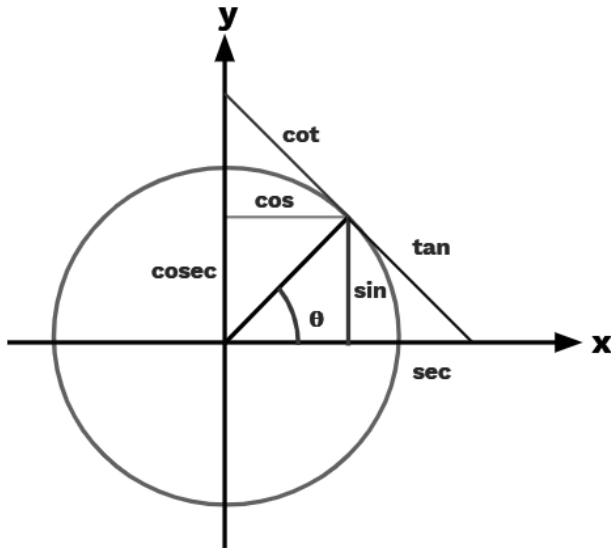


Trigonometric Equations

4

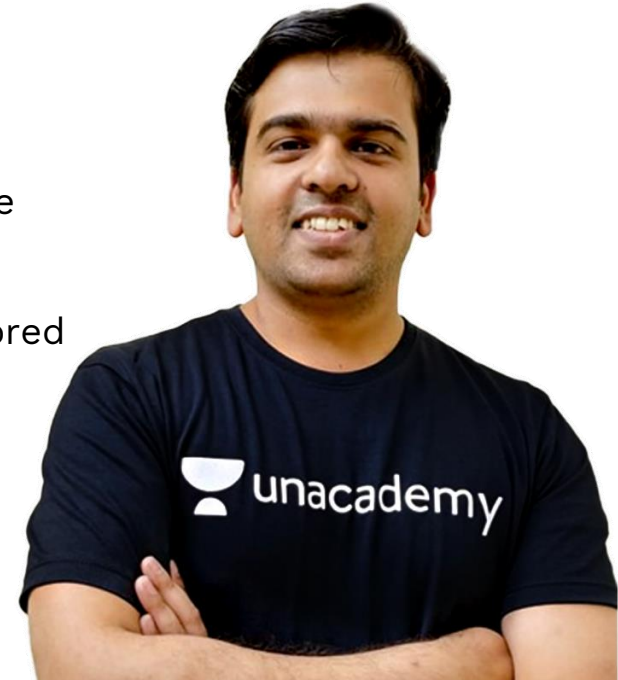


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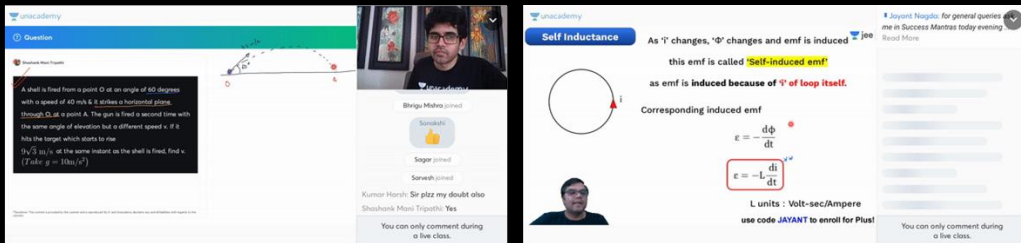
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Questions

A shell is fired from a point O at an angle of 60 degrees with a speed of 40 m/s. It strikes a horizontal plane through O at a point A. The gun is fired a second time with the same angle of elevation but a different speed v . If it hits the target which starts to rise $(\sqrt{3}/2) \sin t$ at the same instant as the shell is fired, find v . (Take $g = 10 \text{ m/s}^2$)

Shreyas Mishra joined

Sagar joined

Saravali joined

Kumar Harsh: Sir plz my doubt also

Shashank Masi Tripathi: Yes

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Self Inductance

As \vec{I} changes, $\vec{\Phi}$ changes and emf is induced

this emf is called **Self-induced emf**

as emf is induced because of \vec{I} of loop itself.

