YAKEEN NEET 2.0

2026

Vectors

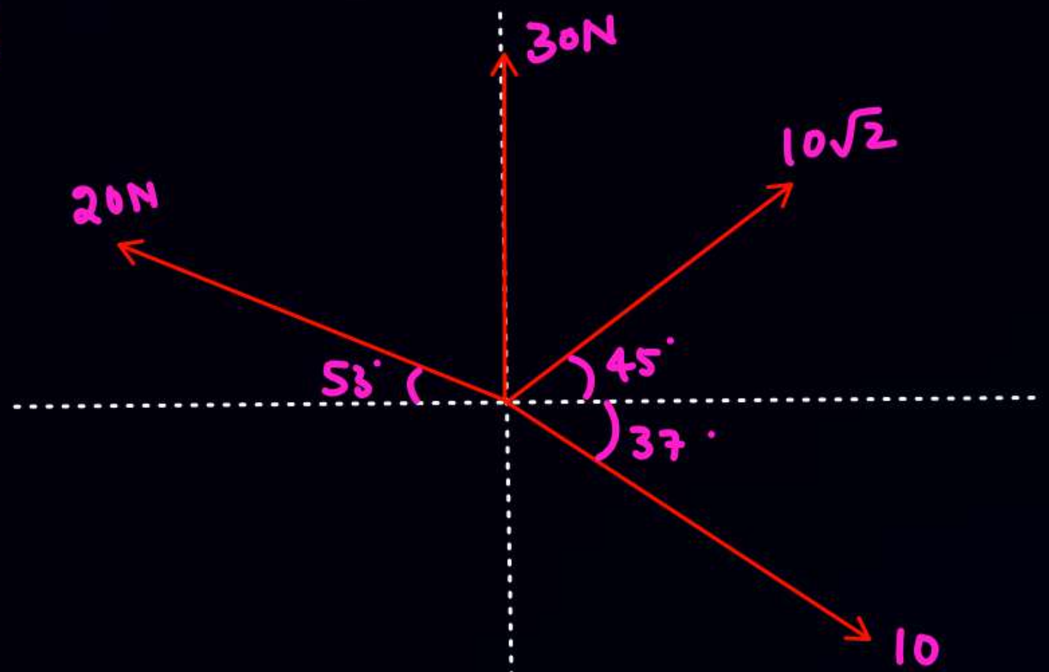
PHYSICS | Lecture – 08

By – Saleem Ahmed Sir

Todays Goal

- Ques Practice & Dot product

Q

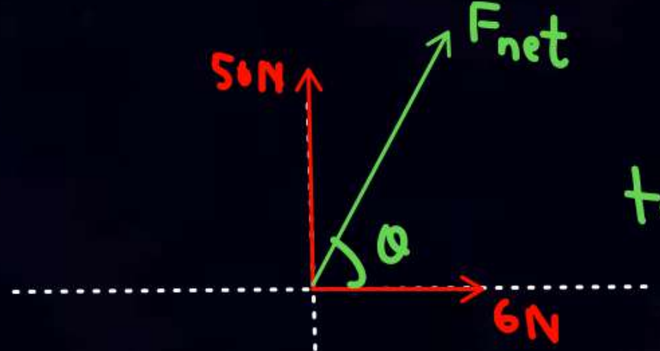


① $F_{net} = ?$

② $a = ?$

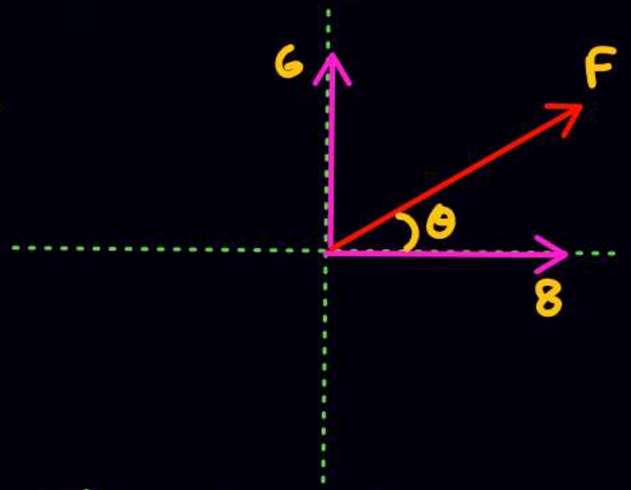
Sol^n

$\vec{F}_{net} = 6\hat{i} + 50\hat{j}$



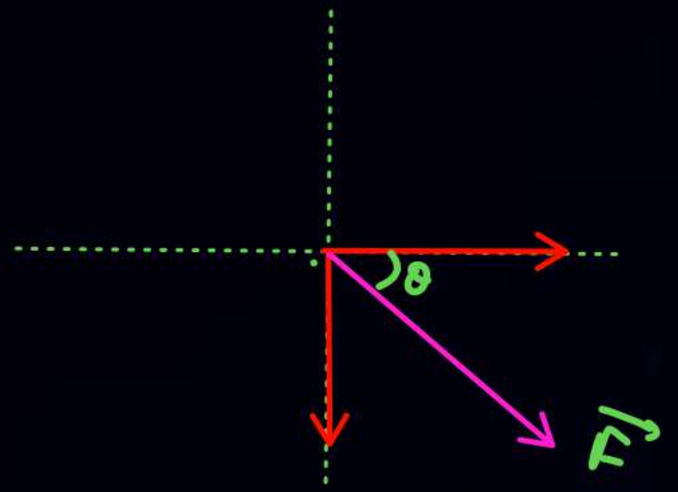
$\tan\theta = \frac{50}{6}$

Q



$\vec{F} = 8\hat{i} + 6\hat{j}$

