vec{B}$

* cross product ka use to Result vector me aata hia

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

$\vec{L} = \vec{r} \times \vec{P}$

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

$\vec{v} = \vec{\omega} \times \vec{r}$

$\vec{\tau} \perp r\ \vec{F}$

dir^n of $\vec{A} \times \vec{B}$ is perpendicu to $\vec{A}$ & $\vec{B}$

$\vec{A} \times \vec{B}$ Perpendicula to plane of $\vec{A}$ & $\vec{B}$.

Angle B/w $\vec{A} \times \vec{B}$ & $\vec{A}$ is 90°

Angle B/w $\vec{A} \times \vec{B}$ & $\vec{B}$ is 90°

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

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

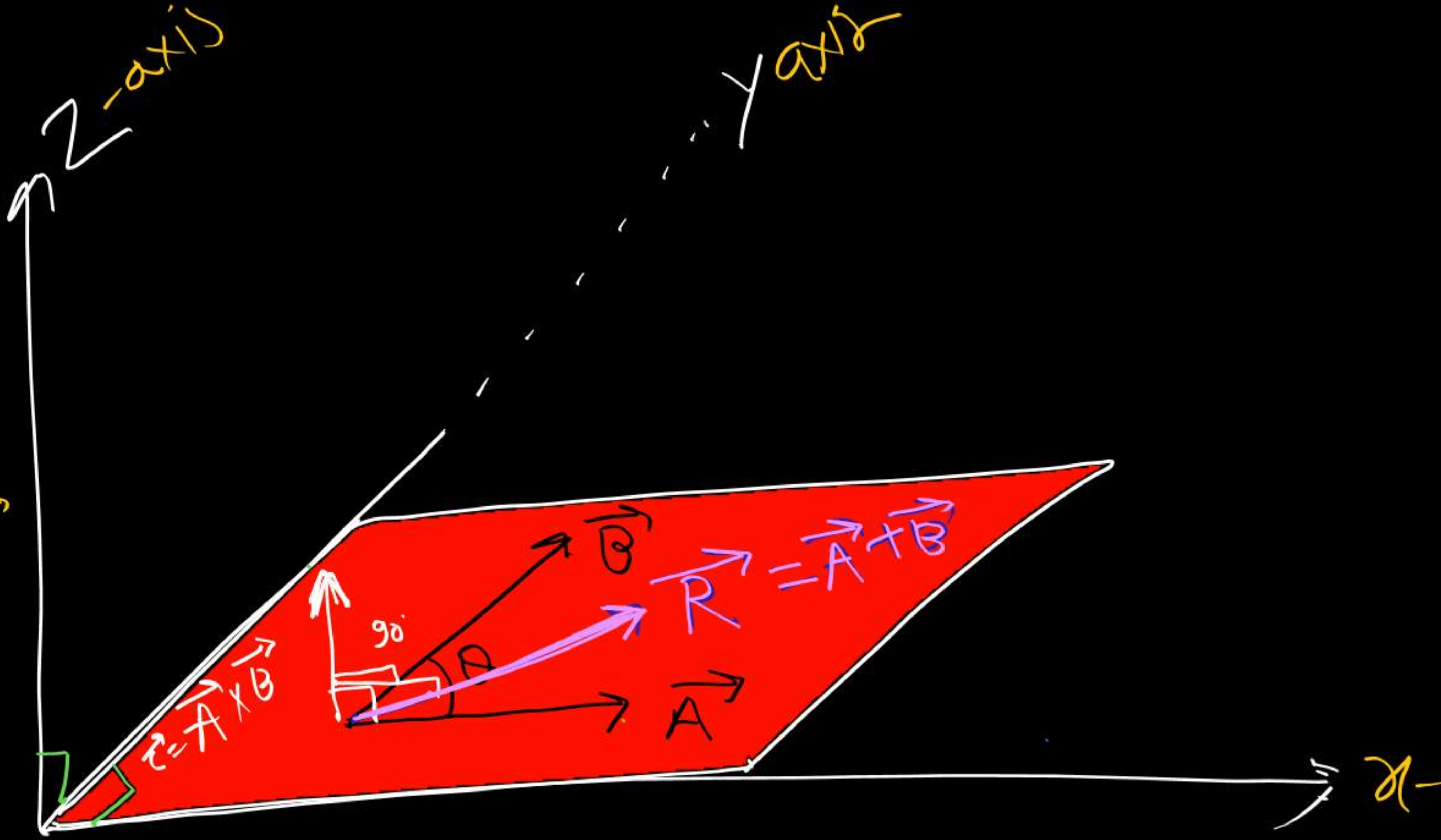
$$(\vec{A}+\vec{B})\cdot(\vec{A}\times\vec{B}) = ??$$

$$\vec{R}\cdot\vec{C} = 0 \checkmark$$

In the plane of $\vec{A}$ & $\vec{B}$

⊥r to $\vec{A}$ & $\vec{B}$

$$\boxed{\vec{R} \perp_r \vec{C}}$$



$$\hat{i} \times \hat{i} = 1 \times 1 \sin 0 = 0$$

$$\hat{j} \times \hat{j} = 1 \times 1 \sin 0 = 0$$

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

$$i \cdot i = 1$$

$$j \cdot j = 1$$

$$k \cdot k = 1$$

i, j, k are cyclic unit vectr

$$\hat{i} \to \hat{j} \to \hat{k} \to \hat{i} \to \hat{j} \to \hat{k}$$

so on.

