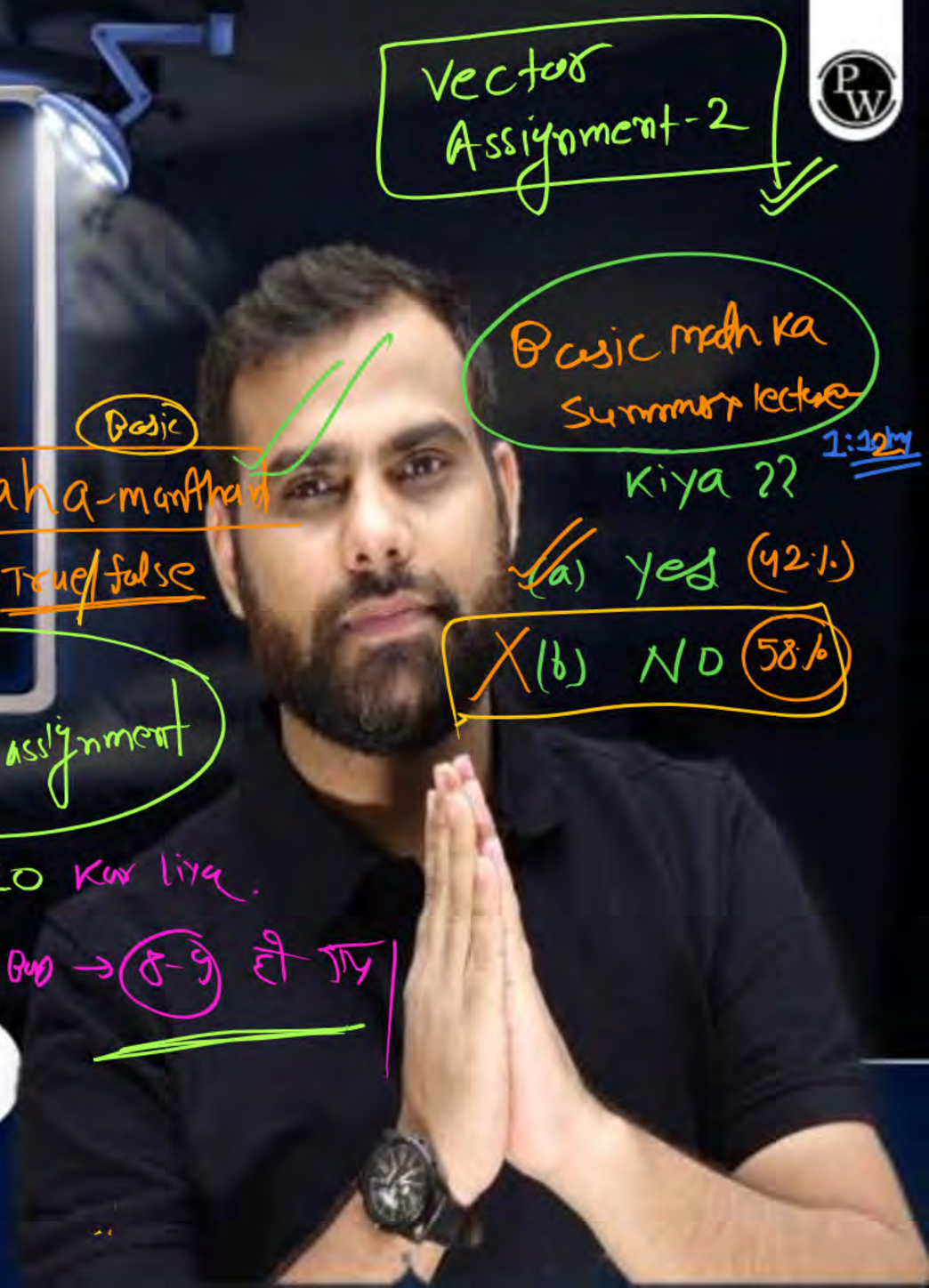
YAKEEN NEET 2.0

2026

Vectors

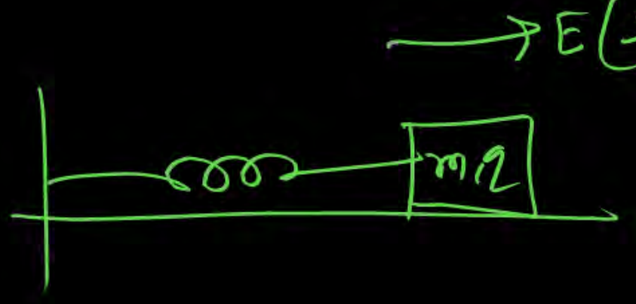
Physics | Lecture - 7

By- Manish Raj (MR Sir)



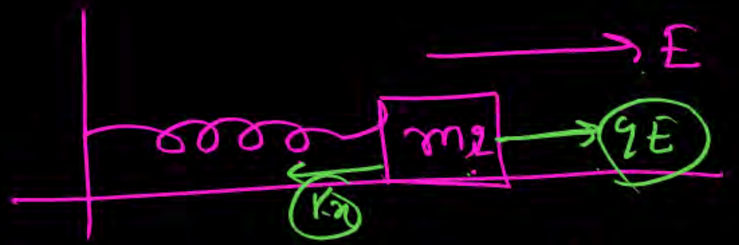
Topics to be covered

1. # H/W
2.
3. Dot Product
4.