$\tan\theta = \frac{6}{8}$



$\vec{F} = 8\hat{i} - 8\hat{j}$

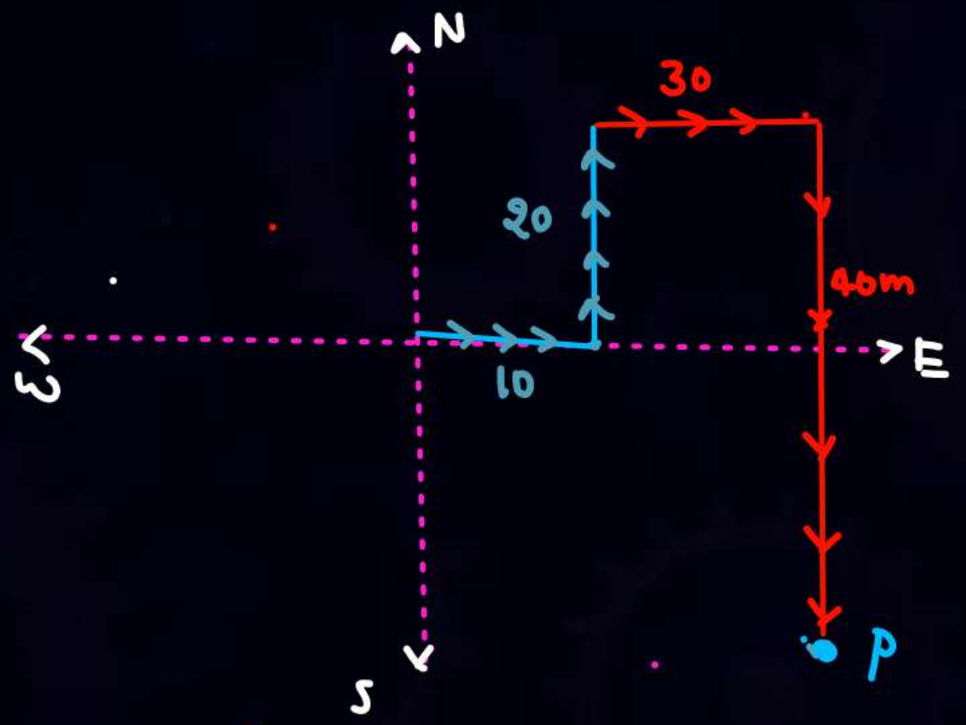
$\tan\theta = \frac{8}{8} = 1$

Q A boy start moving from origin and he travel 10m along east and then he turn to left side and move 20 m along north after that he turn to right and cover a distance of 30 m, after that again he turn right and travel 40m and reaches the point P. If at P he goes inside to earth 10m in a well