cyclic → +ve

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

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

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

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

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

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

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

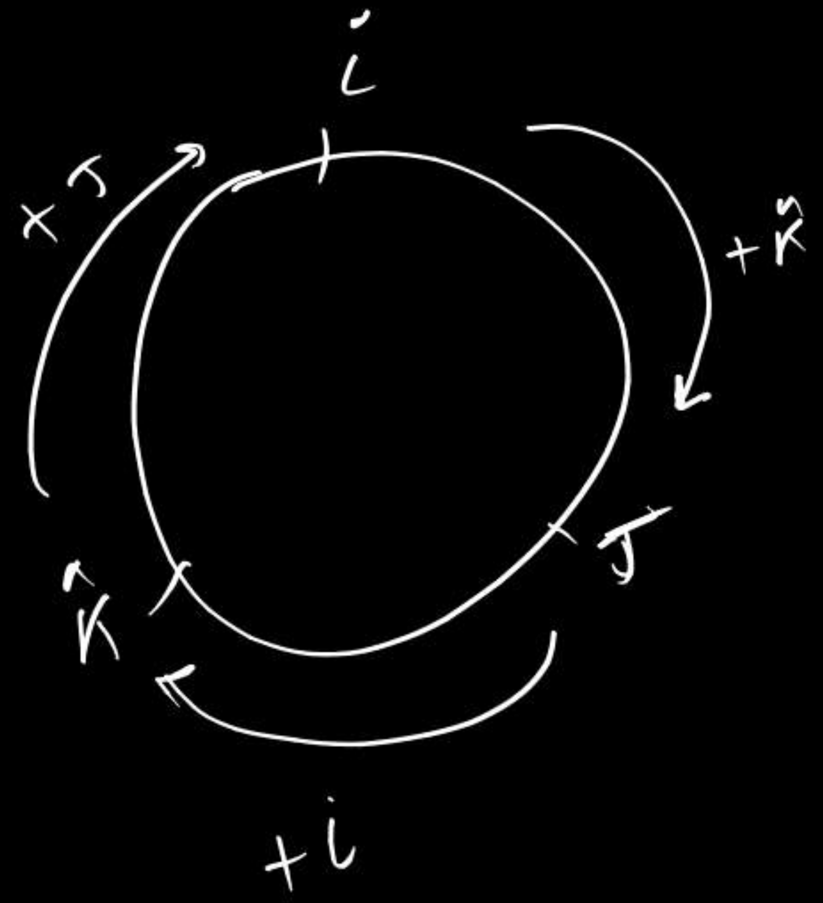
$$\hat{i} \times \hat{k} = -\hat{j}$$

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

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

easy

$$i \longrightarrow j \longrightarrow \hat{k} \longrightarrow i$$



$$\left\{\begin{array}{l}\vec{A} = 2i - \hat{j} \\ \vec{B} = 2i + 3\hat{j}\end{array}\right\} \longrightarrow \vec{A} \,\&\, \vec{B} \text{ are in xy plan.}$$

find $\vec{A} \times \vec{B}$

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

$$= 0 + 6\hat{k} - 2(-\hat{k}) + 0$$

$$= 6\hat{k} + 2\hat{k}$$

$$\vec{A} \times \vec{B} = +8\hat{k}$$

feel Kar

$\vec{A} \times \vec{B}$ in z-axis

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

$$= 0 - 2(\hat{k}) + 6(-\hat{k}) + 0$$

$$= -2\hat{k} - 6\hat{k}$$

$$= -8\hat{k}$$

MR*

$$\boxed{\begin{array}{l}\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A} \\ \vec{A} \times \vec{B} = -\vec{B} \times \vec{A}\end{array}}$$

$$\left\{\begin{array}{l} i \times j = +k \\ j \times i = -k \end{array}\right.$$

Direction of $\vec{A} \times \vec{B}$:

$$\begin{array}{ccccc} \vec{R} & = & \vec{A} & \times & \vec{B} \\ \uparrow & & \uparrow & & \uparrow \\ \text{result} & & 1^{\text{st}} & & 2^{\text{nd}} \\ & & \text{vector} & & \text{vector} \end{array}$$

Place four finger in the director of 1^{st} vector and then slap in the direction of $\vec{B}$ (2^{nd} vector) then thumb represent direction of $(\vec{A} \times \vec{B})$

Question

If $|\vec{A} \times \vec{B}| = \sqrt{3}\,(\vec{A} \cdot \vec{B})$ then find angle between $\vec{A}$ and $\vec{B}$.

NEET

$$\cancel{AB}\sin\theta = \sqrt{3}\,\cancel{AB}\cos\theta$$

$$\tan\theta = \sqrt{3}$$

$$\theta = 60^\circ$$

Question

If $|\vec{A} \times \vec{B}| = \sqrt{3}\,\vec{A} \cdot \vec{B}$, then the value of $|\vec{A} + \vec{B}|$ is: **[AIPMT 2007]**