Corresponding induced emf

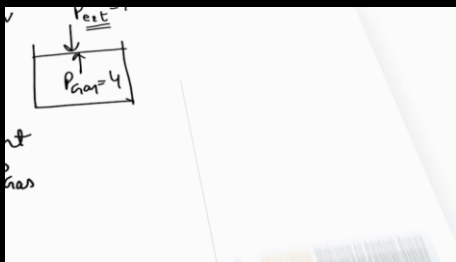
$$\mathcal{E} = -\frac{d\Phi}{dt}$$

$$\mathcal{E} = -L \frac{dI}{dt}$$

L units: Volt-sec/Ampere

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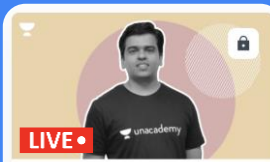


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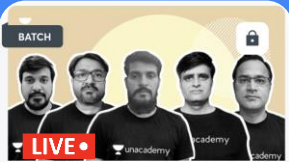
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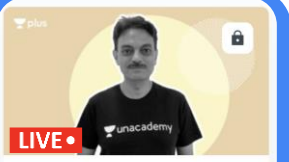
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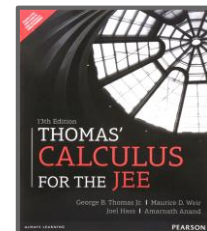
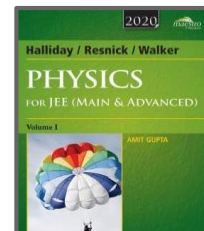
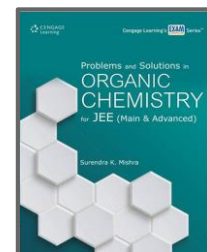
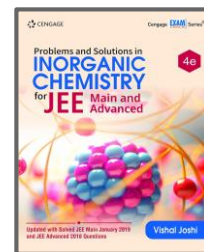
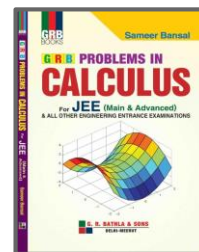
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LET'S BEGIN!!

Homework Question





Solve : $\underbrace{3\cos x + 3\sin x} + \underline{\underline{\sin 3x}} - \underline{\underline{\cos 3x}} = 0$

$$3(\sin x + \cos x) + (3\sin x - 4\sin^3 x) - (4\cos^3 x - 3\cos x) = 0$$

$$\Rightarrow 6(\sin x + \cos x) - 4(\sin^3 x + \cos^3 x) = 0$$

$$\Rightarrow 6(\underbrace{\sin x + \cos x}) - 4\left(\underbrace{(\sin x + \cos x)^3} - \overbrace{3(\sin x)(\cos x)}^{(\sin x + \cos x)}\right) = 0$$

$$a^3 + b^3 = \underline{\underline{(a+b)^3}} - 3\underline{\underline{ab}}(\underline{\underline{a+b}})$$

Now. $\begin{cases} \boxed{\sin x + \cos x = t} \\ 1 + 2 \sin x \cos x = t^2 \\ \sin x \cos x = \left(\frac{t^2 - 1}{2}\right) \end{cases}$

$$\Rightarrow 6t - 4\left(t^3 - 3\left(\frac{t^2 - 1}{2}\right)(t)\right) = 0$$

$$6t - 4t^3 + 6t(t^2 - 1) = 0$$

$$\cancel{6t} - 4t^3 + 6t^3 - \cancel{6t} = 0$$

$$2t^3 = 0$$

$$\Rightarrow \boxed{t = 0}$$

$$\Rightarrow \sin x + \cos x = 0$$

$$\sin x = -\cos x$$


$$\tan x = -1$$


$$x = n\pi - \frac{\pi}{4}$$

$$n \in \mathbb{I}$$



7. Use of limited range of $\sin x$ and $\cos x$


$$[-1, 1]$$


$$[-1, 1]$$

Eg:

$$\underbrace{\sin x + \cos x}_{\rightarrow [-\sqrt{2}, \sqrt{2}]} = 2$$



If $x, y \in [0, 2\pi]$, then total number of ordered pairs (x, y) satisfying the equation, $\sin x \cdot \cos y = 1$, is equal to:

A. 1

✓ B. 3

C. 5

D. 7

$$\sin x \cdot \cos y = 1$$

Case-1: $\sin x = 1$ & $\cos y = 1$

$$x = (4n+1)\frac{\pi}{2}$$

$$x = \pi/2$$

$$y = 2m\pi$$

$$y = 0, 2\pi$$

Case-2:

$$\sin x = -1 \text{ \& \& } \cos y = -1$$

$$x = (4n-1)\frac{\pi}{2}$$

$$x = 3\pi/2$$

$$y = (2n+1)\pi$$

$$y = \pi$$

$$\left\{ \begin{array}{l} \left(\frac{\pi}{2}, 0 \right) \\ \left(\frac{\pi}{2}, 2\pi \right) \\ \left(\frac{3\pi}{2}, \pi \right) \end{array} \right.$$



Solve: $\sin 3x + \cos 2x = -2$

- A. $(4n - 1) \pi/2$ ✓ B. $(4n + 1) \pi/2$
C. $(2n - 1) \pi/2$ D. None of these

$$\sin 3x + \cos 2x = -2$$

$$\sin 3x = -1 \quad \& \quad \cos 2x = -1$$

$$3x = (4n - 1) \frac{\pi}{2} \quad \& \quad 2x = (2n + 1) \pi$$

$$x = \frac{(4n - 1)\pi}{6} \quad \& \quad x = \frac{(2n + 1)\pi}{2}$$

$$\cap$$

(Common values)

$$\left\{ x = (4n-1) \frac{\pi}{6} \right.$$

$$\left\{ -\frac{\pi}{6}, \frac{3\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}, \frac{15\pi}{6}, \dots, \frac{27\pi}{6} \right.$$

$$\frac{\pi}{2}$$

$$\frac{5\pi}{2}$$

$$\frac{9\pi}{2}$$

$$\left\{ x = (2n+1) \frac{\pi}{2} \right.$$

$$\frac{\pi}{2}$$

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

$$\frac{5\pi}{2}$$

$$\frac{7\pi}{2}$$

$$\frac{9\pi}{2}$$

Ans: $\frac{\pi}{2}, \frac{5\pi}{2}, \frac{9\pi}{2} \dots$

1, 5, 9, ...

$$a=5; d=4 \Rightarrow T_n = 5 + (n-1)4$$

$$= (4n+1)$$

$(4n-3)\frac{\pi}{2}$

is also correct

$(4(n+1)-3)\frac{\pi}{2}$



The general solution of the equation, $\cos x \cos 6x = -1$ is

✓ **A.** $x = (2n + 1)\pi, n \in \mathbb{I}$

B. $x = 2n\pi, n \in \mathbb{I}$

✓ **C.** $x = (2n - 1)\pi, n \in \mathbb{I}$

D. None of these

$$\cos x \cos 6x = -1$$

Case-1 : $\cos x = 1$ & $\cos 6x = -1$

$x = 2n\pi$ & $6x = (2n+1)\pi$

(no common values)

$x = (2n+1)\frac{\pi}{6}$

Case-2: $\cos x = -1$ & $\cos 6x = 1$

$$\boxed{x = (2n+1)\pi} \quad \& \quad 6x = 2n\pi$$

$$\boxed{x = \frac{n\pi}{3}}$$

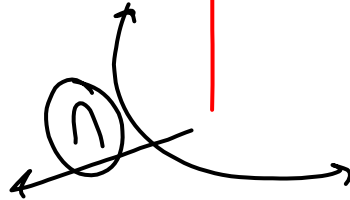
$$x = \pi, 3\pi, 5\pi, \dots$$

$$x = 0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi$$

$$\frac{4\pi}{3}, \frac{5\pi}{6}, 2\pi$$

$$\frac{2\pi}{3}, \frac{8\pi}{3}, 3\pi$$

$$\boxed{(2n+1)\pi}$$





8. Use of limited range trigonometric expressions

$$\underbrace{a \cos x \pm b \sin x}_{\downarrow}$$
$$\left[-\sqrt{a^2 + b^2}, \sqrt{a^2 + b^2} \right]$$



The value of 'a' for which of the equation, $a^2 - 2a + \sec^2 \pi (a + x) = 0$ has solution is :

A.

