YAKEEN NEET 2.0

2026

Basic Maths and Calculus (Mathematical Tools)

Physics | Lecture - 4

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Topics to be covered

1. Phase difference & Phasor diagram.
2. Vector
3. A/C → 70%
4. S.H.M → 30%
   - Sound → 20%
   - Wave optics → 30%
   - EM Wave → 20%

→ (a) Yes

(b) NO

Recap of previous lecture

1

2

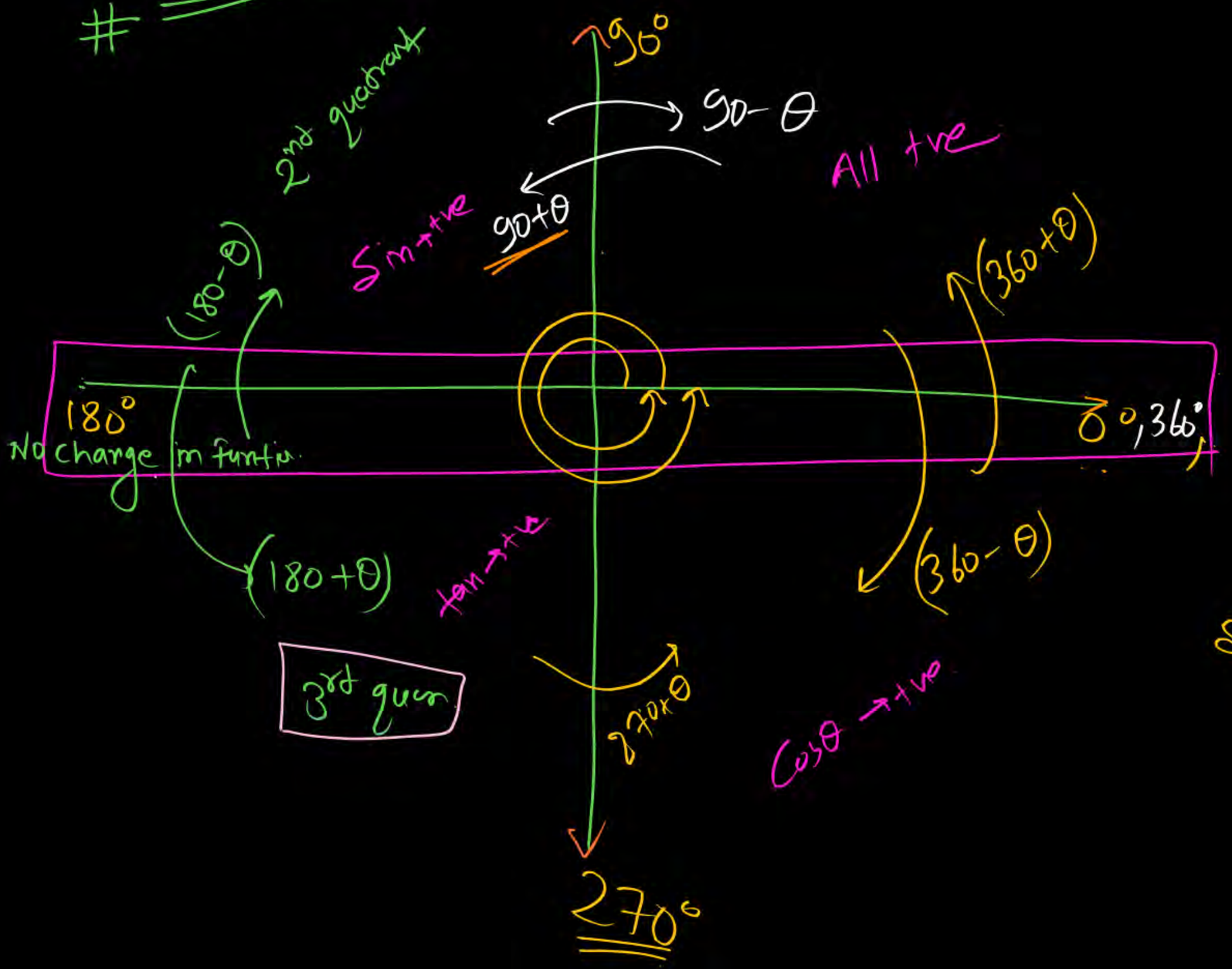
3

4

→ function

Clars full Temprament focus se
karo, clas ka H/w rough me ya
kuch Question Jo na bane, badhiya ho
H/w usko notes me likh lo.

Revision



$\sin 0^\circ = 0 = \sin 360^\circ$

$\cos 0^\circ = 1 = \cos 360^\circ$

$\cos 180^\circ = -1$

$\sin 90^\circ = 1$

$\sin(270) = -1$

Step-1 → function X is quadrant me hai uske according sign likho

$\sin(180+\theta) = -\sin\theta$

$(180+\theta)$
$(180-\theta)$ → No change
$360+\theta$
$360-\theta$

$\sin(90-\theta) = +\cos\theta$

$\cos(90+\theta) = -\sin\theta$

$\sin(90+\theta) = +\cos\theta$

$\cos(90-\theta) = +\sin\theta$

$\sin(180+\theta) = -\sin\theta$

$\cos(180+\theta) = -\cos\theta$

$\cos(180-\theta) = -\cos\theta$

$\sin(180+\theta) = -\sin\theta$

$\sin\theta \rightleftarrows \cos\theta$

$\tan\theta \rightleftarrows \cot\theta$

$\sec\theta \rightleftarrows \operatorname{cosec}\theta$

Note: ध्यान रखना

$\sin(270+\theta) = -\cos\theta$

$\sin(270-\theta) = -\cos\theta$

$\cos(270+\theta) = +\sin\theta$

$\sin(360+\theta) = +\sin\theta$

$\sin(360-\theta) = -\sin\theta$

$\cos(360-\theta) = +\cos\theta$

Step-1 → sign dikha karo

$\sin(127^\circ) = \sin(180-53) = +\sin 53^\circ = \frac{4}{5}$ ✓

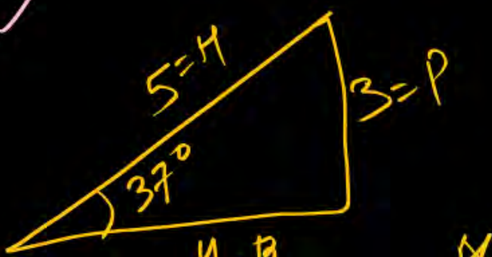
$\cos(143^\circ) = \cos(180-37) = -\cos 37^\circ = -\frac{4}{5}$ ✓

$= \cos(90^\circ+53^\circ) = -\sin 53^\circ = -4/5$ ✓

$\tan(143^\circ) = \tan(180-37^\circ) = -\tan 37^\circ = -\frac{3}{4}$ ✓

$\sin(750^\circ) = \sin(720^\circ+30) = +\sin 30^\circ = +\frac{1}{2}$

1st quadrant



$\sin 37^\circ = \frac{3}{5}$

Phase of Trigonometric function :-

→ phase is angle Inside Trigonometric function.

$y = 5 \sin(\theta)$

θ = phase.

$y = 4 \cos(\theta + \phi)$

phase $= \theta + \phi$

$y = 3 \sin(\omega t + \phi + \pi/4)$

phase at time 't' $= \omega t + \phi + \pi/4$

$y = 6 \sin(\omega t + \phi)$

phase

Phase difference :- Angle difference b/w two same Trigonometric function.