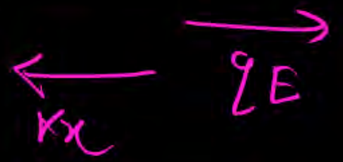


max elongation

$$x = \left(\frac{2qE}{K}\right)$$



elongation at equilibrium



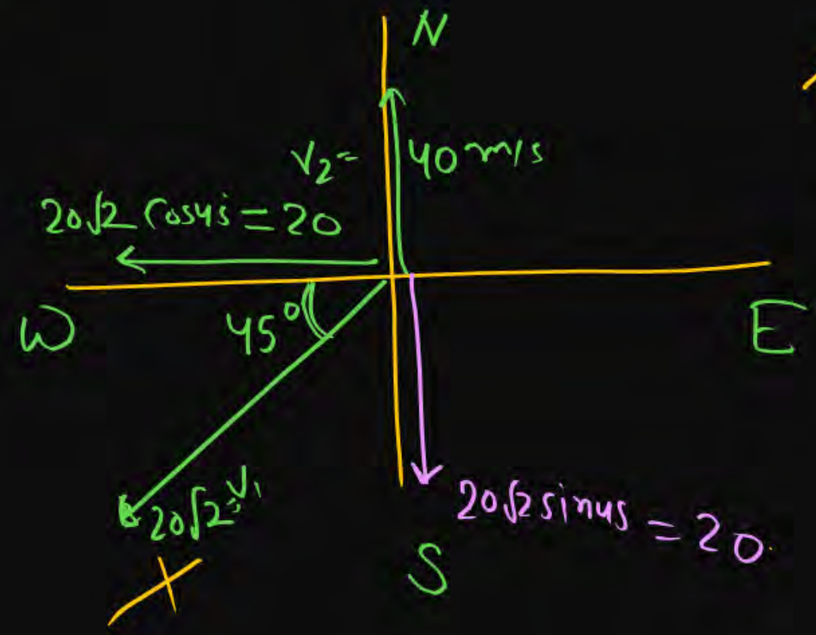
$$Kx = qE$$

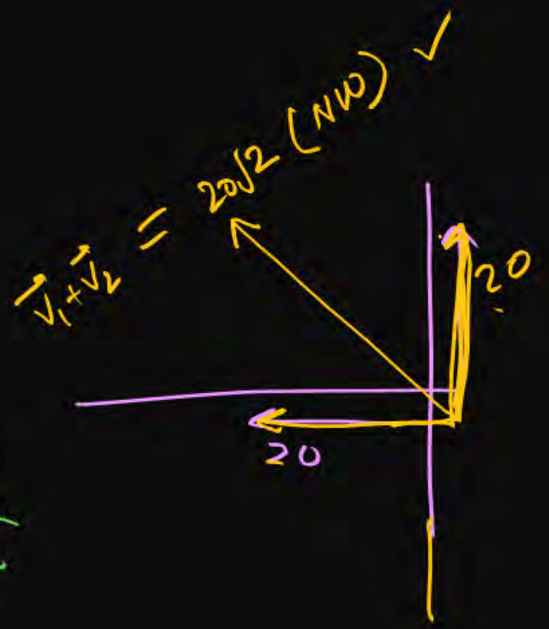
$$x = \frac{qE}{K} \text{ V}$$

Question H/W

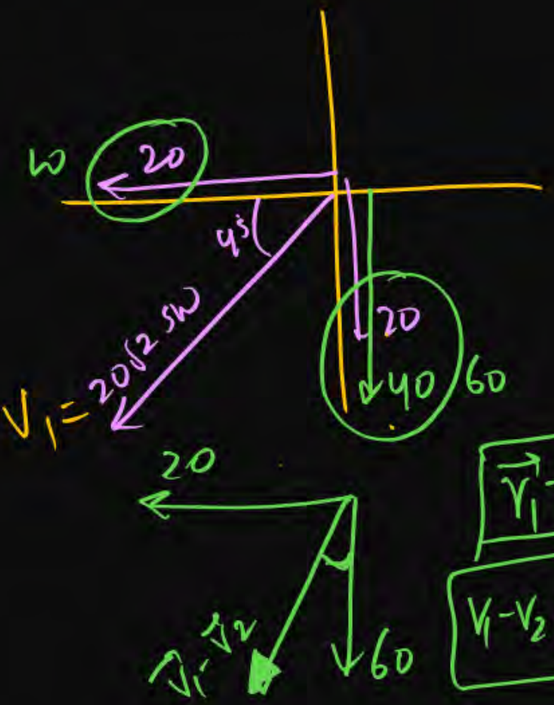
Two object moving with velocity $V_1 = 20\sqrt{2}$ South-West and $V_2 = 40$ m/s North then $\vec{V}_1 + \vec{V}_2 = ?$