$\theta = 60^\circ$

(1) $\left(A^2 + B^2 + \dfrac{AB}{\sqrt{3}}\right)^{1/2}$

(2) $A + B$

(3) $\left(A^2 + B^2 + \sqrt{3}AB\right)^{1/2}$

(4) $\left(A^2 + B^2 + AB\right)^{1/2}$

$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

$= \left(A^2 + B^2 + 2AB\cos 60^\circ\right)^{1/2}$

$= \left(A^2 + B^2 + \cancel{2}AB\frac{1}{\cancel{2}}\right)^{1/2}$

$= (A^2 + B^2$

matrix method of cross-Product

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

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

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$$\vec{A}\times\vec{B} = \hat{i}(A_yB_z - A_zB_y) + \hat{j}(A_zB_x - A_xB_z) + \hat{k}(A_xB_y - A_yB_x)$$

with cyclic order

$i \to j \to \hat{k}$

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

$\vec{L} = \vec{r}\times\vec{p}$

dir of EM wave $= \hat{E}\times\hat{B}$

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

$B \propto (I\vec{dl}\times\hat{r})$

$\vec{F} = I\vec{dl}\times\vec{B}$

MR* BOX

Area of Parallogram $= \vec{A}\times\vec{B}$

Area of Triangle $= \frac{1}{2}(\vec{A}\times\vec{B})$

$\vec{A}$ & $\vec{B}$ are Two side of Parallogram

$$\vec{A} \times \vec{B} = \begin{vmatrix} i & j & k \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

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

$$= \hat{i}\left(A_y B_z - A_z B_y\right) + \hat{j}\left(A_z B_x - A_x B_z\right) + \hat{k}\left(A_x B_y - A_y B_x\right)$$

Physics मेंगा

Question

The torque of force $5\hat{\imath} + 3\hat{\jmath} - 7\hat{k}$ about the origin is τ. If the force acts on a particle whose position vector is $2\hat{\imath} + 2\hat{\jmath} - \hat{k}$ then the value of τ will be: **[NEET 2022]**

1. $11\hat{\imath} + 19\hat{\jmath} - 4\hat{k}$
2. $-11\hat{\imath} + 9\hat{\jmath} - 4\hat{k}$
3. $-17\hat{\imath} + 19\hat{\jmath} - 4\hat{k}$
4. $17\hat{\imath} + 9\hat{\jmath} - 16\hat{k}$

$$\tau = r \times F = \begin{vmatrix} i & \hat{j} & k \\ 2 & 2 & -1 \\ 5 & 3 & -7 \end{vmatrix} = i(-14 - (-3)) + \hat{j}(-5 - (-14)) + \hat{k}(6 - 10)$$

$$= -11i + 9\hat{j} - 4\hat{k}$$

Question

Find torque ($\vec{\tau} = \vec{r} \times \vec{F}$) of a force $\vec{F} = -3\hat{\imath} + \hat{\jmath} + 5\hat{k}$ acting at the point $\vec{r} = 7\hat{\imath} + 3\hat{\jmath} + \hat{k}$.

[AIIMS 2009]

H/W

1. $14\hat{\imath} - 38\hat{\jmath} + 16\hat{k}$
2. $4\hat{\imath} + 4\hat{\jmath} + 6\hat{k}$
3. $-14\hat{\imath} + 38\hat{\jmath} - 16\hat{k}$
4. $-21\hat{\imath} + 3\hat{\jmath} - 5\hat{k}$

Question

If the angle between the vector $\vec{A}$ and $\vec{B}$ is θ, the value of the product $(\vec{B} \times \vec{A}) \cdot \vec{A}$ is equal to

(1) Zero

(2) $BA^2 \sin\theta \cos\theta$

(3) $BA^2 \cos\theta$

(4) $BA^2 \sin\theta$

H/W

Question

Find the torque of force $\vec{F} = 5\hat{\imath} + 3\hat{\jmath} - 7\hat{k}$ about origin if the force acts on the particle whose position vector is $2\hat{\imath} + 2\hat{\jmath} + \hat{k}$. (use torque = $\vec{r} \times \vec{F}$) **[JEE Main 2022]**

(1) $11\hat{\imath} + 19\hat{\jmath} - 4\hat{k}$

(2) $-11\hat{\imath} + 9\hat{\jmath} - 16\hat{k}$

(3) $-17\hat{\imath} + 19\hat{\jmath} - 4\hat{k}$

(4) $-17\hat{\imath} + 9\hat{\jmath} + 16\hat{k}$

H/W

Question

The angle between vectors $(\vec{A} \times \vec{B})$ and $(\vec{B} \times \vec{A})$ is

1. zero
2. π
3. $\pi/4$
4. $\pi/2$

Question

Find the torque about the origin when a force of $3\hat{j}$ N acts on a particle whose position vector is $2\hat{k}$ m. [NEET 2020]

(1) $6\hat{i}$ Nm

(2) $6\hat{j}$ Nm

(3) $-6\hat{i}$ Nm

(4) $6\hat{k}$ Nm

Question

For a plane electromagnetic wave propagation in x-direction, which one of the following combination gives the correct possible directions for electric field (E) and magnetic field (B) respectively?