$y_1 = A \sin(\omega t + \pi/2)$ → ϕ_1

$y_2 = A \sin(\omega t)$ → ϕ_2

Soln

$\phi = \phi_1 - \phi_2$

$= \omega t + \pi/2 - \omega t$

$\boxed{\phi = \pi/2}$

Ans

$y_1 = A \sin(\omega t + \pi/3)$ → ϕ_1 (let)

$y_2 = A \sin(\omega t - \pi/3)$ → ϕ_2 (let)

ϕ (phase diff^n) $= \phi_1 - \phi_2$

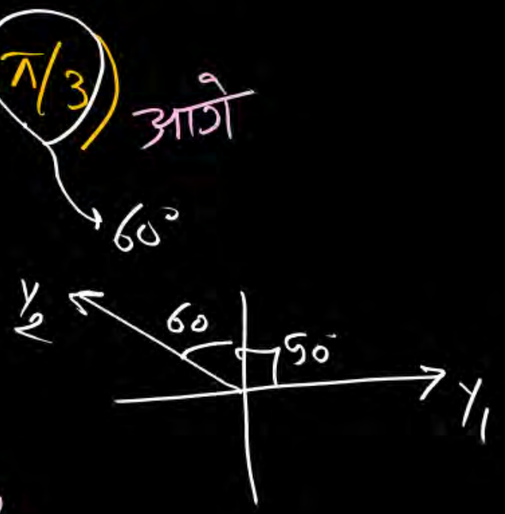
$= \omega t + \pi/3 - (\omega t - \pi/3)$

$= \omega t + \pi/3 - \omega t + \pi/3$

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

$$y_1 = A\cos(\omega t - \pi/2)$$ पीछे

$$y_2 = A\cos(\omega t + \pi/3)$$ आगे



$$\phi = \phi_1 - \phi_2$$

$$= (\omega t - \pi/2) - (\omega t + \pi/3)$$

$$= \omega t - \pi/2 - \omega t - \pi/3$$

$$= -(\pi/2 + \pi/3) = -\frac{5\pi}{6} = \underline{150°}$$

$\phi_2 - \phi_1 = +\frac{5\pi}{6}$

$$y_1 = A\sin(\omega t)$$

$$y_2 = A\sin(\omega t + \pi/6)$$

$$\phi = \phi_1 - \phi_2 = -\pi/6$$

$y_1 = A\sin(\omega t)$

$y_2 = A\sin(\omega t + \pi/2)$

$\phi = \phi_1 - \phi_2 =$

next R

$y_1 = A \sin(\omega t)$

$y_2 = A \sin(\omega t + \pi/2) = A\cos(\omega t)$ आगे

MR* Box

$\sin(90 + \omega t) = \cos(\omega t)$

$\phi = \phi_1 - \phi_2$

$= -\pi/2$

$y_1 = A \sin(\omega t)$

$y_2 = A \cos(\omega t)$ ← आगे ($\pi/2$)

$\phi = \pi/2 = \phi_2 - \phi_1$ (y_2 आगे)

find Phase difference b/w Y_1 & Y_2

$$Y_1 = 4\sin(\theta + \pi/4)$$ आगे

$$Y_2 = 3\sin(\theta - \pi/2)$$ पीछे

$$\phi = \phi_1 - \phi_2$$

$$= (\theta + \pi/4) - (\theta - \pi/2)$$

$$= \pi/4 + \pi/2$$

$$\phi = \frac{3\pi}{4}\,\text{rad} = 135^\circ$$

$$Y_1 = 4\sin(\theta + \pi/3)$$ आगे

$$Y_2 = 3\sin(\theta + \pi/6)$$ पीछे

Sol^n

$$\phi = \phi_1 - \phi_2$$

$$= \theta + \pi/3 - (\theta + \pi/6)$$

$$= \pi/3 - \pi/6$$

$$= \frac{2\pi - \pi}{6} = \frac{\pi}{6}$$

30°

$$Y_1 = 3\cos(\omega t + \pi/2)$$

$$Y_2 = 3\sin(\omega t)$$

Sol^n

$$\phi = \phi_1 - \phi_2$$

$$= \omega t + \pi/2 + \pi/2 - \omega t$$

$$\phi = \pi$$ a

$$Y_1 = 3\sin(\omega t)$$

$$Y_2 = 3\cos(\omega t - \pi/2)$$

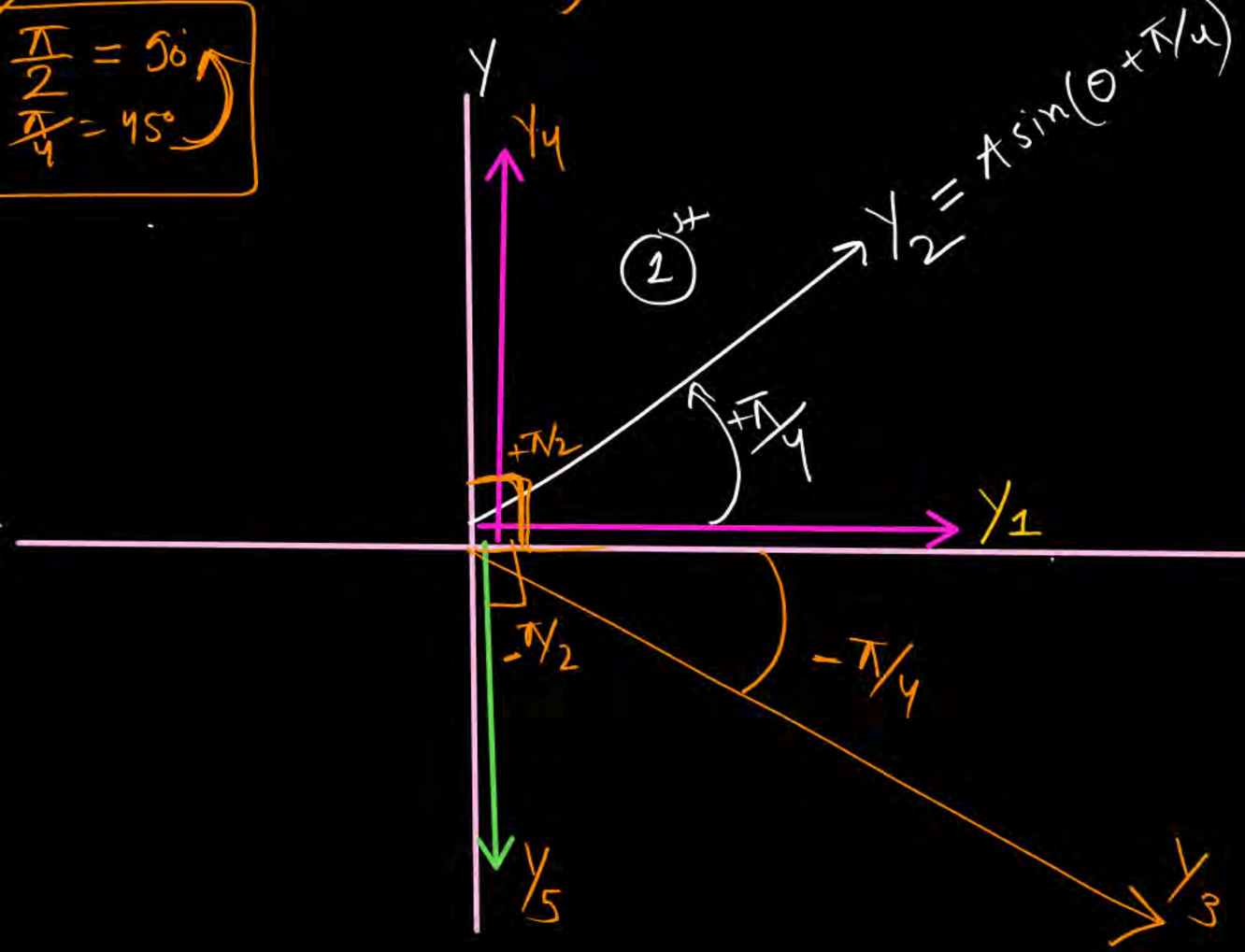
Sol^n $\phi =$ zero

Phase diagram → Representation of Trigonometric function with Phase (Angle)

(This is Not graph)