Distance = $10 + 20 + 30 + 40 + 10 = 110$

Displacement = $10\hat{i} + 20\hat{j} + 30\hat{i} - 40\hat{j} - 10\hat{k}$

$= 40\hat{i} - 20\hat{j} - 10\hat{k}$



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

Direction Cosine

If $\vec{A}$ makes angle α with $+x$-Axis
" " " β " $+y$-Axis
" " " γ " $+z$ Axis

Component of $\vec{A}$ along x-Axis $= A\cos\alpha = A_x$
" " " y Axis $= A\cos\beta = A_y$
" " " z-Axis $= A\cos\gamma = A_z$

$$\cos\alpha = \frac{A_x}{A} \qquad \cos\gamma = \frac{A_z}{A}$$
$$\cos\beta = \frac{A_y}{A}$$

$\Rightarrow$ Direction Cosine.

(Component ≡ projection)

(*)

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

① $|\vec{A}| = \sqrt{3^2+4^2+5^2} = 5\sqrt{2}$

② Component of $\vec{A}$ along x-Axis $= 3\hat{i}$

" " " " y-Axis $= 4\hat{j}$

" " " z-Axis $= 5\hat{k}$

③ Component of $\vec{A}$ on x-y plane $= 3\hat{i}+4\hat{j}$

" " " y-z " $= 4\hat{j}+5\hat{k}$

" " " X-z " $= 3\hat{i}+5\hat{k}$

④ Find direction cosine $\cos\alpha, \cos\beta, \cos\gamma = ?$

Angle made by vector with x-Axis

$= \alpha = ?$

$\cos\alpha = \frac{A_x}{A} = \frac{3}{5\sqrt{2}}$

$\cos\beta = \frac{A_y}{A} = \frac{4}{5\sqrt{2}}$

$\cos\gamma = \frac{A_z}{A} = \frac{5}{5\sqrt{2}} = \frac{1}{\sqrt{2}}$

$\gamma = 45°$

Rough Copy

(Component ≡ projection)

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

④ Find direction cosine $\cos\alpha, \cos\beta, \cos\gamma = ?$

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = \frac{9}{49} + \frac{4}{49} + \frac{36}{49}$$

$$= \frac{\cancel{49}}{\cancel{49}} = 1$$

Angle made by vector with x-Axis

$= \alpha = ?$

$$\cos\alpha = \frac{A_x}{A} = \frac{3}{7}$$

$$\cos\beta = \frac{A_y}{A} = \frac{-2}{7}$$

$$\cos\gamma = \frac{A_z}{A} = \frac{6}{7}$$

* $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$ (Always)

* $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 1$ ✗

$= 2$ ✓

Proof

* $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$1 - \sin^2\alpha + 1 - \sin^2\beta + 1 - \sin^2\gamma = 1$

$2 = \sin^2\alpha + \sin^2\beta + \sin^2\gamma$

Q If $\vec{A}$ make angle 45°, 60° with X-Axis & y-Axis. Find angle made by $\vec{A}$ with z Axis

Soln $\alpha = 45$, $\beta = 60$, $\gamma = ?$

$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$\cos^2 45 + \cos^2 60 + \cos^2\gamma = 1$

$\frac{1}{2} + \frac{1}{4} + \cos^2\gamma = 1$

$\cos^2\gamma = \frac{1}{4}$

$\cos\gamma = \pm\frac{1}{2}$

$\gamma = 60, 120$

Q $\alpha = 45^\circ$, $\beta = 30$, $\gamma = ?$

$\cos^2 45 + \cos^2 30 + \cos^2 \gamma = 1$

$\frac{1}{2} + \frac{3}{4} + \cos^2 \gamma = 1$

$\cos^2 \gamma = 1 - \frac{1}{2} - \frac{3}{4} = \frac{4-2-3}{4}$

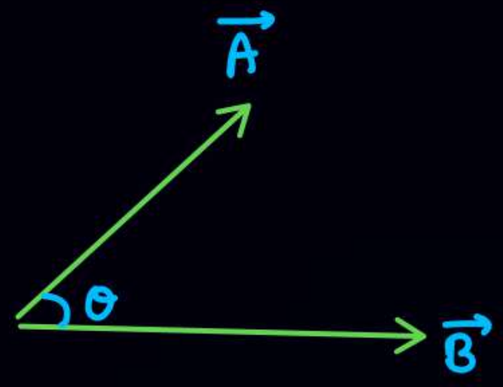
$\cos^2 \gamma = -\frac{1}{4}$ (Not possible)