Soln





Soln $\vec{V}_1 - \vec{V}_2 = \vec{V}_1 + (-\vec{V}_2)$



$\vec{V}_1 - \vec{V}_2 = 20\hat{i} + 60\hat{j}$

$V_1 - V_2 = -20\hat{i} - 60\hat{j}$

Question

H/w
Component ke sath

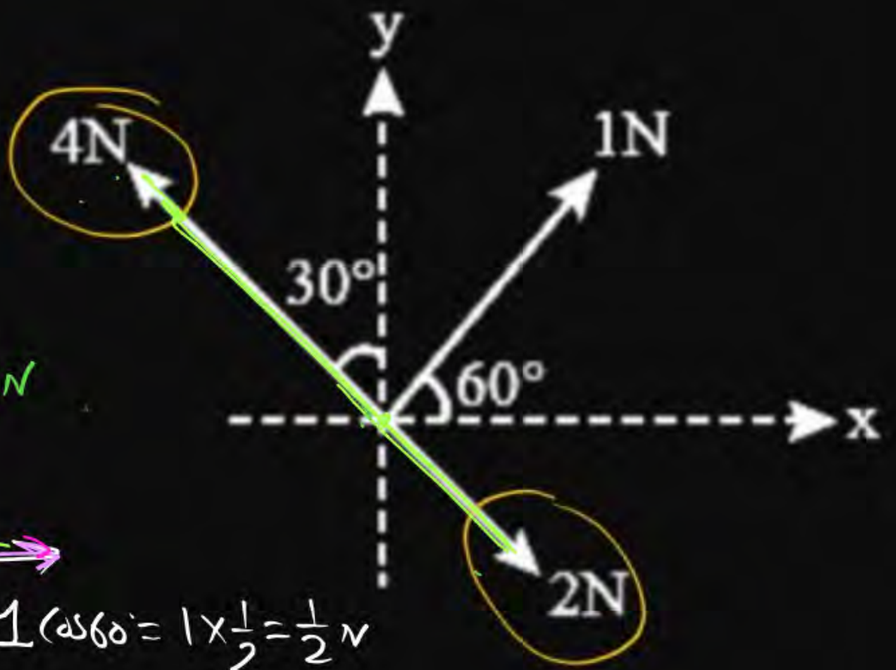
NEET-2014

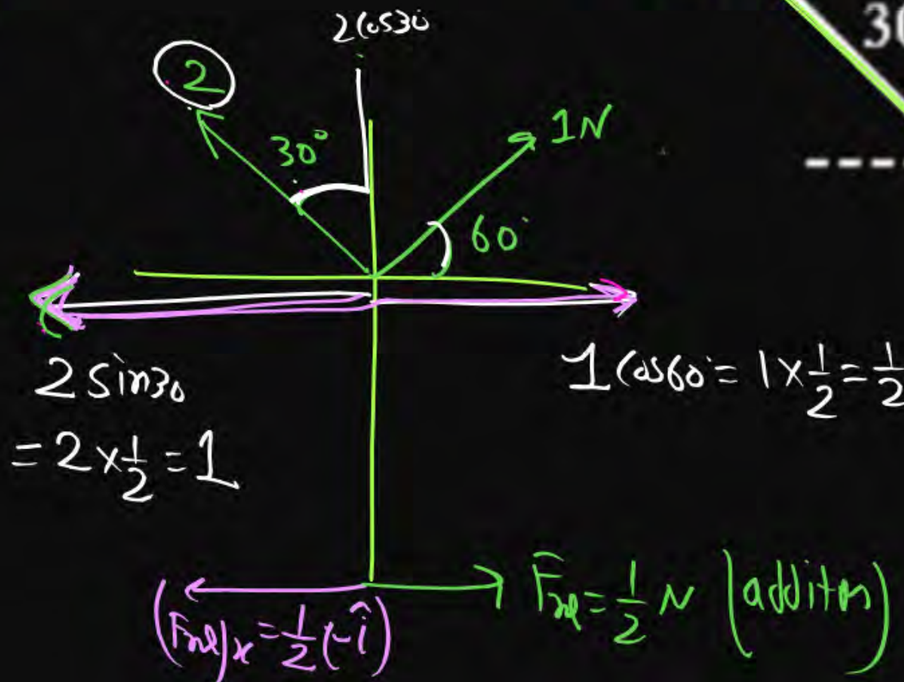
Three force acting on the body as shown in figure. To have resultant force only along y-axis, magnitude of minimum additional force needed is?

1. $\sqrt{3}$ N
2. $\frac{\sqrt{3}}{2}$ N
3. 1.5 N
4. $\frac{1}{2}$ N

$\vec{F}_{net} = \hat{j}$ (const)

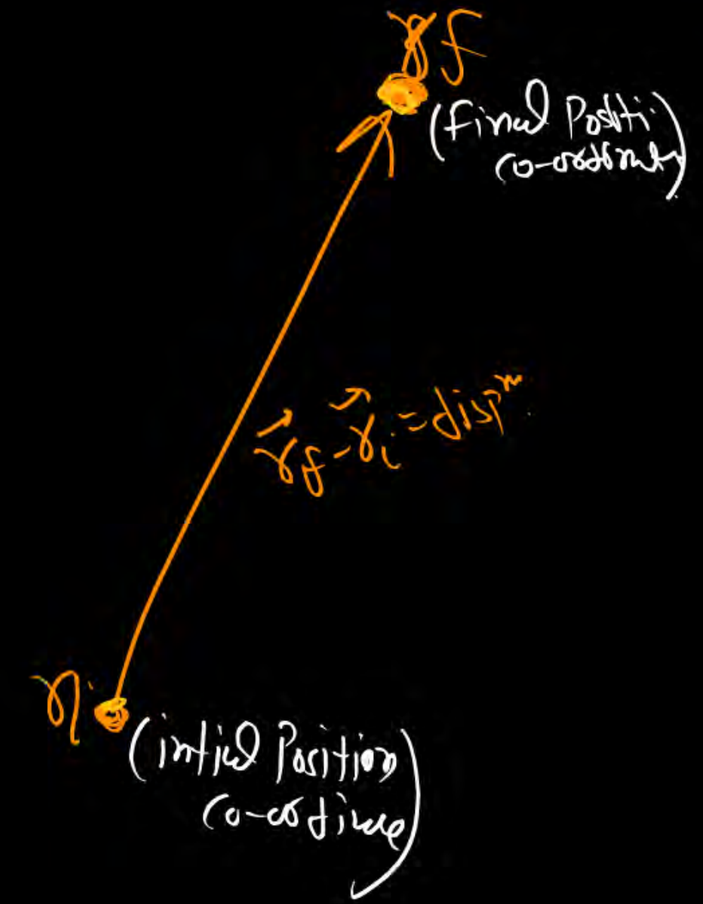
$F_{net} = 0$



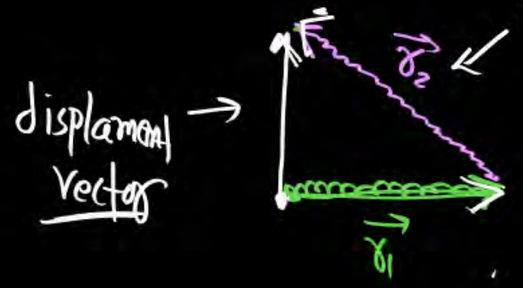


Displacement $= \vec{r}_f - \vec{r}_i$

($\vec{r}_f$: final Position co-ordinate)