$\frac{\pi}{2} = 90°$

$\frac{\pi}{4} = 45°$



$$Y_1 = A\sin\theta$$

$$Y_2 = A\sin(\theta+\pi/4) = A\sin(\theta+45°)$$

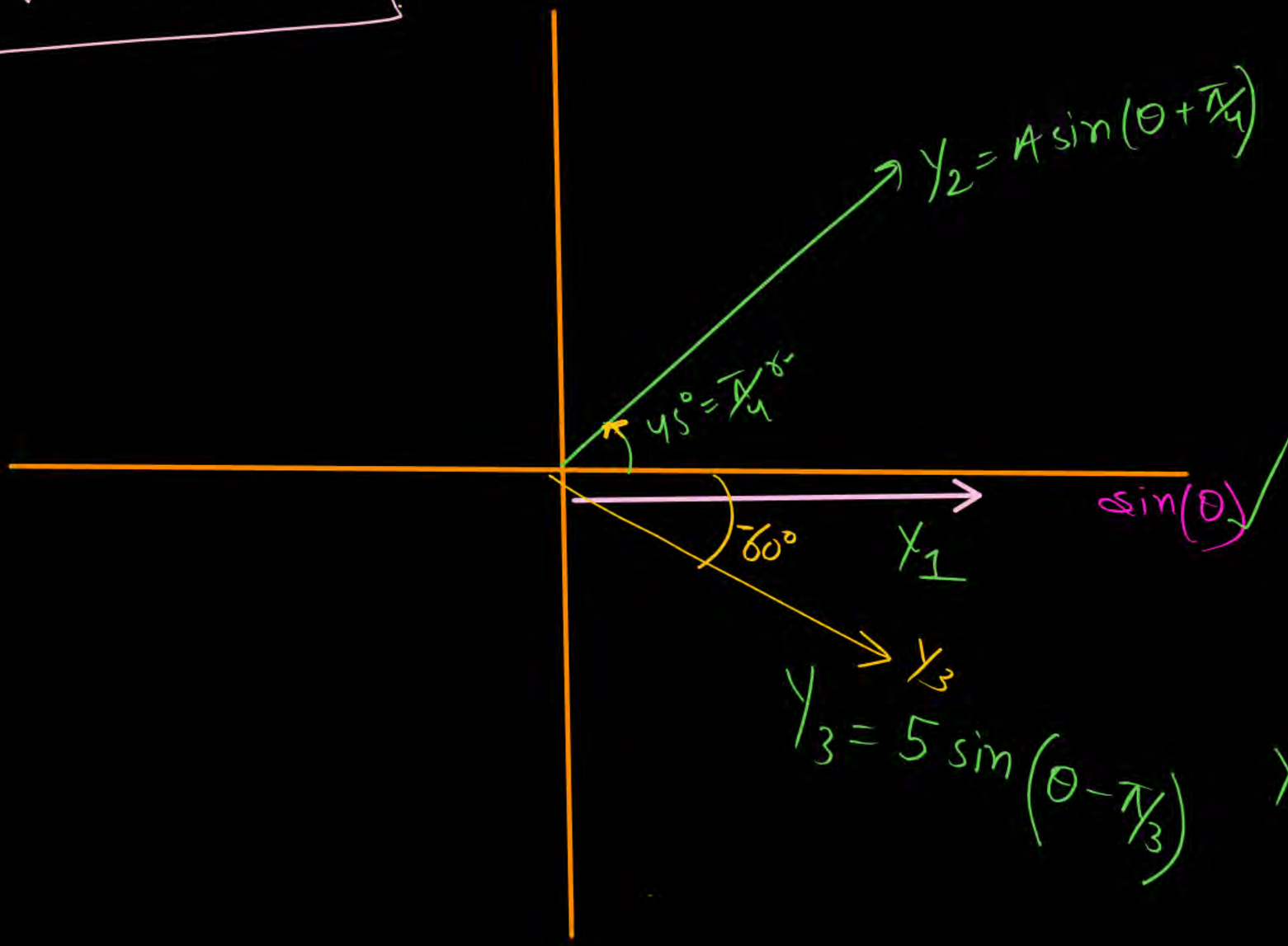
$$Y_3 = A\sin(\theta-\pi/4) = A\sin(\theta-45)$$

$$Y_4 = A\sin(\theta+\pi/2)$$

$$Y_5 = A\sin(\theta-\pi/2)$$

+ve → Anticlock
-ve → clockwise

← mR* Box



mR* Box

$\frac{\pi}{3}$ rad $= \frac{180°}{3} = 60°$

$\frac{\pi}{6}$ rad $= \frac{180°}{6} = 30°$

$\frac{\pi}{2}$ rad $= 90°$

$\frac{\pi}{4}$ rad $= 45°$

$y_3 = 5\sin(\theta - \pi/3)$

$y_1 = 3\sin\theta$

$y_2 = 4\sin(\theta + \pi/4)$

Draw this in phasor diagram

(#)