$\cos \gamma = -\frac{1}{2}$

$\gamma = 120^\circ$

Dot product

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



magnitude of $\vec{A}$

magnitude of $\vec{B}$

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

* If $\theta = 90^\circ$, $\vec{A}\cdot\vec{B} = 0$

Q Two vector of magnitude 10 unit & 20 unit are at angle 60°. find their dot product

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

$= 10 \times 20 \times \cos 60$

$= 10 \times 20 \times \frac{1}{2} = 10 \times 10$

$= \underline{100}$

Q $\vec{A} = \hat{i}$

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

$\hat{i} \cdot \hat{i} = ?$

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

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

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

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

$\hat{i} \cdot \hat{i} = 1$

Q $\vec{A} = \hat{i}$

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

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

$\hat{i} \cdot \hat{j} = 1 \times 1 \times \cos 90$

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

$\hat{i} \cdot \hat{i} = \hat{j} \cdot \hat{j} = \hat{k} \cdot \hat{k} = 1$

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

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

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

$\vec{A}\cdot\vec{B} = 3\times2 + 4\times6$

$= 6 + 24 = 30$

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

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

$\vec{A}\cdot\vec{B} = 6 - 12 - 20 = -26$

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

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

$\vec{A}\cdot\vec{B} = -12 + 12 = 0$

Find $\vec{A}\cdot\vec{B}$

① $\vec{A} = 4\hat{\imath} + 3\hat{\jmath}$

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

$\vec{A}\cdot\vec{B} = 4+3 = 7$

② $\vec{A} = 4\hat{\imath} - 3\hat{\jmath}$

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

$\vec{A}\cdot\vec{B} = 4-3 = 1$

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

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

$\vec{A}\cdot\vec{B} = 3+8-15 = -4$

④ $\vec{A} = -3\hat{\imath} - 4\hat{\jmath} + 6\hat{k}$

$\vec{B} = 2\hat{\imath} + 6\hat{\jmath} + 5\hat{k}$

$\vec{A}\cdot\vec{B} = -6-24+30 = 0$

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

⑤ $\vec{A} = \hat{\imath} - \hat{\jmath}$

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

$\vec{A} = \hat{\imath} - \hat{\jmath} + 0\hat{k}$

$\vec{B} = 0\hat{\imath} + \hat{\jmath} + 3\hat{k}$

$\vec{A}\cdot\vec{B} = 0 - 1 + 0 = -1$

$|\vec{B}| = \sqrt{1^2+1^2} = \sqrt{2}$

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