#



↑ distance move by Partical alng arrow

displacement vector $= \vec{r}_1 + \vec{r}_2$

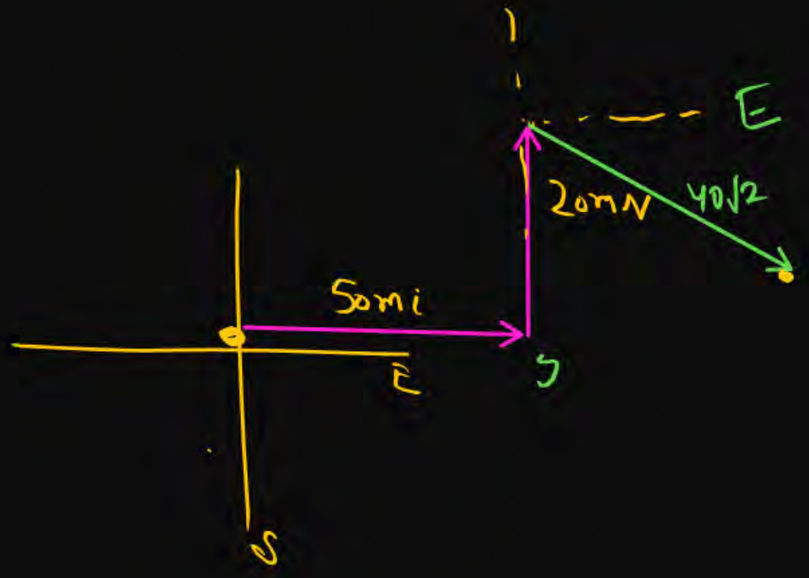
Question 11/W

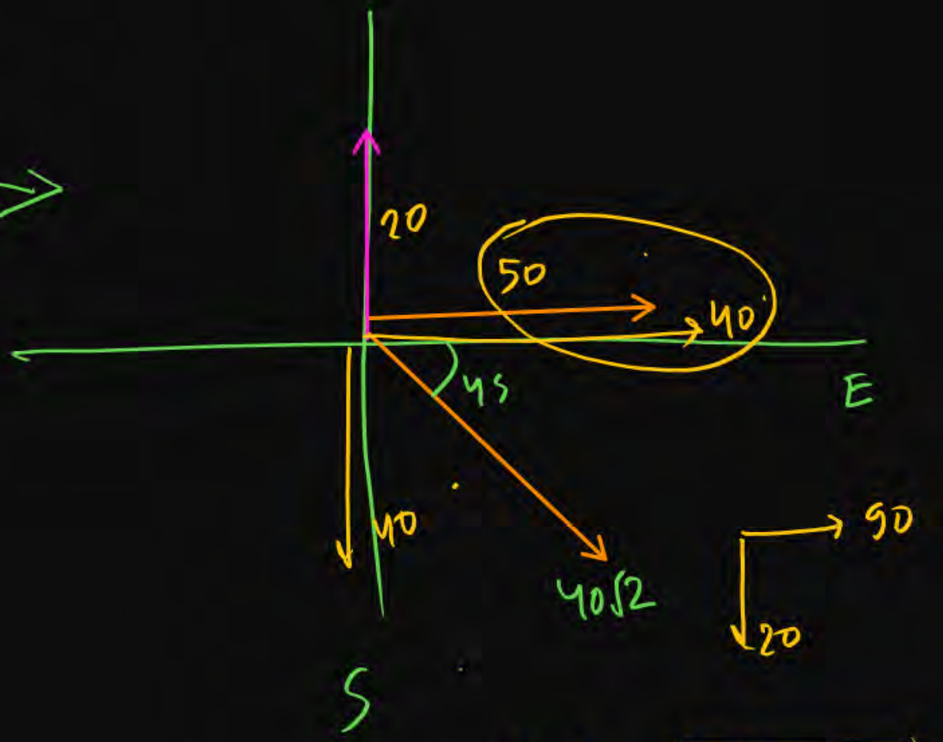
If a student moves as given below:

(i) 50m in East

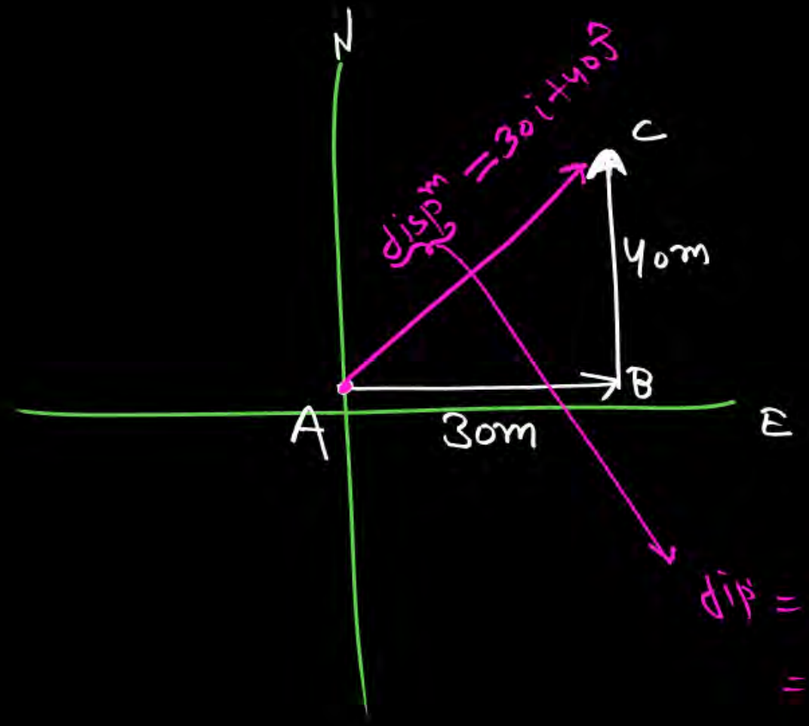
(ii) 20m in North

(iii) $40\sqrt{2}$m in S-E direction. Find net Displacement?





$disp = \sqrt{(90)^2 + (20)^2}$ ✓



$$\text{dis} = \sqrt{(30)^2 + (40)^2}$$

$$= \sqrt{900 + 1600}$$

$$= 50\,\text{m}$$

Question

H/W

If $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = \hat{i} + 2\hat{j} + 3\hat{k}$ find:

(i) $\vec{A} + \vec{B}$

(ii) $\vec{B} - \vec{A}$

(iii) $\vec{B} - \frac{\vec{A}}{2}$

(iv) $2(\vec{A}) + \vec{B}$

(v) $\vec{A} - 2(\vec{B})$

$\vec{A}+\vec{B} = 3i + 5\hat{j} + 7k$

$\vec{B} - \frac{\vec{A}}{2} = i + 2\hat{j} + 3k - \left(\frac{2i + 3j + 4k}{2}\right)$

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

easy

Question H/W

If $\vec{A}+\vec{B}+\vec{C}=0$ and $\vec{A}=2\hat{i}+\hat{j}-\hat{k}$ and $\vec{B}=\hat{i}+2\hat{j}+\hat{k}$, then find $\vec{C}$?

$2\hat{i}+\hat{j}-\hat{k}+\hat{i}+2\hat{j}+\hat{k}+\vec{C}=0$

$3\hat{i}+3\hat{j}+\vec{C}=0$

$\vec{C}=-3\hat{i}-3\hat{j}$

Simply

$\hat{C}=\dfrac{\vec{C}}{|\vec{C}|}=\dfrac{-3\hat{i}-3\hat{j}}{3\sqrt{2}}$ ✓

Question HW

this is not force

Force of magnitude 20 N acting along vector $\vec{A} = 2\hat{i} + 3\hat{j} - \sqrt{3}\hat{k}$, then find force in vector form and acceleration of object if mass 5 kg.