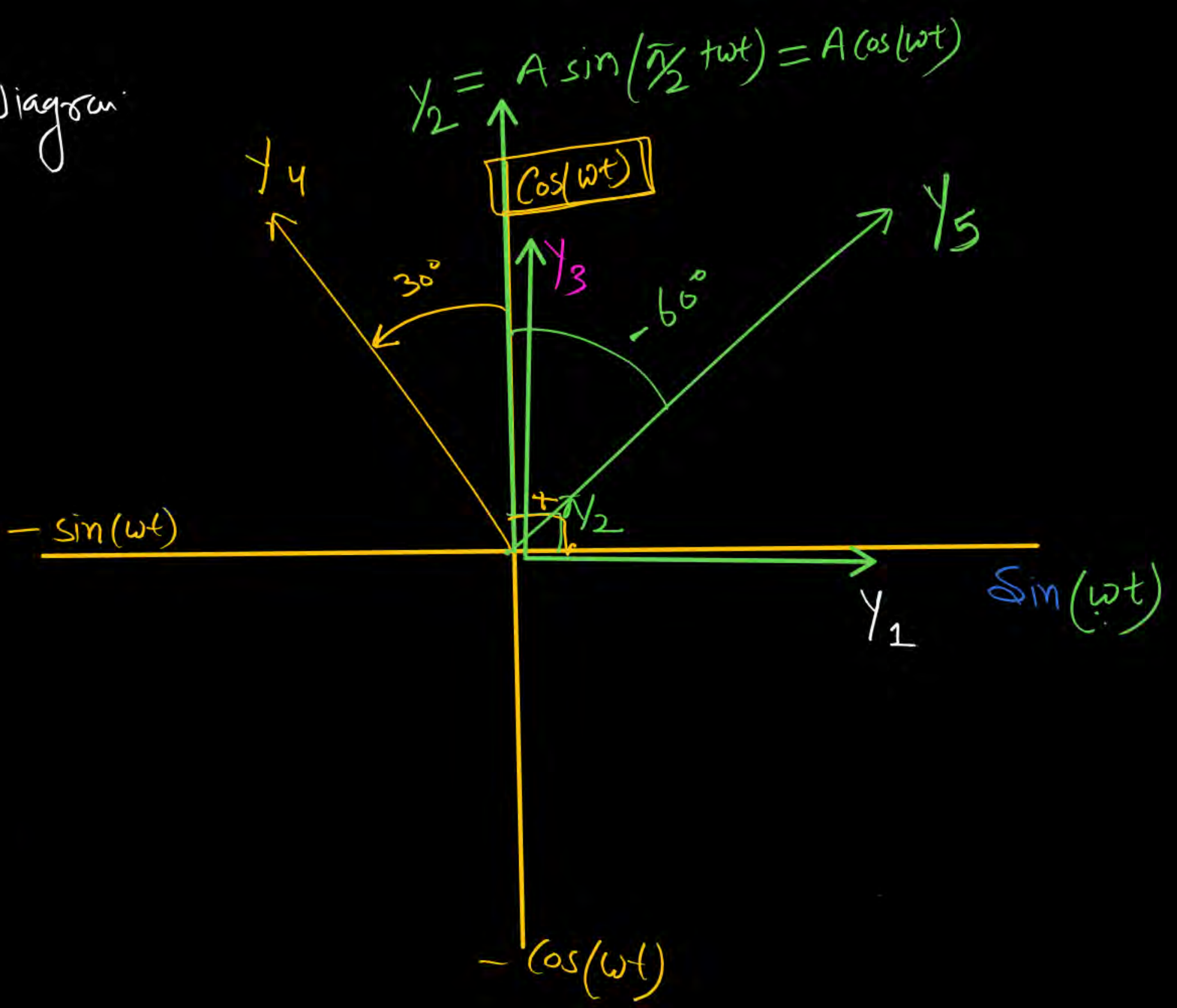
$Y_1 = A \sin(\omega t)$

$Y_2 = A \sin(\omega t + \pi/2)$

$Y_3 = A \cos(\omega t)$

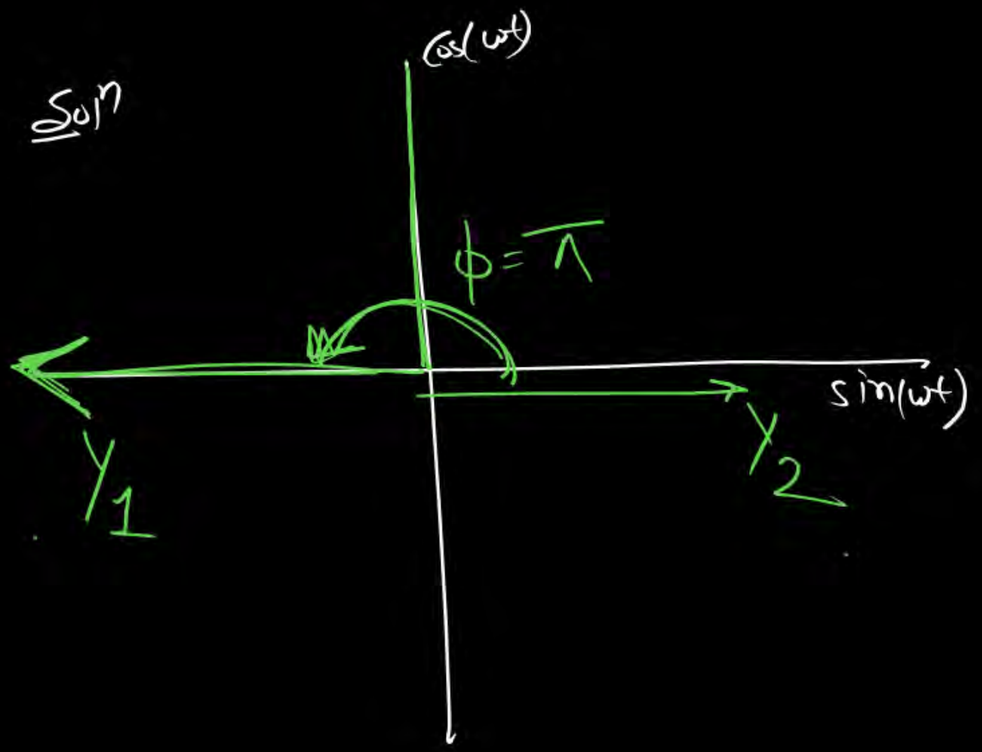
$Y_4 = A \cos(\omega t + 30^\circ)$

$Y_5 = A \cos(\omega t - 60^\circ)$



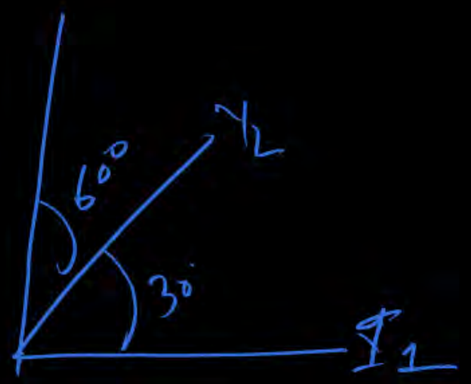
(Q) $Y_1 = 3\cos(\omega t + \pi/2)$

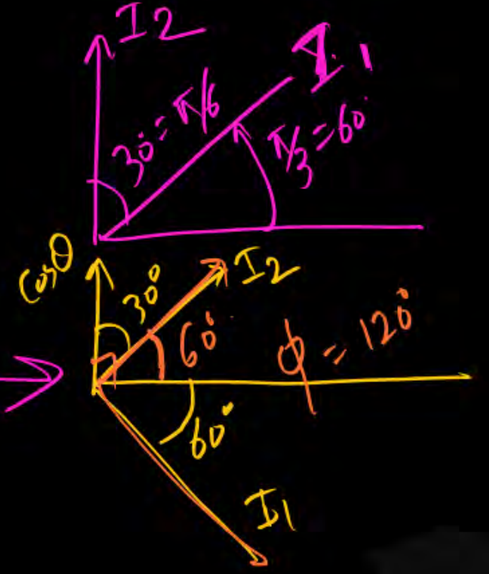
$Y_2 = 3\sin(\omega t)$



VECTOR/SHM/Wave/Wave Optics/EM Wave/ A/C

Equation – 1	Equation – 2	Phase difference
$I_1 = I_0 \sin(\theta + \pi/3)$	$I_2 = I_0 \sin(\theta - \pi/6)$	$\phi = 90^\circ = \pi/2$
$I_1 = I_0 \sin(\theta + \pi/3)$	$I_2 = I_0 \cos(\theta + \pi/3)$	$\phi = \pi/2$
$I_1 = 4 \sin(\omega t)$	$I_2 = I_0\, 4 \cos(\omega t - \pi/3)$	$\phi = 30^\circ = \pi/6$
$I_1 = 3 \sin(\omega t + \pi/2)$	$I_2 = 5 \cos(\omega t)$	$\phi = 0$
$I_1 = 4 \cos(\omega t - \pi/2)$	$I_2 = 4 \sin(\omega t + \pi/2)$	$\phi = \pi/2$ (pt)
$I_1 = 3 \sin(\omega t + \pi/3)$	$I_2 = 3 \cos(\omega t)$	$\pi/6$
$I_1 = 4 \sin(\theta - 60^\circ)$	$I_2 = 4 \cos(\theta - 30^\circ)$	$120^\circ = \frac{2\pi}{3}$ rad





Question

Equation of a.c. current $I = -I_0 \cos(\omega t)$ and a/c voltage is $V = V_0 \sin(\omega t - \pi/6)$ then find phase difference between current and voltage:

NEET

1. $\frac{2\pi}{3}$
2. $\frac{\pi}{3}$
3. $\frac{\pi}{6}$
4. $\frac{5\pi}{6}$

Trigonometric function maximum / minima.

$y = 3\sin\theta \longrightarrow y_{max} = 3 \quad | \quad y_{min} = -3$

$y = 3\cos\theta + 4\cos\theta \longrightarrow y_{max} = +7 \quad | \quad y_{min} = -7$

$y = (3+4)\cos\theta = 7\cos\theta$

---

mR* box

$y = a\sin\theta + b\cos\theta$

$y_{max} = +\sqrt{a^2+b^2}$

*$y_{min} = -\sqrt{a^2+b^2}$

$y = 3 + 4\sin\theta \longrightarrow y_{max} = 3 + 4(\sin\theta)_{m.} \quad | \quad y_{min} = 3 - 4 = -1$

$y_{max} = 7$

$y = 3\sin\theta + 4\cos\theta \Longrightarrow y_{max} = \sqrt{3^2+4^2} = \sqrt{25} = +5 \quad y_{min} = -5$

we will learn it in maxima & minima

$y = 3\sin\theta + 4\sin\theta \rightarrow y_{max} = 7 \quad y_{min} = -7$

Question

If $y = A \sin\theta + B \cos\theta$ then find maximum value of y.

$y = \sqrt{A^2 + B^2}$ Ans

Question

If $y = \sin\theta + 2\cos\theta$ then find maximum value of y.

Soln $\quad y = \sin\theta + 2\cos\theta$

$$y_{max} = \sqrt{1^2 + 2^2}$$

$$= \sqrt{5}$$

$$y = \frac{4}{3\sin\theta + 2\cos\theta}$$

H/W

find minimum value of 'y'.

$$y_{min} = \frac{4}{(3\sin\theta + 2\cos\theta)_{max}}$$

Question

Current in A/C circuit is $I_1 = I_0 \sin(\omega t - 30°)$ and voltage across it $V = V_0 \cos(\omega t)$

Find phase difference?