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

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

$7 = 5 \times \sqrt{2}\cos\theta$

$\cos\theta = \frac{7}{5\sqrt{2}}$

$\theta = \cos^{-1}\left(\frac{7}{5\sqrt{2}}\right)$

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

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

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

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

$4 - 3 = 5 \times \sqrt{2}\cos\theta$

$\cos\theta = \frac{1}{5\sqrt{2}}$

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

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

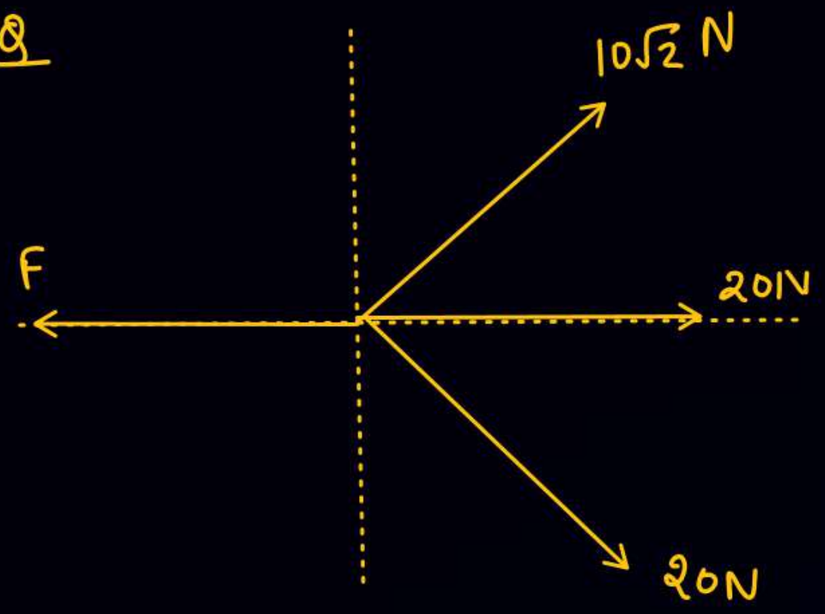
Angle b/w $\vec{A}$ & $\vec{B}$

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

$2 - 3 + 6 = 7\sqrt{3}\cos\theta$

$\cos\theta = \frac{5}{7\sqrt{3}}$

Q



Find F so that $F_{net} = 0$

Q11 The unit vector parallel to the resultant of the vectors $\vec{A} = 4\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{B} = -\hat{i} + 3\hat{j} - 8\hat{k}$ is

(A) $\frac{1}{7}(3\hat{i} + 6\hat{j} - 2\hat{k})$

(B) $\frac{1}{7}(3\hat{i} + 6\hat{j} + 2\hat{k})$

(C) $\frac{1}{49}(3\hat{i} + 6\hat{j} - 2\hat{k})$

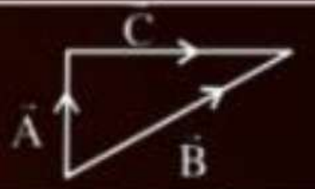
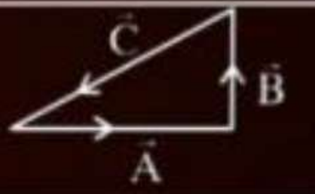
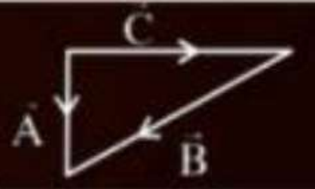
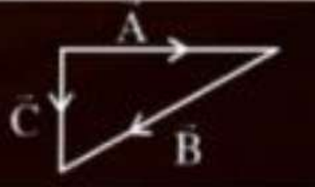
(D) $\frac{1}{49}(3\hat{i} - 6\hat{j} + 2\hat{k})$

QUESTION

Match List I with List II.

[JEE Main-2021]

Choose the correct answer from the options given below:

List I		List II	
(a)	$\vec{C}-\vec{A}-\vec{B}=0$	(i)	
(b)	$\vec{A}-\vec{C}-\vec{B}=0$	(ii)	
(c)	$\vec{B}-\vec{A}-\vec{C}=0$	(iii)	
(d)	$\vec{A}+\vec{B}=-\vec{C}$	(iv)	

1. (a)→(iv), (b)→(i), (c)→(iii), (d)→(ii)
2. (a)→(iv), (b)→(iii), (c)→(i), (d)→(ii)
3. (a)→(iii), (b)→(ii), (c)→(iv), (d)→(i)
4. (a)→(i), (b)→(iv), (c)→(ii), (d)→(iii)

Ans : (2)

QUESTION

Which of the following relation is true for two unit vectors $\hat{A}$ and $\hat{B}$ making an angle θ to each other?

[JEE Main-2022]

1. $|\hat{A}+\hat{B}| = |\hat{A}-\hat{B}|\tan\frac{\theta}{2}$
2. $|\hat{A}-\hat{B}| = |\hat{A}+\hat{B}|\tan\frac{\theta}{2}$
3. $|\hat{A}+\hat{B}| = |\hat{A}-\hat{B}|\cos\frac{\theta}{2}$
4. $|\hat{A}-\hat{B}| = |\hat{A}+\hat{B}|\cos\frac{\theta}{2}$

Ans : (2)

QUESTION

When vector $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ is subtracted from vector $\vec{B}$, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector $\vec{B}$ will be:

[11 April 2023 - Shift 2]

1. $\sqrt{5}$
2. 3
3. $\sqrt{6}$
4. $\sqrt{33}$

Ans : (4)

QUESTION

Two forces having magnitude A and $\frac{A}{2}$ are perpendicular to each other. The magnitude of their resultant is:

[08 April 2023 - Shift 1]