(1) $\hat{j} \times \hat{k}, \hat{j} + \hat{k}$

(2) $-\hat{j} \times \hat{k}, -\hat{j} - \hat{k}$

(3) $\hat{j} \times \hat{k}, -\hat{j} - \hat{k}$

(4) $-\hat{j} \times \hat{k}, -\hat{j} + \hat{k}$

Question

Vector $a\hat{\imath} + b\hat{\jmath} + \hat{k}$ and $2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}$ are perpendicular to each other when $3a + 2b = 7$, the ratio of a to b is:

(1) $1/2$

(2) 2

(3) 3

(4) $3/2$

Question

If $\vec{F}$ is the force acting on particle having position vector $\vec{r}$ and $\vec{\tau}$ to the torque of this force about origin, then

(1) $\vec{r}\,.\,\vec{\tau} > 0$ and $\vec{f}\,.\,\vec{\tau} < 0$

(2) $\vec{r}\,.\,\vec{\tau} = 0$ and $\vec{f}\,.\,\vec{\tau} \neq 0$

(3) $\vec{r}\,.\,\vec{\tau} = 0$ and $\vec{f}\,.\,\vec{\tau} = 0$

(4) $\vec{r}\,.\,\vec{\tau} \neq 0$ and $\vec{f}\,.\,\vec{\tau} = 0$

Question

Position of particle is given by $\vec{r} = \hat{\imath} + 2\hat{\jmath} - \hat{k}$ and momentum $\vec{p} = 3\hat{\imath} + 4\hat{\jmath} - 2\hat{k}$. The angular momentum is perpendicular to

1. x-axis
2. z-axis
3. y-axis
4. Line at equal to all three axis

4 W

Question

Find the torque of force $\vec{F} = 5\hat{\imath} + 3\hat{\jmath} - 7\hat{k}$ about origin if the force acts on the particle whose position vector is $2\hat{\imath} + 2\hat{\jmath} + \hat{k}$. (use torque = $\vec{r} \times \vec{F}$) **[JEE Main 2022]**

1. $11\hat{\imath} + 19\hat{\jmath} - 4\hat{k}$
2. $-11\hat{\imath} + 9\hat{\jmath} - 16\hat{k}$
3. $-17\hat{\imath} + 19\hat{\jmath} - 4\hat{k}$
4. $-17\hat{\imath} + 9\hat{\jmath} + 16\hat{k}$

H/W

Maha-manthan sheet

MahaManthan ASSIGNMENT

Basic Mathematics

Assignment-01
By: M.R. Sir

1. $\int 0\, dx = C$, where C is the constant of integration. **True/False**

2. $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ is valid for all real values of n. **True/False**

3. The area under the curve can be negative. **True/False**

4. If a function $f(x)$ is always positive, then its integral is always increasing. **True/False**

5. $\int \frac{1}{r^2} dr = -\frac{1}{r} + C$ which is used in both electrostatics and gravitation. **True/False**