$\pi/6$

Do it right now

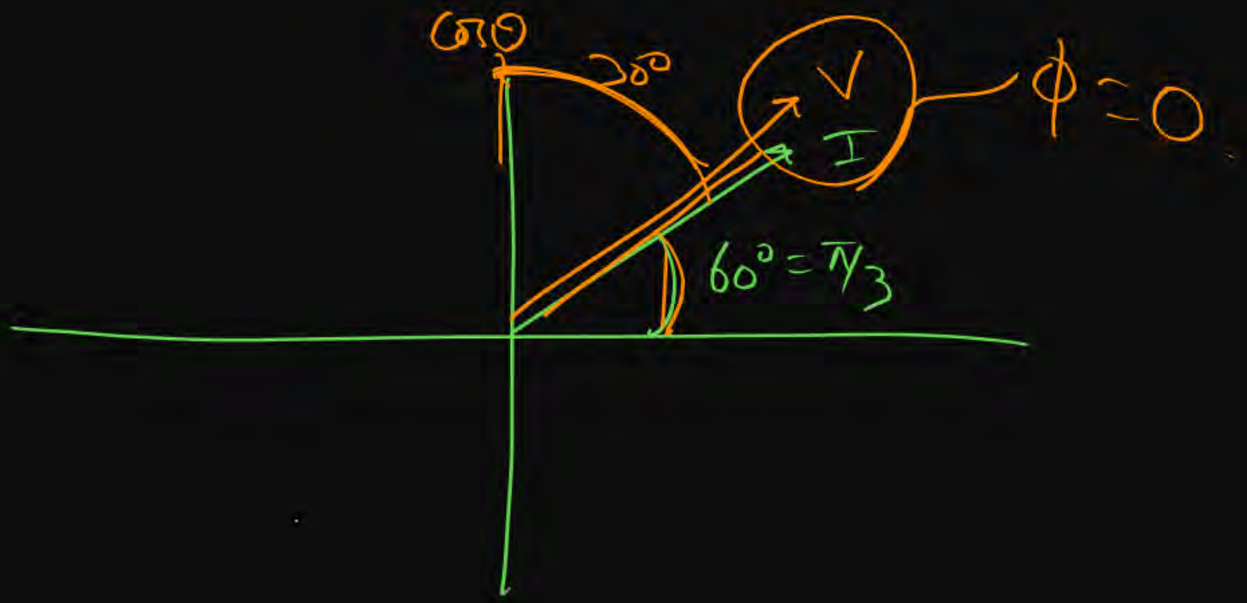
1. Equation of current and voltage

$I = 10 \sin\left(\theta + \frac{\pi}{3}\right)$ and $V = 10 \cos\left(\theta - \frac{\pi}{6}\right)$

$\frac{\pi}{3} = 60°$; $\frac{\pi}{6} = 30°$

then phase difference between current and voltage.

A/c chapter



$\phi = ??$

(a) zero

(b) $\pi/2$

(c) $\pi/6$

(d) $\pi/3$

Question π/ω

If $y_1 = 2 \sin(5\pi t)$ and $y_2 = 2 \cos(5\pi t - \pi/3)$, what is the phase difference between the two waveforms?

Question

H/W

If $y_1 = 4 \sin(\omega t - \pi/6)$ and $y_2 = 4 \sin(\omega t + \pi/6)$, what is the phase difference between the two waveforms?

1. $\pi/6$
2. $\pi/3$
3. $\pi/2$
4. 3π

Question H/W

Two waves are represented by the equations $y_1 = 4 \sin(3t)$ and $y_2 = 4 \sin(3t + \pi/2)$. Determine the phase difference between the two waves.

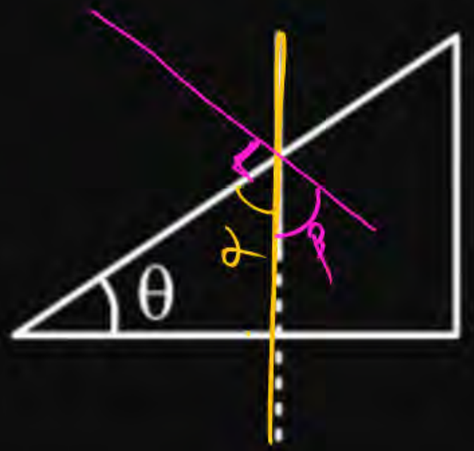
Question

H/W

The equation of two waves are given as $y_1 = 3 \sin(4\pi t)$ and $y_2 = 3 \cos(4\pi t + \pi/3)$. Determine the phase difference between the two waves.

More Concept of Trigonometry required in physics

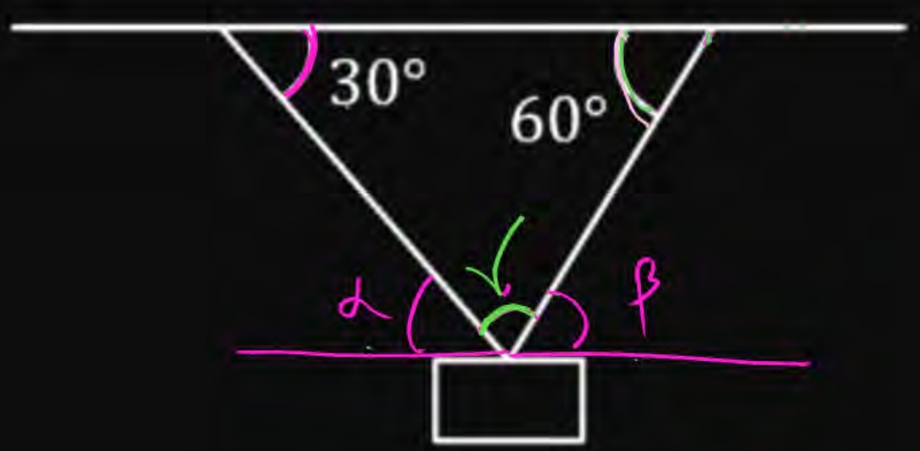
H/W

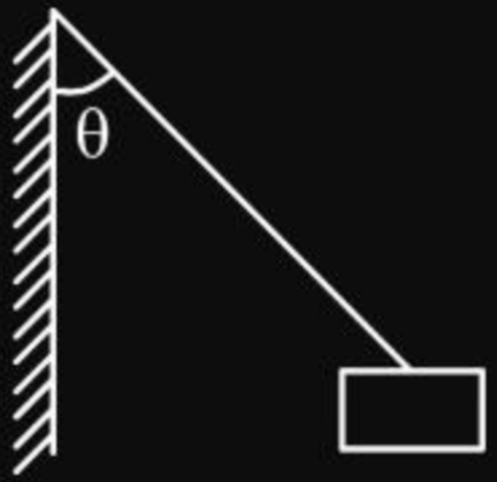


find $\alpha = ??$

$\beta = ?$

find α, β & γ =?




θ

A/P series :— Sequence of number where the difference between any two consecutive number is constant. → common diffre

1, 2, 3, 4, 5, 6, 7, 8, 9, - - - - ⟶ A/P series ✓

$d = 1$

2, 4, 6, 8, 10, 12, 14 - - - - → A/P

3 5 7 9 12 15 , 17

$d = 2$

d (Common diff^{n}) $= n^{th} - (n-1)^{th}$.

AP → No A/P sere.

✓ 1, 3, 5, 7, 9, 11, 13, 15, 17, ⟶ A/P ✓✓ $d = 2$

Question

Which of the following series is not arithmetic progression.