1. $\frac{\sqrt{5}A}{4}$
2. $\frac{\sqrt{5}A}{2}$
3. $\frac{5A}{2}$
4. $\frac{\sqrt{5}A^2}{2}$

Ans : (2)

QUESTION

If two vectors $\vec{A}$ and $\vec{B}$ having equal magnitude R are inclined at an angle θ, then

[31 Jan. 2024 - Shift 2]

1. $|\vec{A}-\vec{B}|=\sqrt{2}R\sin\left(\frac{\theta}{2}\right)$
2. $|\vec{A}+\vec{B}|=2R\sin\left(\frac{\theta}{2}\right)$
3. $|\vec{A}+\vec{B}|=2R\cos\left(\frac{\theta}{2}\right)$
4. $|\vec{A}-\vec{B}|=2R\cos\left(\frac{\theta}{2}\right)$

Ans : (3)

QUESTION

A vector in $x-y$ plane makes an angle of 30° with y-axis. The magnitude of y-component of vector is $2\sqrt{3}$. The magnitude of x-component of the vector will be:

[15 April 2023 - Shift 1]

1. $\frac{1}{\sqrt{3}}$
2. 6
3. 2
4. $\sqrt{3}$

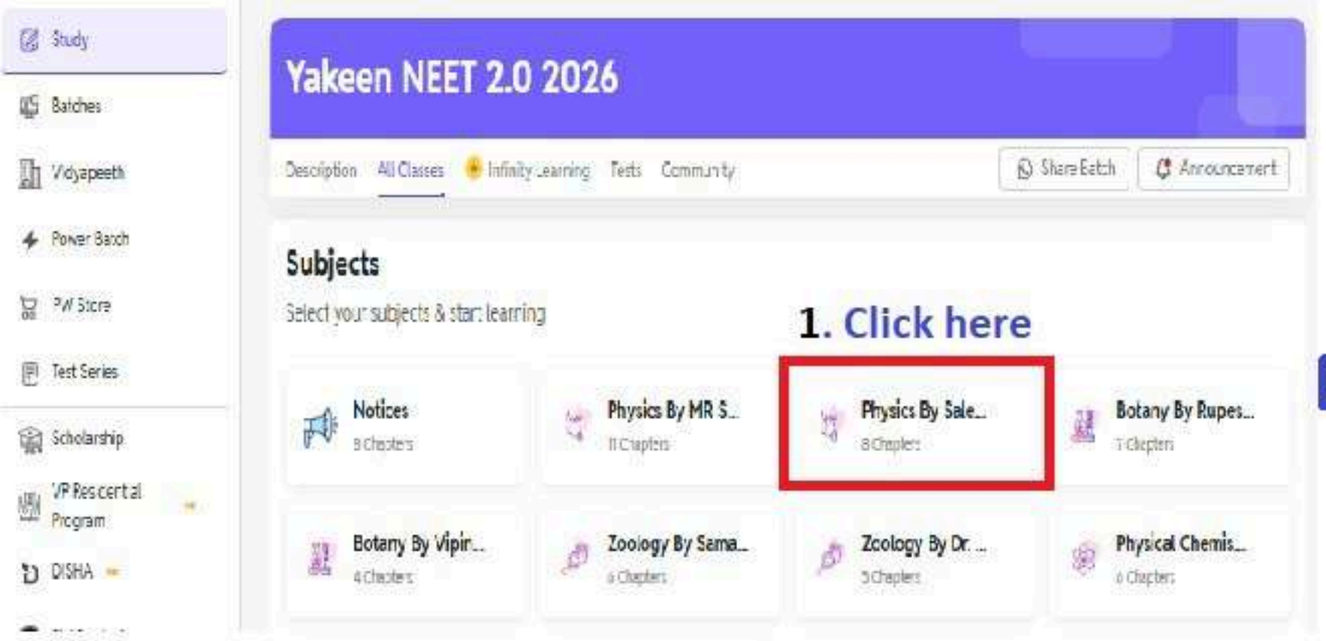
Ans : (3)

QUESTION

The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is half that of $\vec{B}$. The angle between vectors $\vec{A}$ and $\vec{B}$ is _____ °.