6. The area under a sine wave over a complete cycle is zero. **True/False**

7. Integrating the square of sine or cosine over a full period gives a nonzero average. **True/False**

8. The area under a curve $y = f(x)$ from $x = a$ to $x = b$ is given by $\int_a^0 f(x)dx$. **True/False**

9. $\int k.f(x)dx = k\int f(x)dx$, where k is a constant. **True/False**

10. Integration is a way to add small pieces together to find a total. **True/False**

11. Integration is only used in maths, not in real life. **True/False**

12. Learning integration now will help me later in physics. **True/False**

13. The slope of the line $y = -2x + 3$ is negative, so it goes downward from left to right. **True/False**

14. The x-intercept of the line $y = mx + c$ is $x = c/m$. **True/False**

15. Two lines are parallel if their slopes are equal. **True/False**

16. Two lines are perpendicular if product of their slopes is equal to 1. **True/False**

17. A line passing through origin always has y-intercept 0. **True/False**

18. The equation $3x + 4y = 0$ represents a line that passes through the origin. **True/False**

19. For the parabola $y = ax^2$, the axis of symmetry is the y-axis. **True/False**

20. The graph of $y = -x^2$ is concave upward. **True/False**

21. The graph of $y = x^2$ is a U-shape. **True/False**

22. All parabolas open upwards. **True/False**

23. Parabolas are important in physics because projectiles follow this path. **True/False**

24. A circle can intersect the x-axis at more than 2 points. **True/False**

25. The graph of $x^2 + y^2 = 0$ represents a point of zero radius at the origin. **True/False**

26. The diameter of the circle $x^2 + y^2 = 49$ is 7. **True/False**

27. All circles are symmetric about both x and y-axes. **True/False**

28. An ellipse has two foci and two axes (major and minor). **True/False**

29. A circle is a special case of an ellipse when $a = b$. **True/False**

30. The distance between the foci increases as the ellipse becomes more stretched. **True/False**

31. The ellipse can never pass through the origin. **True/False**

32. The rectangular hyperbola never touches either axis. **True/False**

33. As $x \to 0^+, y \to \infty$ in the graph of $xy = c$. **True/False**

34. The rectangular hyperbola passes through the origin. **True/False**

35. The rectangular hyperbola always lies in only one quadrant. **True/False**

36. The identity $\sin^2\theta + \cos^2\theta = 1$ holds for all real values of θ. **True/False**

37. The maximum value of sin(θ) and cos(θ) is 2. **True/False**

38. The function sin(θ) is periodic with period 360°. **True/False**

39. tan(θ) is undefined at θ = 90°. **True/False**

40. The graph of sin(θ) oscillates between –1 and +1. **True/False**

41. If sin(θ) = 3/5, then cos(θ) = 4/5. **True/False**

42. tan(θ) = sin(θ)/cos(θ) is undefined when cos(θ) = 0. **True/False**

43. sin(2θ) = 2sin θ co sθ is valid only for acute angles. **True/False**

44. For θ in the third quadrant, both sine and cosine are positive. **True/False**

45. If sin (θ) + cos (θ) = 1, then $\sin^2(\theta) + \cos^2(\theta) = 1$ still holds. **True/False**

46. The derivative of a constant function is zero. **True/False**

47. If $f(x) = \sin(x^2)$, then $f'(x) = 2x\cos(x^2)$. **True/False**

48. If $f(x)$ is increasing, then $f'(x) > 0$ for all x. **True/False**

49. The product rule states that $\frac{d}{dx}(uv) = u'v + uv'$. **True/False**

50. The derivative of $\tan(x)$ is $\sec^2(x)$. **True/False**

51. If $f'(x) = 0$ and $f''(x) > 0$, then x is a local minimum. **True/False**

52. If $f'(x) = 0$ and $f''(x) < 0$, then x is a local minimum. **True/False**

53. The point where a function changes from increasing to decreasing is called a maximum. **True/False**

54. Slope of upward parabola is positive and increasing. **True/False**

55. Sum of root of quadratic equation $ax^2 + bx + c = 0$ is b/a. **True/False**

56. Differentiation of $\sin 30°$ is $\cos 30°$. **True/False**

57. Integration of constant function is zero. **True/False**

58. Magnitude of slope of rectangular hyperbola is decreasing **True/False**

59. $y = 2x^2 - 4x$ slope of slope at $x = 1$ is positive. **True/False**

60. Differentiation of e^x is e^x. **True/False**

61. $\frac{1}{(0.4)^{\text{infinity}}}$ is zero. **True/False**

62. $\log e^{xy} = \log e^x . \log e^y$ **True/False**

ANSWER KEY

1. True
2. False
3. True
4. True
5. True
6. True
7. True
8. True
9. True
10. True
11. False
12. True
13. True
14. False (It's $x = -c/m$)
15. True
16. False
17. True
18. True
19. True
20. False (It's downward)
21. True
22. False (If $a < 0$, it opens downwards)
23. True
24. False
25. True
26. False (Diameter is 14)
27. True
28. True
29. True
30. True
31. False
32. True
33. True
34. False
35. False
36. True
37. False (maximum is 1)
38. True
39. True
40. True
41. False (depends on quadrant, and Pythagorean identity)
42. True
43. False (valid for all θ)
44. False (both are negative)
45. True
46. True
47. True
48. False (It can be 0 at some points)
49. True
50. True
51. True
52. True
53. True
54. True
55. False
56. False
57. False
58. True
59. True
60. False
61. False
62. False


YAKEEN
NEET 2.0
2026
Vector
Physics
Assignment-02
By- Manish Raj (MR Sir)

Question-01

Check which of the following is a unit vector:

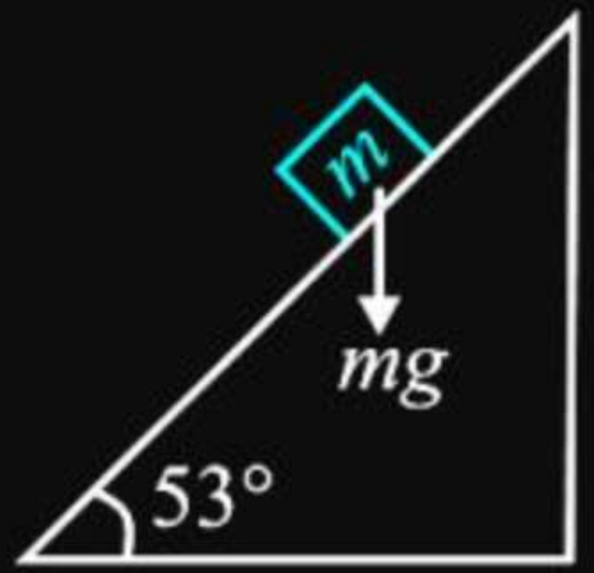
1. $\vec{A} = \frac{1}{\sqrt{3}}\hat{\imath} + \frac{1}{\sqrt{3}}\hat{\jmath}$
2. $\vec{B} = \sin\theta\,\hat{\imath} - \cos\theta\,\hat{\jmath}$
3. $\vec{C} = \frac{\hat{\imath}}{\sqrt{3}} - \frac{\hat{\jmath}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$
4. $\vec{D} = 0.8\hat{\imath} - 0.6\hat{\jmath}$
5. $\vec{E} = \frac{3}{5}\hat{\imath} + \frac{4}{5}\hat{\jmath}$

Question-02

Draw given vector in graphical representation:
Force 10 N 30° North of East

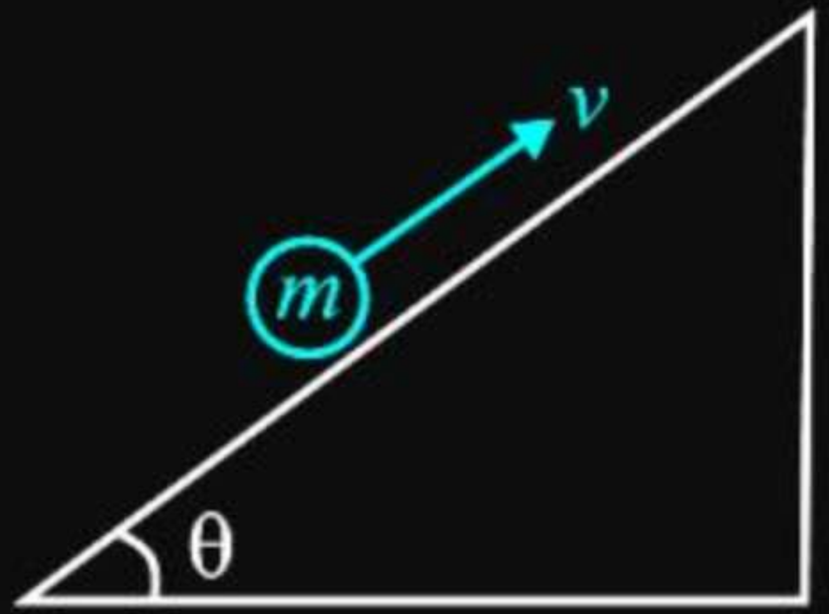
Question-03

Find component of gravitational force along inclined plane and perpendicular to inclined plane.