1. 2, 8, 15, 15, 27, _ _ _ _ _ _ _ _ _

2. 3, 6, 12, 24, _ _ _ _ _ _ _ _ _

3. 4, 1, –2, –5, –8, _ _ _ _ _ _ _ _ _

4. –5, –3, –1, 1, _ _ _ _ _ _ _ _ _

4/3

Question

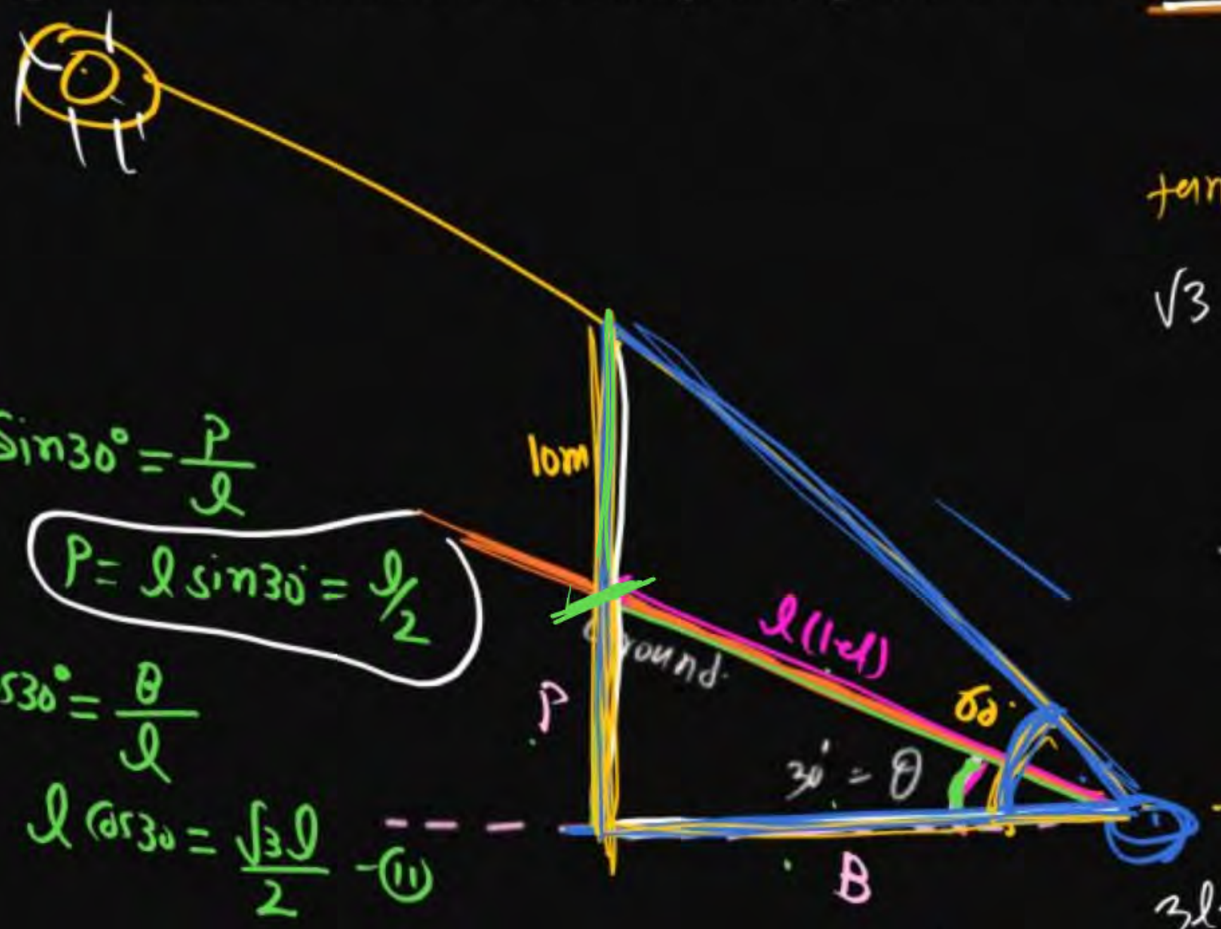
H/W → PhD. on ***

H/W से करना है

A vertical pole of height $h = 10$ m stands on ground that slopes upwards at a constant angle $\alpha = 30°$ with the horizontal. If the sun's angle of elevation above the horizontal is $\theta = 60°$, what is the length of the shadow cast by the pole on the sloping ground?

↳ Inclined Plane

1. 5 m
2. 10 m ✓
3. $10\sqrt{3}$ m
4. $\frac{10}{\sqrt{3}-1}$ m



$\sin 30° = \frac{P}{l}$

$P = l \sin 30° = l/2$

$\cos 30° = \frac{B}{l}$

$B = l \cos 30° = \frac{\sqrt{3}l}{2}$ ---(1)

$\tan 60° = \frac{10+P}{B}$

$\sqrt{3} = \frac{10 + \frac{l}{2}}{\frac{\sqrt{3}l}{2}}$

उपरोक्त Sacho

$\sqrt{3} \times \frac{\sqrt{3}l}{2} = 10 + \frac{l}{2}$

$\frac{3l}{2} = 10 + \frac{l}{2}$

$\frac{3l}{2} - \frac{l}{2} = 10$

$\frac{3l-l}{2} = 10$

$l = 10$

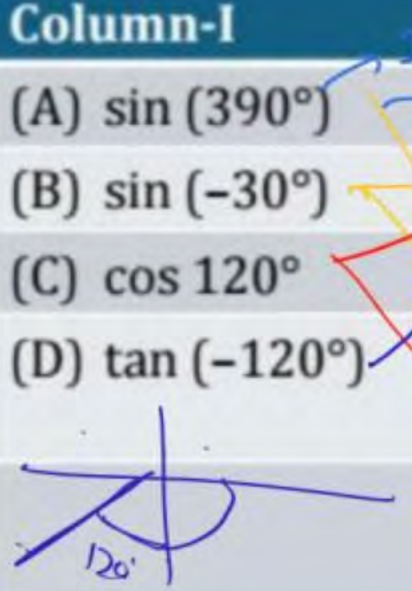
Question challenger Question (H/W)

$\cos(120) = -\frac{\sqrt{3}}{2} = \frac{1.91}{2}$

Suggest suitable match between function given in the first column and its description given in the second column.

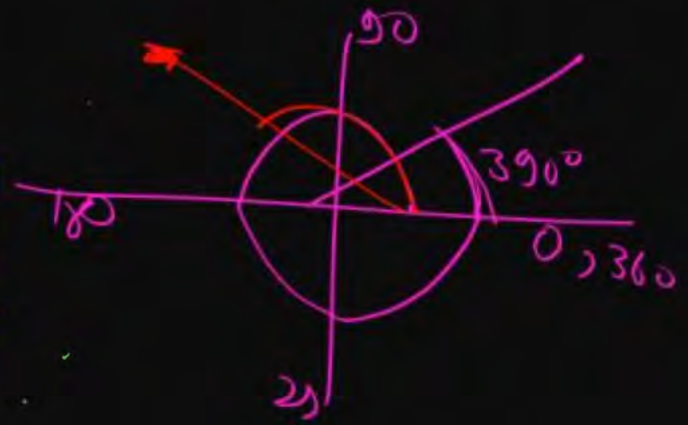
1. A→PT, B→QT, C→QT, D→PS
2. A→PT, B→QS, C→QT, D→PS
3. A→QT, B→QS, C→PT, D→PS
4. A→QS, B→PT, C→QT, D→PS