$|\vec{F}| = 20\,N$ given

$\hat{F} = \hat{A}$ yes

unit vector does not have unit & dimension

$$\hat{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{2i + 3\hat{j} - \sqrt{3}\hat{k}}{\sqrt{4+9+3}} = \left(\frac{2i + 3\hat{j} - \sqrt{3}\hat{k}}{4}\right)$$

$$\vec{F} = |\vec{F}|\,\hat{f}$$

$$\vec{F} = 20\left(\frac{2i + 3\hat{j} - \sqrt{3}\hat{k}}{4}\right)^{5}$$

$$a = \frac{\vec{F}}{m} = 2i + 3\hat{j} - \sqrt{3}\hat{k}$$

Start the class

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

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

find $\frac{\vec{A}}{\vec{B}}$??

→ Division of vector is Not defined.

→ soln

$\frac{|\vec{A}|}{|\vec{B}|}$ = This is possible

$\frac{|\vec{A}|}{|\vec{B}|} = \frac{2\sqrt{2}}{3\sqrt{2}} = \frac{2}{3}$

~~(a) 2/3 (22%)~~

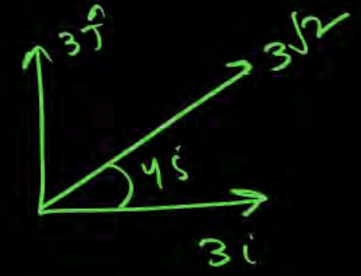
~~(b) 3/2~~

53% ~~(c) $\frac{2\hat{i}+2\hat{j}}{3\hat{i}+3\hat{k}}$~~

(d) Not Possible

$\frac{\text{Scalar}}{\text{Vector}} = \frac{|\vec{A}|}{\vec{B}}$ ✗ Not Possible

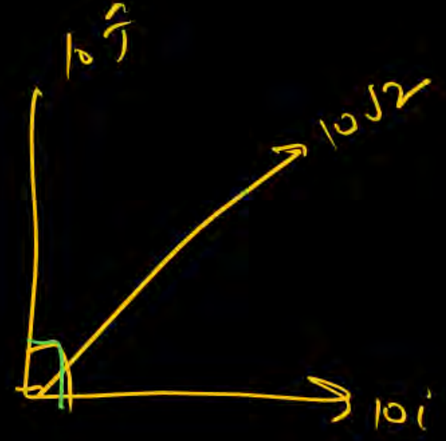
$\frac{\text{Vector}}{\text{Scalar}} = \frac{\vec{A}}{|\vec{B}|}$ ✓ ← Scalar