Question-04

Component of velocity along x and y-axis.



Question-05

Find unit vector of given vector:

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

$\vec{B} = -3\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$

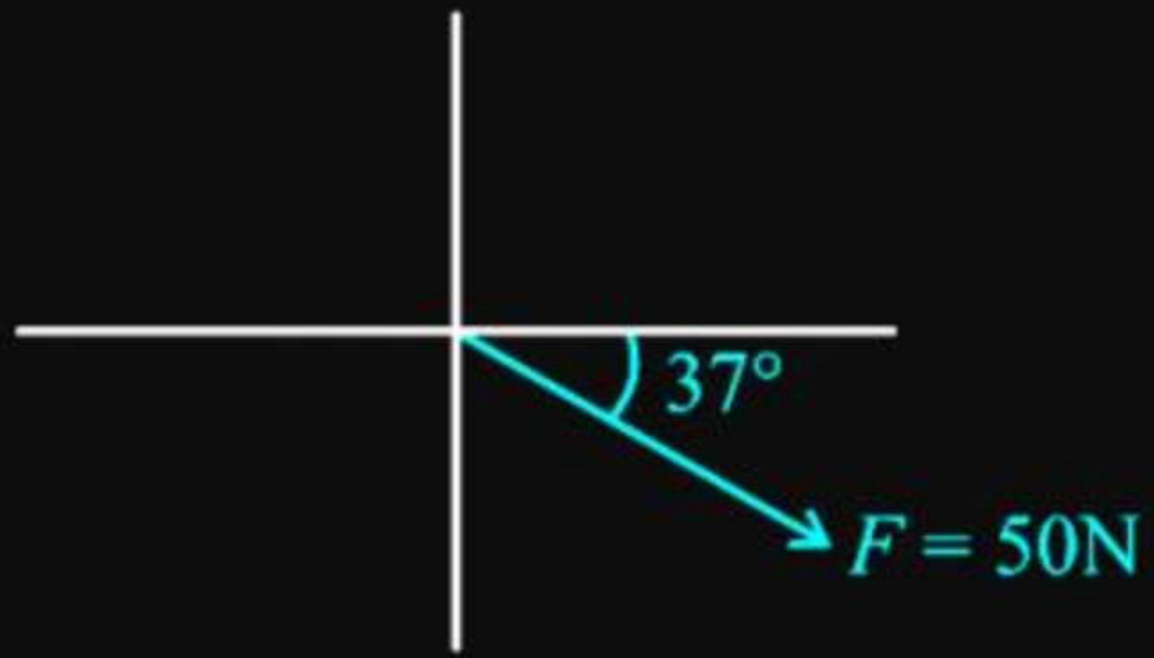
$\vec{C} = 2\hat{\imath} + 3\hat{\jmath} - \hat{k}$

$\vec{D} = \hat{\imath} + \hat{\jmath} - 2\hat{k}$

Question-06

Following vector are given:

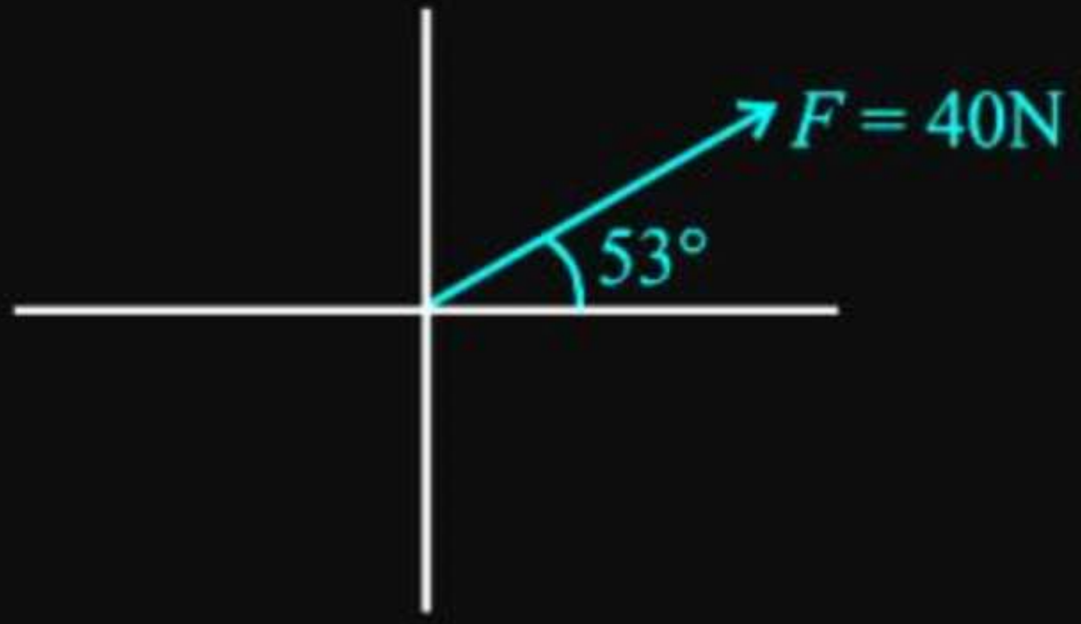
Then write it in vector form



Question-07

Following vector are given:

Then write it in vector form



Question-08

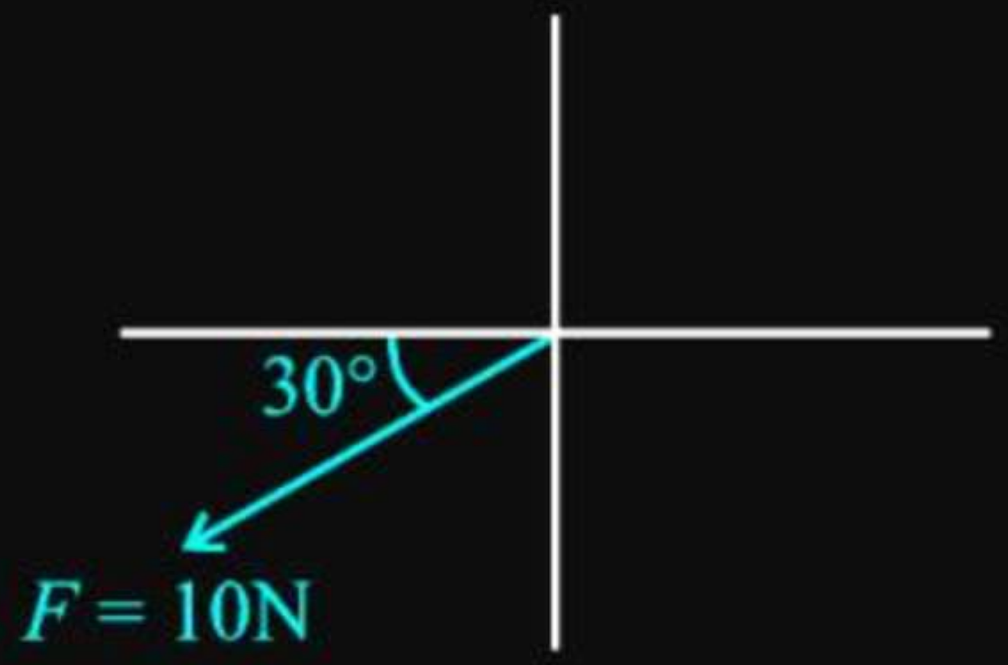
Following vector are given:

Then write it in vector form

Question-09

Following vector are given:

Then write it in vector form



Question-10

Draw given vector in graphical representation:

Object is moving with velocity 60 m/s at 60° South of west

Question-11

Draw given vector in graphical representation:

30 N force at 53° North of West

Question-12

Draw given vector in graphical representation:

Force 40 N 53° South of East

Question-13

A null vector is defined as a vector having:

1. Zero Direction
2. Zero magnitude and undefined direction
3. Maximum magnitude and fixed direction
4. Zero magnitude and fixed direction

Question-14

Which of the following sets can never represent a system of collinear vectors?

(1) 2 N right, 3 N right, 5 N left

(2) 2 N up, 4 N up, 6 N down

(3) 2 N right, 3 N up, 4 N down

(4) 5 N left, 5 N right

Question-15

If $\vec{A}+\vec{B}=0$, what is the value of $|\vec{A}|+|\vec{B}|$?

(1) 0

(2) $|A+B|$

(3) $2|A|$

(4) $|A|-|B|$

Question-16

Which of the following sets of components gives a vector of zero magnitude?

1. $(0, 0)$
2. $(3, -3)$
3. $(1, -1)$
4. $(2, 2)$

Question-17

A vector $\vec{A}$ has a magnitude of 5. You are told that the x-component of this vector is also 5. What can you conclude about the y-component?

1. It is zero
2. It is positive
3. It is imaginary
4. It is negative

Question-18

A vector $\vec{V}$ has a magnitude of 1 and makes equal angles with x, y and z axes. What is each component?

(1) $\frac{1}{\sqrt{3}}$

(2) $\frac{1}{3}$

(3) 1

(4) $\frac{1}{\sqrt{2}}$

Question-19

A person walks 1 m east, then 1 m north. What is the unit vector in the direction of net displacement?

(1) $\frac{1}{\sqrt{2}}(\hat{\imath}+\hat{\jmath})$

(2) $\frac{1}{2}(\hat{\imath}+\hat{\jmath})$

(3) $(\hat{\imath}+\hat{\jmath})$

(4) $\frac{1}{\sqrt{3}}(\hat{\imath}+\hat{\jmath})$

Question-20

Let $\vec{A} = a\hat{\imath} + b\hat{\jmath}$ be a unit vector. If $a = \frac{3}{5}$, find b.

(1) $\frac{4}{5}$

(2) $\frac{2}{5}$

(3) $\sqrt{\left(\frac{1-9}{25}\right)}$

(4) 1

Question-21

Assertion (A): The sum of two unit vectors can never be a unit vector.

Reason (R): The magnitude of the sum of two unit vectors is always greater than 1.

1. Both A and R are true, and R is the correct explanation of A.
2. Both A and R are true, but R is not the correct explanation of A.
3. A is false, but R is true.
4. Both A and R are false.