[09 Apr. 2024 – Shift 2]

Ans : (150)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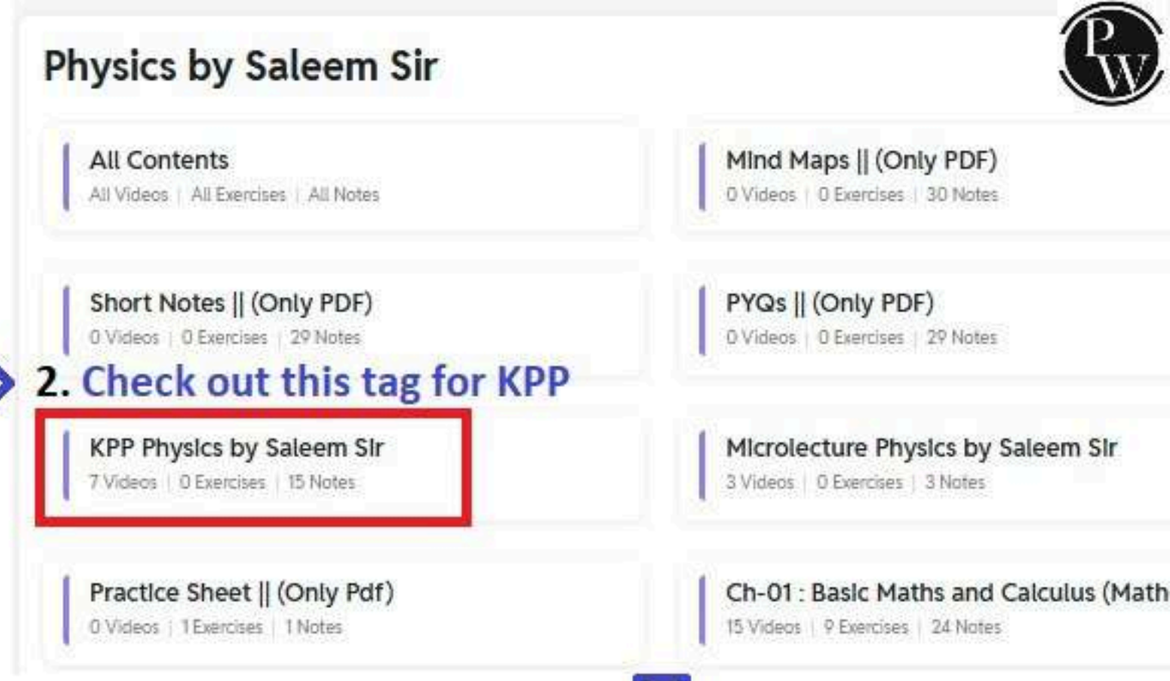
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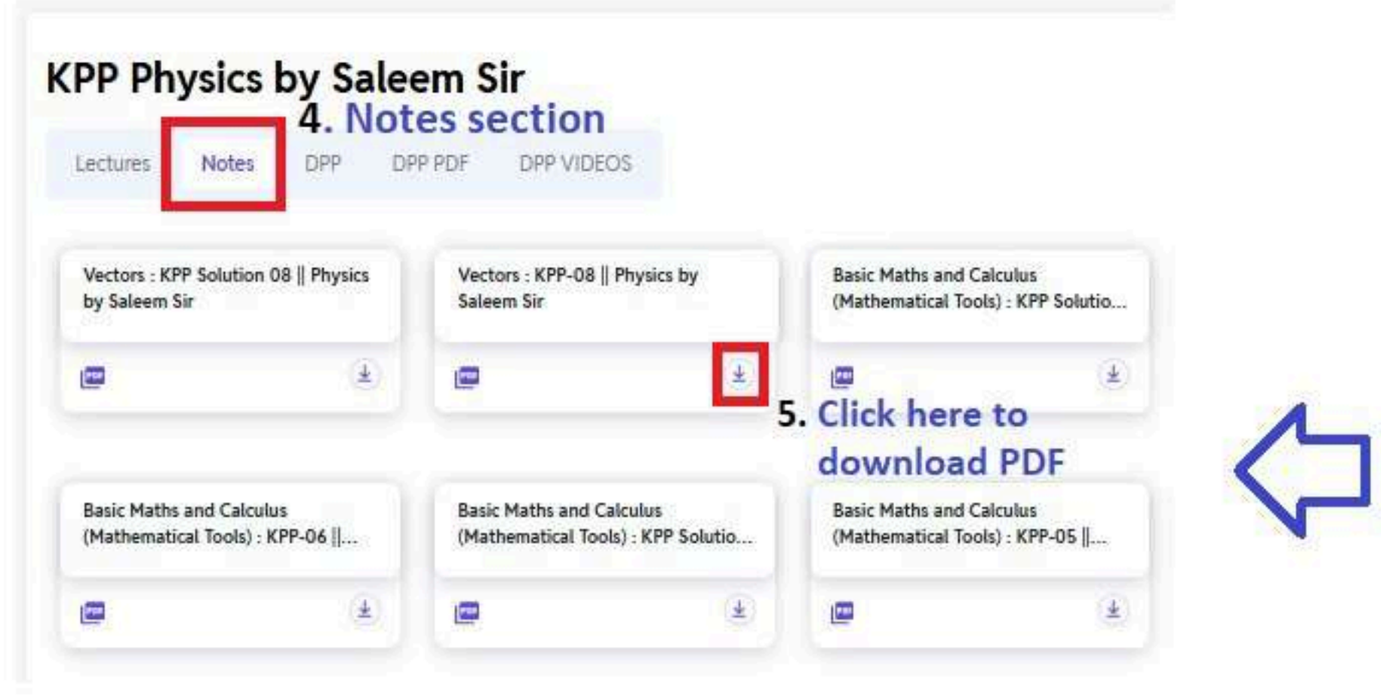