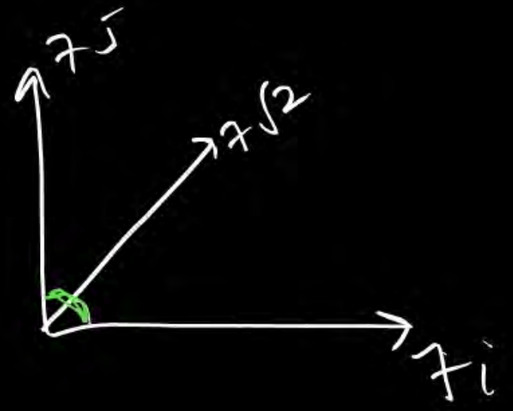


$\vec{A} = 3i + 3\hat{j}$

$|\vec{A}| = \sqrt{9+9} = \sqrt{18}$

$= \sqrt{9 \times 2} = 3\sqrt{2}$



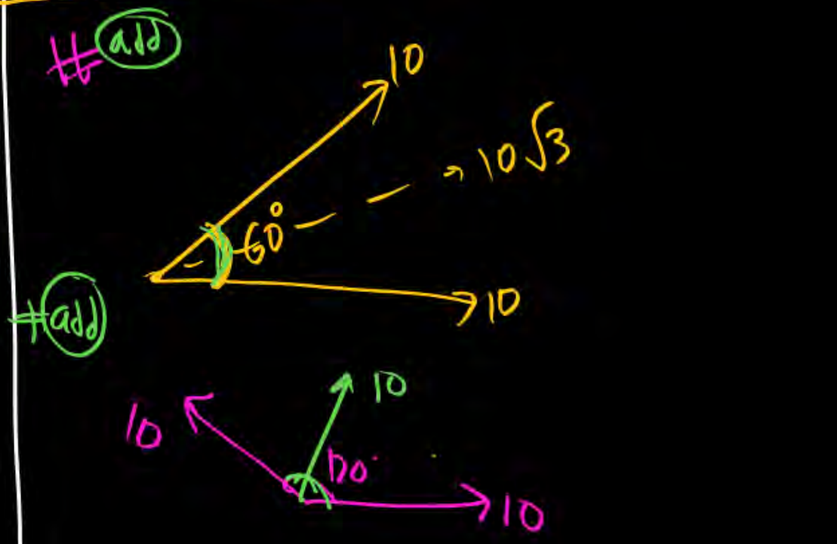


$\vec{A} = 2i + 2\hat{j} + 2\hat{k}$

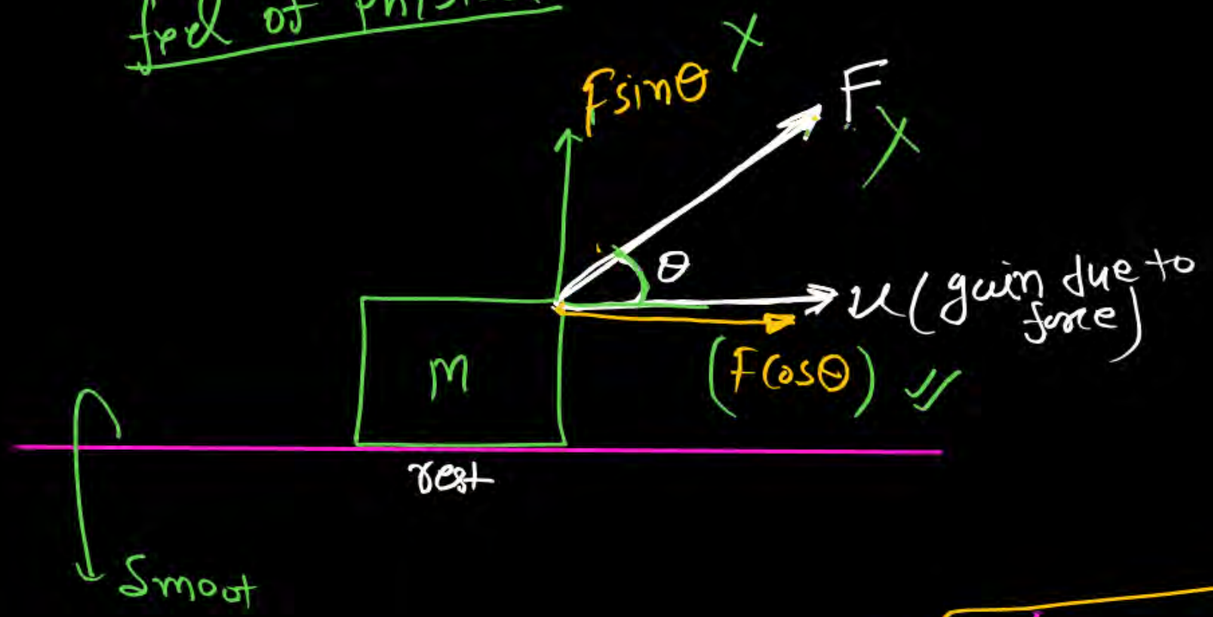
$|\vec{A}| = \sqrt{4+4+4}$

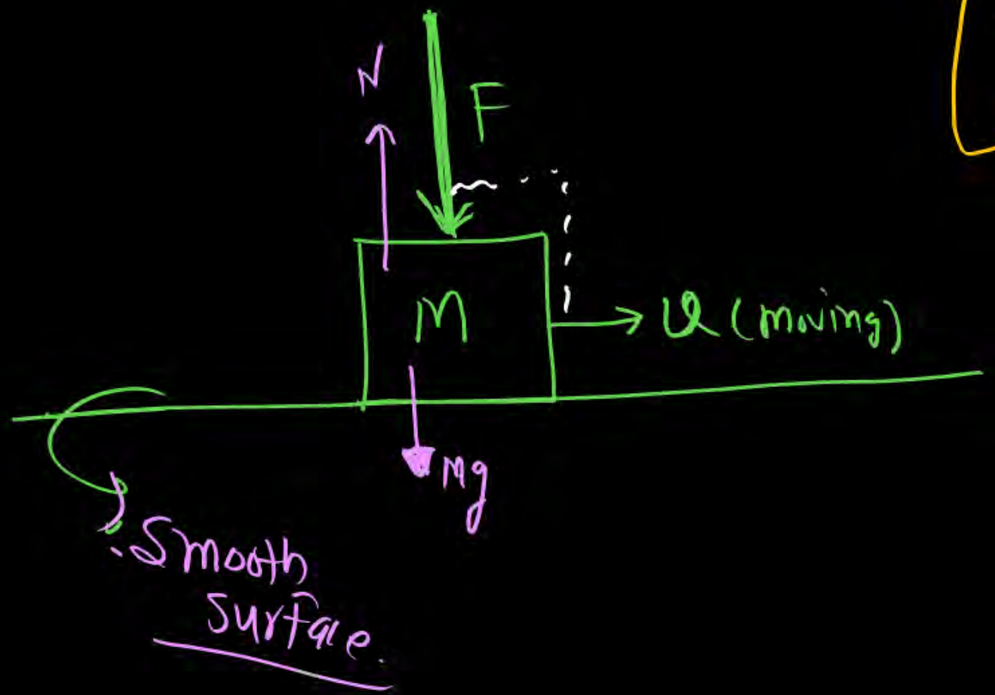
$= \sqrt{12} = \sqrt{4 \times 3}$

$= 2\sqrt{3}$



feel of physics





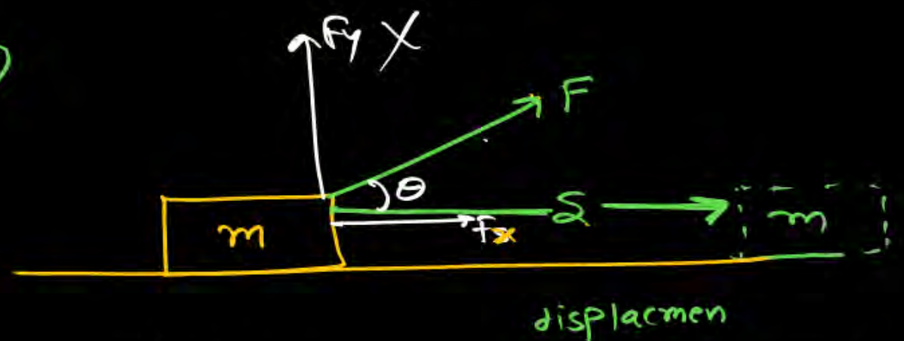
Mausi Ki Kasam. (Y- chapal मारी)

(a) decrease (46!)

(b) Increase

(c) No effect

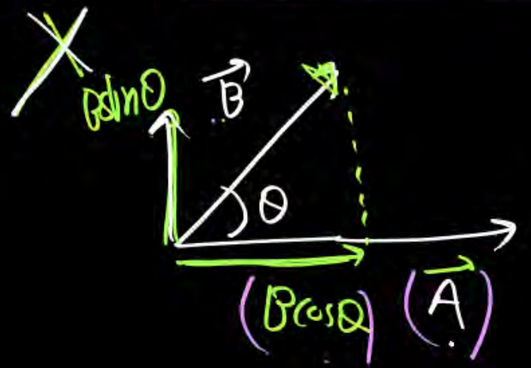
(#)



Work due to this force $= (F_x)\, s_x \Rightarrow W =$ (component of force along displ^m) $\times$ displ^m.

Dot Product [Scalar Product]

Result scalar hoga.



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

- θ → Angle b/w $\vec{A}$ & $\vec{B}$
- A → magnitude of A
- B → magnitude of B

Example

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

$Pow^2 = \vec{F} \cdot \vec{v}$

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

$\phi = \vec{E} \cdot \vec{A}$ → flux (scalar)

$\vec{P}$ → dipole moment

Question

which of the following operation is possible ??