Question-22

Three equal vectors are placed head to tail forming a triangle. What is the resultant vector?

(1) Equal to each vector

(2) 0

(3) Double of one vector

(4) Cannot be determined

Question-23

Two vectors are added and the resultant is smaller than both. What must be the angle between them?

1. $< 90^\circ$
2. $= 90^\circ$
3. $> 90^\circ$
4. $= 0^\circ$

Question-24

Vector addition is commutative.

(1) True

(2) False

Question-25

Vector addition violates the triangle inequality.

(1) True

(2) False

Question-26

Assertion (A): The direction of the vector $\vec{A} + \vec{B}$ lies between the directions of $\vec{A}$ and $\vec{B}$.

Reason (R): Vector addition follows the triangle law or parallelogram law of vectors.

1. Both A and R are true, and R is the correct explanation of A.
2. Both A and R are true, but R is not the correct explanation of A.
3. A is false, but R is true.
4. Both A and R are false.

Question-27

Triangle law of vector addition holds when vectors are:

1. Collinear
2. Coplanar and in same direction
3. Represented as two adjacent sides of a triangle taken in same order
4. Draw from the same origin

Question-28

A particle undergoes two displacements represented by vectors $\vec{A}$ and $\vec{B}$, making an angle θ between them. If resultant displacement is less than both A and B, what can be said about θ?

(1) $\theta = 0°$

(2) $\theta = 90°$

(3) $\theta > 90°$

(4) $\theta = 180°$

Question-29

Two forces of magnitude 8 N and 15 N respectively act at a point. If the resultant forces is 17 N, the angle between the forces has to be

(1) 60°

(2) 45°

(3) 90°

(4) 30°

Question-30

Two $\vec{F}_1 = 5\ \text{N}$ due to east and $F_2 = 10\ \text{N}$ due north then resultant of these two force is

(1) $5\sqrt{5}\ \text{N}$

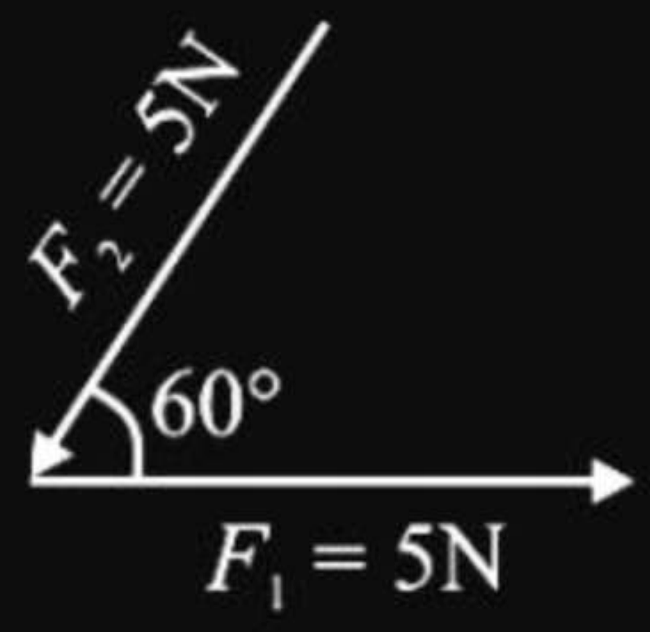
(2) $15\ \text{N}$

(3) $5\ \text{N}$

(4) $\sqrt{5}\ \text{N}$

Question-31

Find net force = $(\vec{F}_1 + \vec{F}_2)$?



Question-32

Two forces of 10 N and 6 N act upon a body. The direction of the forces are unknow. The resultant forces on the body may be

(1) 15 N

(2) 3 N

(3) 17 N

(4) 2 N

Question-33

If $\vec{R} = \vec{A} + \vec{B}$ and $R = A + B$ then angle between $\vec{A}$ and $\vec{B}$ must be

1. $90°$
2. $60°$
3. $0°$
4. $180°$

Question-34

If $\vec{R} = \vec{A} + \vec{B}$ and $R^2 \pm A + B$ then angle between $\vec{A}$ and $\vec{B}$ may be

1. $90°$
2. $60°$
3. $120°$
4. $80°$

Question-35

Two vector of magnitude 2 then resultant of these two vector may be?

1. 2
2. 8
3. 5
4. 6

Question-36

Two force 5N and 2N acting on object then net force on object must not be:

(1) 2N

(2) 1N

(3) 6N

(4) Both (1) and (2)

Question-37

Vector $\vec{A}$ is 2m long at 60° above the +x-axis and $\vec{B}$ is 2m long at 60° below the +x-axis then resultant will be:

Question-38

If vector sum of two unit vector is a unit vector then:

Question-39

The ratio of maximum and minimum magnitude of resultant of two vectors $\vec{a}$ and $\vec{b}$ is $3:1$, then $\vec{b}$ in term of $|B|$.

Question-40

Find angle between force $2P$ and $\sqrt{2}P$ act so that resultant force is $P\sqrt{10}$.

Question-41

Two vector of magnitude 2 and 4 and resultant is $2\sqrt{3}$ find angle between vectors.

Question-42

The sum of the magnitude of two force is 18 and magnitude of their resultant is 12. If resultant is at 90° with the force of smaller magnitude, then what is magnitude of force

Question-43

Which of the combination of three force can give zero resultant.

1. (2, 4, 7)
2. (3, 1, 5)
3. (2, 8, 11)
4. (3, 4, 2)

THANK YOU