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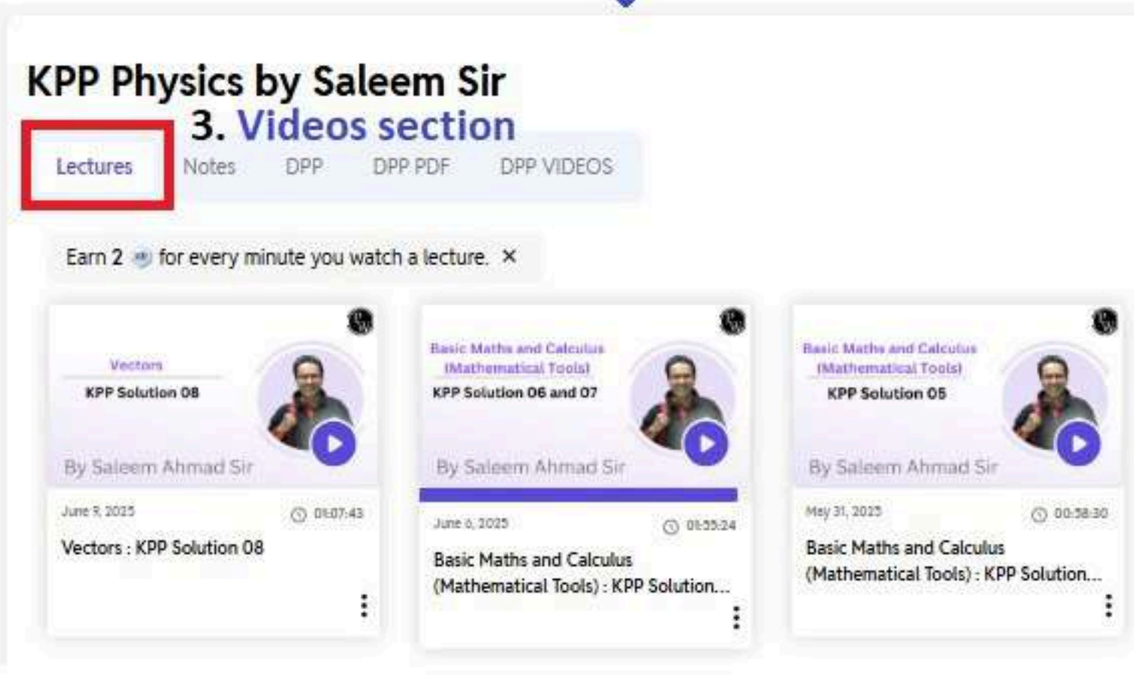
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Home work

- Revise All notes
- KPP 10 (will be uploaded today even.)
- DPP

Thank You