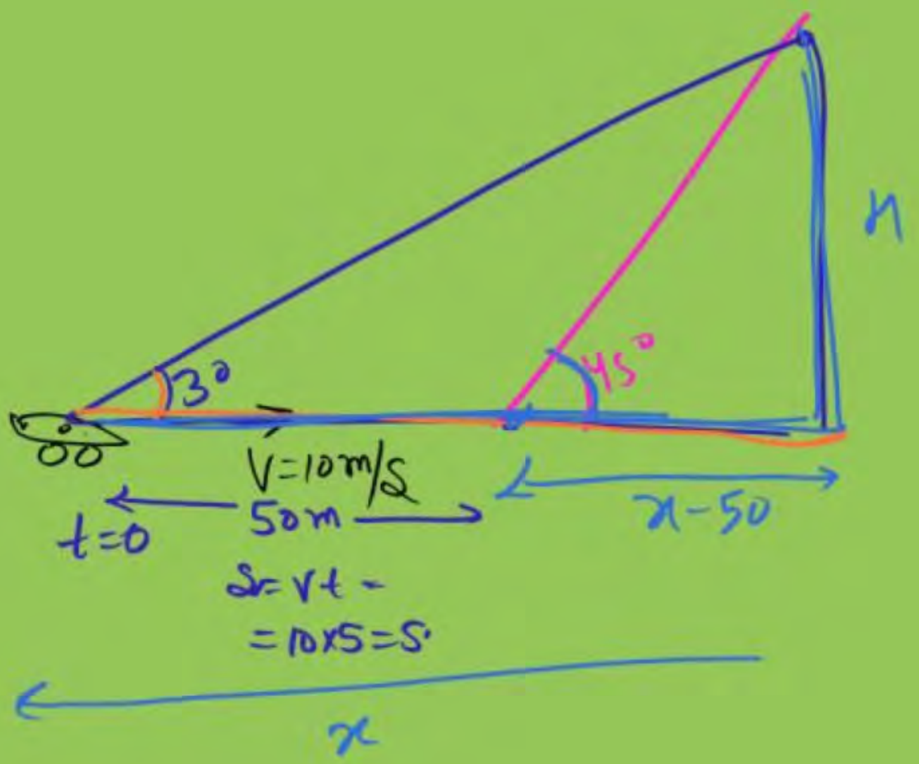
Column-I	Column-II
(A) sin (390°)	(P) Positive
(B) sin (–30°)	(Q) Negative
(C) cos 120°	(R) Zero
(D) tan (–120°)	(S) Modulus is greater than one
	(T) Modulus is less than one



$\sin(390) = \sin(\underbrace{360}_{A} + \underbrace{30}_{B}) = \sin 30 = \frac{1}{2}$

$\sin(-30) = -\frac{1}{2}$





$\tan 30 = \frac{H}{x}$

$\frac{1}{\sqrt{3}} = \frac{H}{x}$ — (1)

$x = \sqrt{3}H$

$\tan 45 = \frac{H}{x-50} = 1$

$H = x - 50$

$H = \sqrt{3}H - 50$

$50 = \sqrt{3}H - H$

$50 = H(\sqrt{3}-1)$ $\quad H = \frac{50}{\sqrt{3}-1}$

$\tan 3^\circ = 3^\circ \times^{\times}$

$\tan(3^\circ) = 3^\circ = 3\left(\frac{\pi \text{ rad}}{180}\right)$ corr.

$(\tan 3^\circ) \neq (\sin 3^\circ)$ correct

b/c As

Question

Find value:

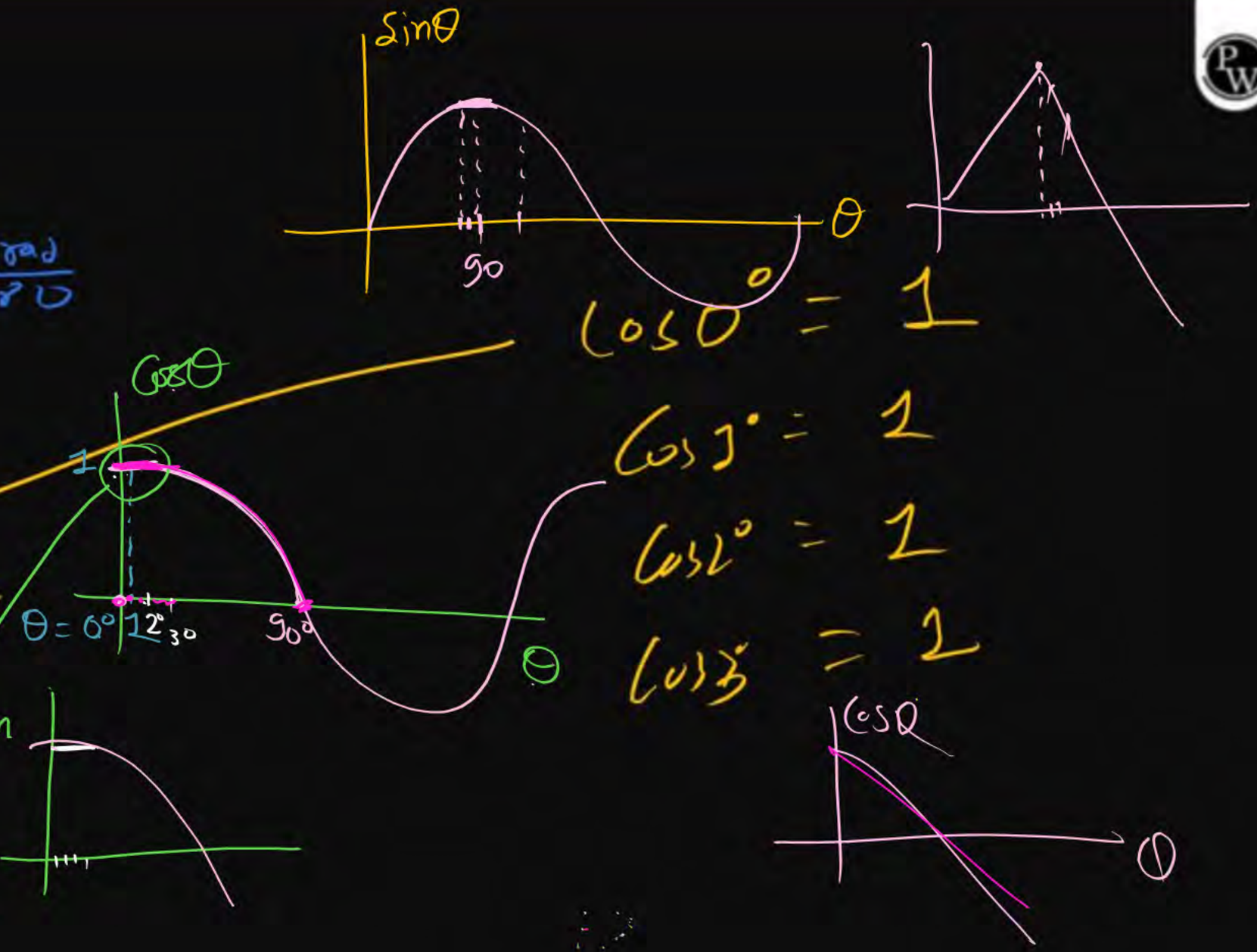
(i) $\sin 2° = 2° \times = 2 \times \frac{\pi \text{ rad}}{180}$