(i) $(\vec{A} \cdot \vec{B}) \cdot \vec{C}$ ⟶ (scalar) · $\vec{C}$ wrong

↑ dot Product

(ii) $\frac{\vec{A} \cdot \vec{B}}{\vec{C}}$ = $\frac{\text{Scalar}}{\vec{C}}$ ✗

$4\vec{A}$ ✓

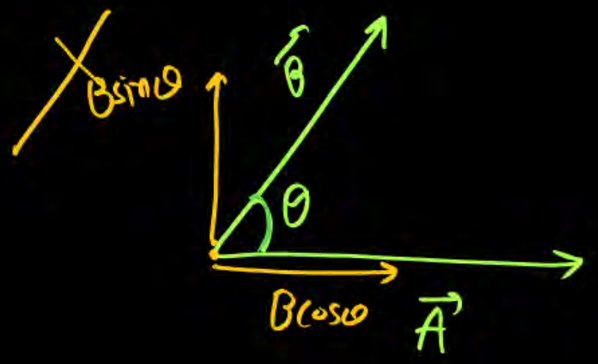
$4 \cdot \vec{A}$ ✗

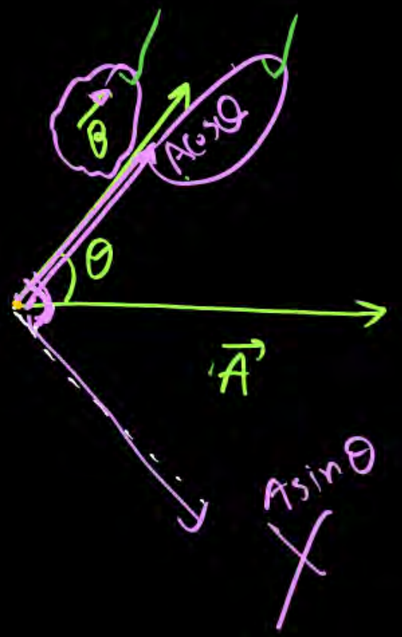
(iii) $\frac{\vec{A}}{(\vec{B} \cdot \vec{C})}$ = $\frac{\vec{A}}{\text{Scalar}}$ ✓✓

(iv) $\vec{A} \cdot B$ ✗ = (vector) · (Scalar)

↑ dot Pr.

Dot Product





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

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

$$\vec{A}\cdot\vec{B} = A(\text{component of } B \text{ along } A)$$

$$= B(\text{component of } A \text{ along } B)$$

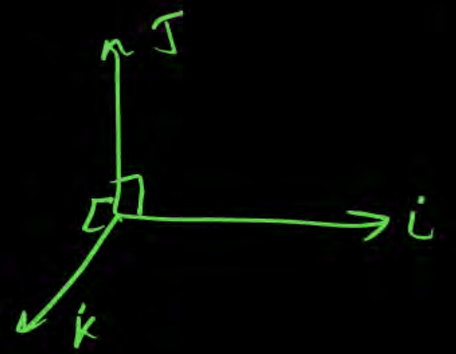
(Q) $|\vec{A}| = 3$ $|\vec{B}| = 4$ Angle b/w them $\theta = 60^\circ$

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

$= 3\times 4\times\cos 60^\circ$

$= 12\times\frac{1}{2} = \underline{\underline{6}}$

$\hat{i}$ = unit vector of x-axis



$\rightarrow \hat{i} \cdot \hat{i} = 1 \times 1 \cos 0^\circ = 1$

$\rightarrow \hat{j} \cdot \hat{j} = 1$

$\rightarrow \hat{k} \cdot \hat{k} = 1$

$$\begin{cases} \hat{k} \cdot \hat{j} = 0 \\ \hat{k} \cdot \hat{i} = 0 \\ \hat{i} \cdot \hat{j} = 1 \times 1 \cos 90^\circ = 0 \end{cases}$$

Dot Product of $\vec{A}$ & $\vec{B}$.

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

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

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

$$\vec{A} \cdot \vec{B} = (A_x \hat{i} + A_y \hat{j} + A_z \hat{k}) \cdot (B_x \hat{i} + B_y \hat{j} + B_z \hat{k})$$

$$= A_x B_x (1) + A_x B_y \hat{i}\cdot\hat{j}^{\,0} + A_y B_y \hat{j}\cdot\hat{j} + A_z B_z \hat{k}\cdot\hat{k}$$

$$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

Scalar Result

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

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

$\vec{A} \cdot \vec{B} = 6 + (-2)(-1) + 12$

$= 6 + 2 + 12$

$= 20$

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

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

$\vec{A} \cdot \vec{B} = -4 - 9 - 24$

$= -37$

Application of Dot Product

(i) To find Angle b/w vectors :-

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

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

$$\theta = \cos^{-1}\left(\frac{\vec{A} \cdot \vec{B}}{AB}\right)$$

Ex $\vec{A} = \hat{i} + \sqrt{3}\hat{j}$ & $\vec{B} = \hat{i}$ ✓

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

Soln

$$\vec{A} \cdot \vec{B} = (\hat{i} + \sqrt{3}\hat{j}) \cdot \hat{i} = 1 + 0$$

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

$$|\vec{B}| = 1$$

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

$$1 = 2 \times 1 \cos\theta$$

$$\cos\theta = \frac{1}{2}$$

$\theta = 60°$

$$\left\{ \begin{array}{l} \vec{A} = i + \hat{j} \\ \vec{B} = 1i - 1\hat{j} \end{array} \right\}$$

(Q) Find Angle B/w $\vec{A}$ & $\vec{B}$

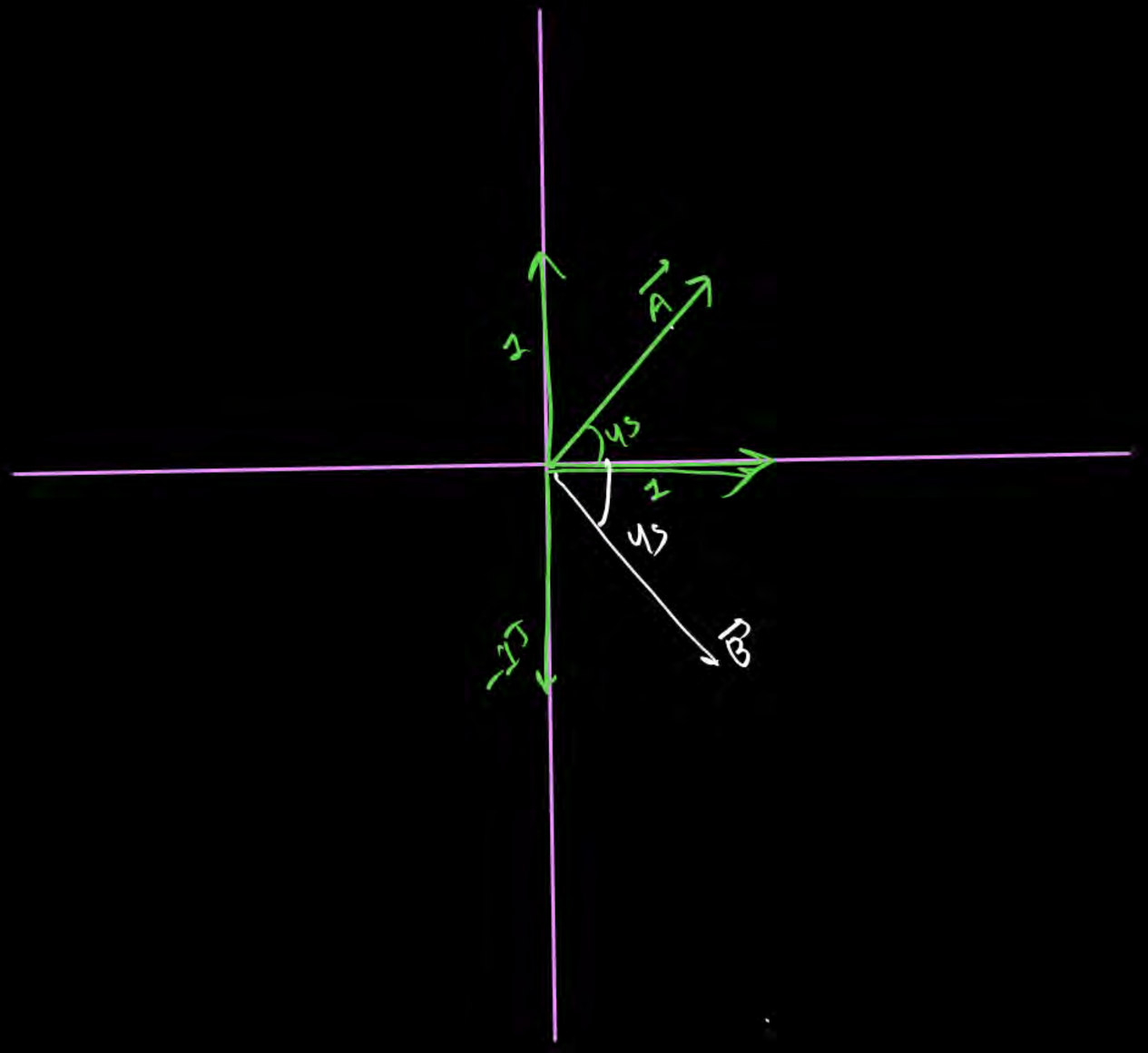
$$\vec{A} \cdot \vec{B} = AB\cos\theta$$

$$1 - 1 = \sqrt{2} \times \sqrt{2} \cos\theta$$

$$0 = 2\cos\theta$$

$$\cos\theta = 0$$

$$\theta = 90$$



$\vec{A} = 2\hat{i} + 3\hat{j} - 5\hat{k}$ $\longrightarrow A = \sqrt{4+9+25}$

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

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

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

$2 - 6 - 15 = \sqrt{38} \times \sqrt{14} \cos\theta$

$\cos\theta = \dfrac{-19}{\sqrt{38} \times \sqrt{14}}$

No need to solve.

Application.

(2) To Check Perpendicular Vectors (or Orthogonal vectors)

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

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

Question

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

$\vec{A} = 2i + 3\hat{j} + \alpha K$

$\vec{B} = \hat{i} - 2\hat{j} + 4\hat{K}$

$\vec{A} \cdot \vec{B} = 2 - 6 + 4\alpha = 0$

$-4 + 4\alpha = 0$

$4\alpha = 4$

$\boxed{\alpha = 1}$ Ans.

Question

If vector $\vec{A} = \cos\omega t\,\hat{i} + \sin\omega t\,\hat{j}$ and $\vec{B} = \cos\frac{\omega t}{2}\,\hat{i} + \sin\frac{\omega t}{2}\hat{j}$ are function of time, then the value of t is at which they are orthogonal to each other is **[2005]**

1. $t = \pi/\omega$
2. $t = 0$
3. $t = \pi/4\omega$
4. $t = \pi/2\omega$

$\vec{A} = \cos(\omega t)\,\hat{i} + \sin(\omega t)\,\hat{j}$

$\vec{B} = \cos\left(\frac{\omega t}{2}\right)\hat{i} + \sin\left(\frac{\omega t}{2}\right)\hat{j}$

$\vec{A}\cdot\vec{B} = \cos(\omega t)\cdot\cos\left(\frac{\omega t}{2}\right) + \sin(\omega t)\cdot\sin\left(\frac{\omega t}{2}\right) = 0$

$= \cos\left(\omega t - \frac{\omega t}{2}\right) = 0$

$\cos\frac{\omega t}{2} = 0$

$\frac{\omega t}{2} = \frac{\pi}{2}$

$t = \frac{\pi}{\omega}$

$\cos(A-B) = \cos A\cdot\cos B + \sin A\sin B$

Applicn

(3) To check unit vectors ✓

if $\vec{A}$ is a unit vector

$$\vec{A} \cdot \vec{A} = A\,A\cos\theta$$

$$= 1 \times 1 \times \cos 0$$

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

(4)th applicn To find Projection of one vector to other

To find Component of one vector along other vector.

$$\frac{\vec{A} \cdot \vec{B}}{Q} = (\text{Compond of } \vec{A} \text{ along } \vec{B})$$

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

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

Compn of $\vec{B}$ along $\vec{A}$

Question

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

Question H/W

If $\vec{A} = 2\hat{\imath} - 4\hat{\jmath} + 3\hat{k}$ and $\vec{B} = 4\hat{\imath} - 8\hat{\jmath} + 6\hat{k}$ find angle between $\vec{A}$ and $\vec{B}$.

1. Zero
2. $90°$
3. $60°$
4. Can't find

Question

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

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 $\vec{B}$.

Question

If a vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to the vector $3\hat{j} - 4\hat{i} + \alpha\hat{k}$, 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. $45°$

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

1. 150 J
2. 20 J
3. 190 J
4. 160 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 $-\hat{\imath} + 2\hat{\jmath} + \hat{k}$. Find work done on the particle

1. 2J
2. 6J
3. -3J
4. zero

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?

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. $\frac{2}{\sqrt{3}}$
3. $\frac{4}{\sqrt{3}}$
4. 0

Question

A vector perpendicular to $\hat{i}+\hat{j}-\hat{k}$ and $\hat{i}-\hat{j}-\hat{k}$ is:

1. $\hat{i}+\hat{j}+\hat{k}$
2. $\hat{i}+\hat{k}$
3. $-\hat{i}+\hat{j}+\hat{k}$
4. $\hat{j}+\hat{k}-2\hat{i}$

H/W

THANK YOU