(ii) $\tan 3° = 3\left(\frac{\pi \text{ rad}}{180}\right)$

(iii) $\cos 3° = 1$

(iv) $\sin(88.5°) \simeq 1$

All Ans



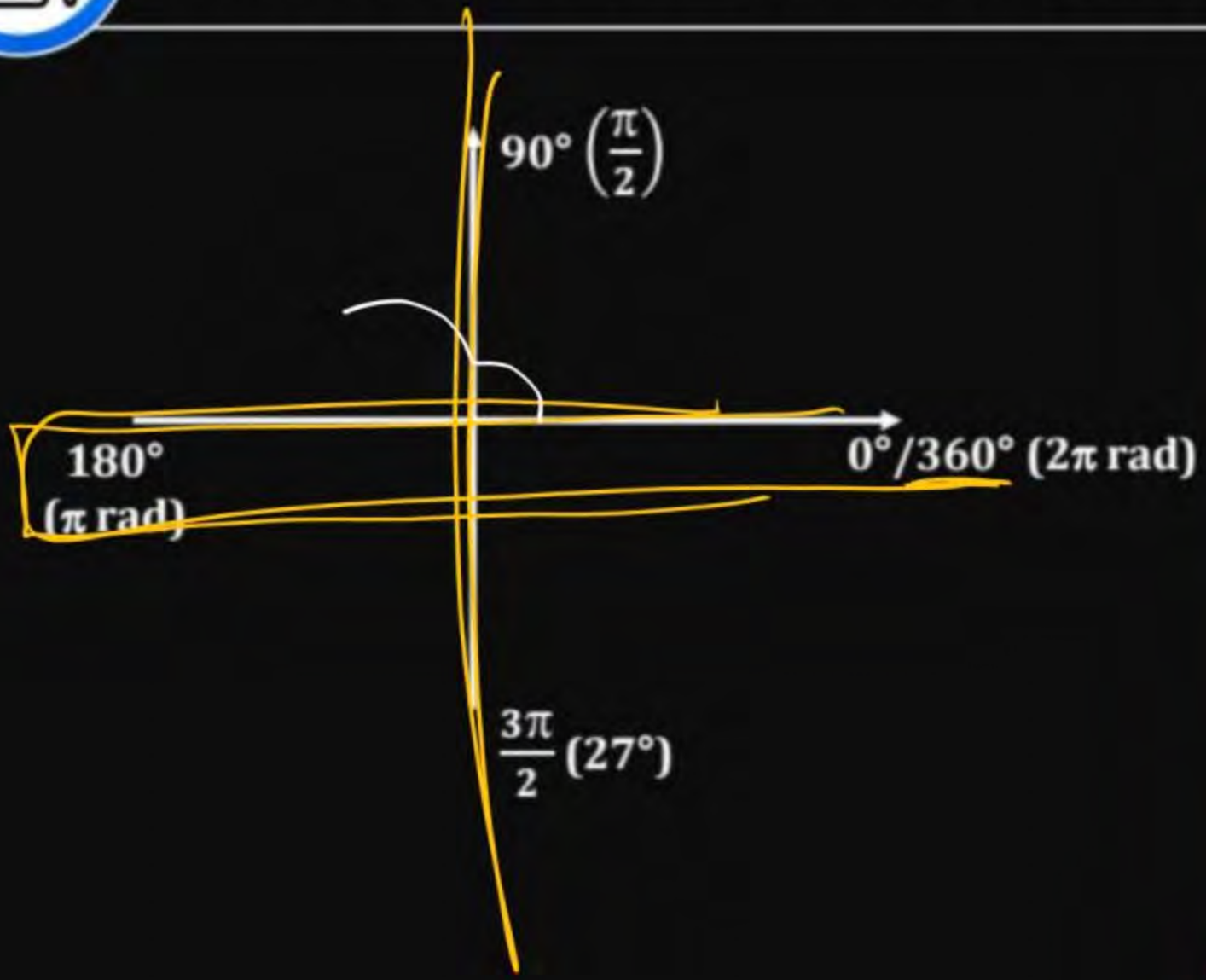
$\cos 0° = 1$

$\cos 1° = 1$

$\cos 2° = 1$

$\cos 3° = 1$

TRIGONOMETRY FUNCTION CHARGE



H/W

$\sin(90° - \theta) = + \cos\theta$

$\cos(90° - \theta) = + \sin\theta$

$\sin(90° + \theta) = + \cos\theta$

$\cos(90° + \theta) = - \sin\theta$

$\sin(180° - \theta) = \sin\theta$

$\cos(180° - \theta) = - \cos\theta$

Question 11/w

Find value of

(i) $\sin(-30°) = -\frac{1}{2}$

(ii) $\cos(-60°) = +\frac{1}{2}$

(iii) $\sin(120°) = \sqrt{3}/2$

(iv) $\sin(390°) = \sin(\underset{A}{360} + \underset{\theta}{30}) = \sin 30$ ✓

H/W

$\sin(360°) = 0$

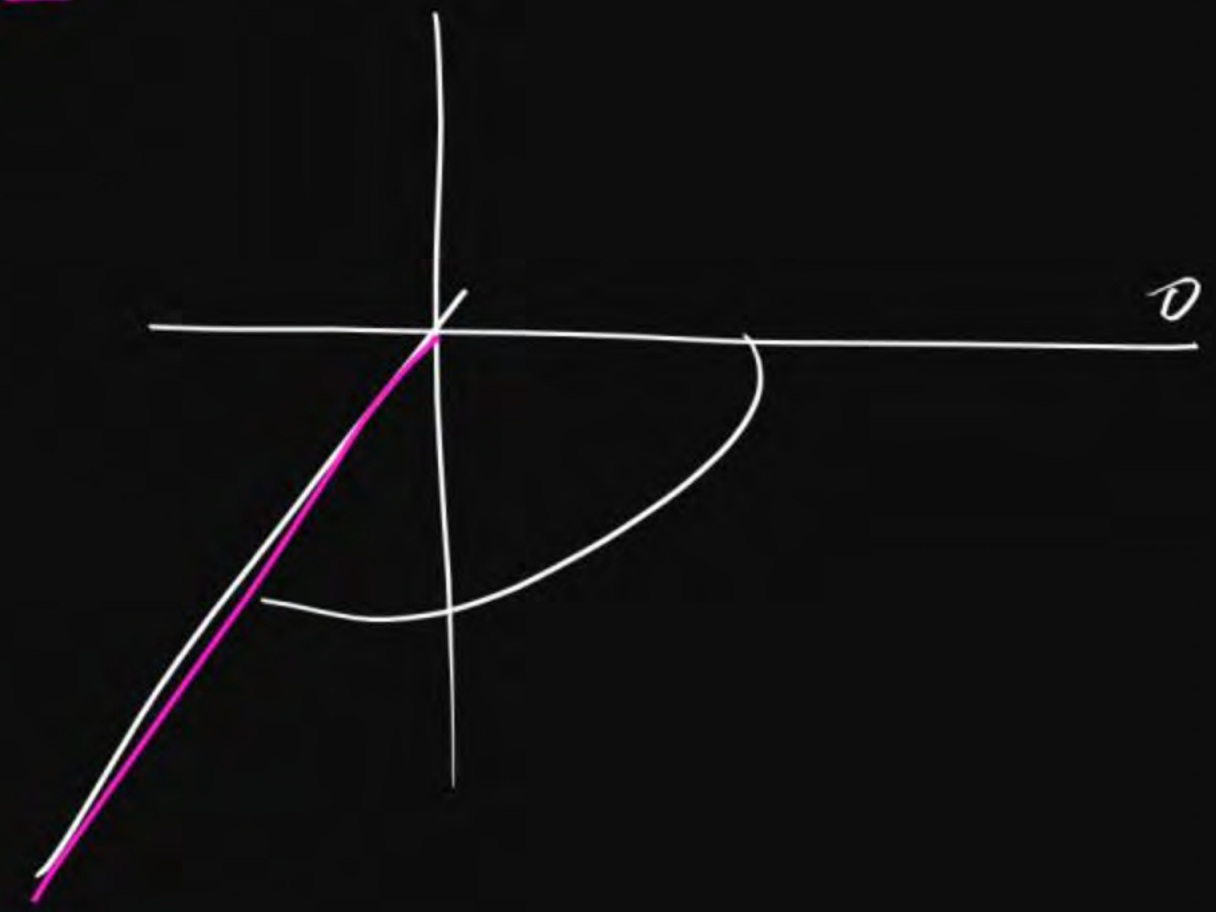
✓ $\sin(450°) = \sin(360 + 90) = \sin 90° = 1$

$\sin(-90°) = -1$

$\sin(120°) = \sqrt{3}/2$

$\sin(-150°) = -\frac{1}{2}$

$\sin(-\theta) = -\sin\theta$



H/W

$\cos(300°) = \cos(360-60) = +\cos 60 = +\frac{1}{2}$

$= \cos 360 \cos 60 + \sin 360 \cdot \sin 60$

$= 1 \cos 60 + 0 = \frac{1}{2}$

$\cos(330°) = \cos(360-30) = \cos 30 = \sqrt{3}/2$

$\tan(240°) = \tan(180+60) = \tan 60 = \sqrt{3}$

$\cos(-30°) = \cos(30) = \sqrt{3}/2$

$\tan(-60°) = -\tan 60 = -\sqrt{3}$

$\cot(-45°) = \frac{1}{\tan(-45)} = \frac{1}{-1} = -1$

Question M/O

If $y = 3\cos(3\theta)$, then find angle at which y will be zero.

$y = 3\cos(3\theta)$

$3\theta = 90$

$\theta = \frac{90}{3} = 30°$ ✓

THANK YOU