1

B.

2

C.

0 or 1

D.

1 or 2

$$\Rightarrow \underbrace{a^2 - 2a + 1}_{(a-1)^2} - 1 + \sec^2 \pi (a+x) = 0$$

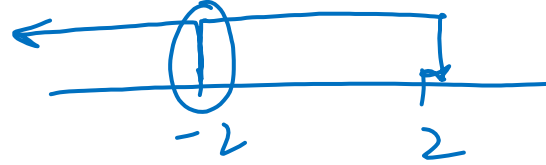
$$\Rightarrow \underbrace{(a-1)^2}_{=0} + \underbrace{\tan^2 \pi (a+x)}_{=0} = 0$$

$$\Rightarrow a = 1$$

$$\Rightarrow \tan^2 \pi x = 0$$



$\sin \theta + \sqrt{3} \cos \theta = \underline{6x - x^2 - 11}$; $\underline{0 \leq \theta \leq 4\pi}$, $x \in \mathbb{R}$, holds for



- ~~A.~~ No value of x and θ
- ☒ B. Two pairs of values of (x, θ)
- ~~C.~~ Two values of x and two values of θ
- ~~D.~~ One values of x and one values of θ

$$\begin{aligned} \underbrace{\sin \theta + \sqrt{3} \cos \theta}_{\downarrow [-2, 2]} &= -(x^2 - 6x + 11) \\ &= -(x^2 - 6x + 9 + 2) \\ &= -((x-3)^2 + 2) \\ &= -(x-3)^2 - 2 \end{aligned}$$

$$LNS = [-2, 2]$$

$$RNS = (-\infty, -2]$$

only possibility is

$$\left\{ \begin{array}{l} LNS = -2 \\ \& RNS = -2 \end{array} \right.$$

$$\underline{\text{For}} \ RNS = -2$$

$$-(x-3)^2 - 2 = -2$$

$$\Rightarrow \boxed{x=3}$$

$$\underline{\text{For}} \ LNS = -2$$

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

$$\frac{1}{2} \sin \theta + \frac{\sqrt{3}}{2} \cos \theta = -1$$

$$\cos\left(\theta - \frac{\pi}{6}\right) = -1$$

$$\theta - \frac{\pi}{6} = (2n+1)\pi$$

$$\boxed{\theta = (2n+1)\pi + \frac{\pi}{6}}$$

$$\text{for } \theta \in [0, 4\pi]$$

$$\theta = \left(\pi + \frac{\pi}{6}\right); \left(3\pi + \frac{\pi}{6}\right)$$



If x and y are the solutions of the equation, $12 \sin x + 5 \cos x = 2y^2 - 8y + 21$.

Then find the value of $\frac{24}{5} \cot\left(\frac{xy}{2}\right)$

For solⁿ:

$$RHS = 13 \Rightarrow \boxed{y=2}$$

$$LHS = 13$$

$$12 \sin x + 5 \cos x = 13$$

$$\left(\frac{12}{13}\right) \sin x + \left(\frac{5}{13}\right) \cos x = 1$$

$$\underbrace{\hspace{10em}}_{[-13, 13]} \quad \underbrace{\hspace{10em}}_{[13, \infty)}$$

$$2(y^2 - 4y) + 21$$

$$2((y-2)^2 - 4) + 21$$

$$2(y-2)^2 - 8 + 21$$

$$\boxed{2(y-2)^2 + 13}$$

$$[13, \infty)$$

$$\left(\frac{12}{13}\right) \sin x + \left(\frac{5}{13}\right) \cos x = 1$$

\downarrow
 $\sin \alpha$

\downarrow
 $\cos \alpha$

$$\cos(x - \alpha) = 1$$

$$\Rightarrow x - \alpha = 2n\pi$$

$$\boxed{x = 2n\pi + \alpha}$$

Now:

$$\frac{24}{5} \cos\left(\frac{x}{2}\right)$$

$$\frac{24}{5} \cos\left(\frac{(2n\pi + \alpha)}{2}\right)$$

$\frac{24}{5} \cos \alpha$

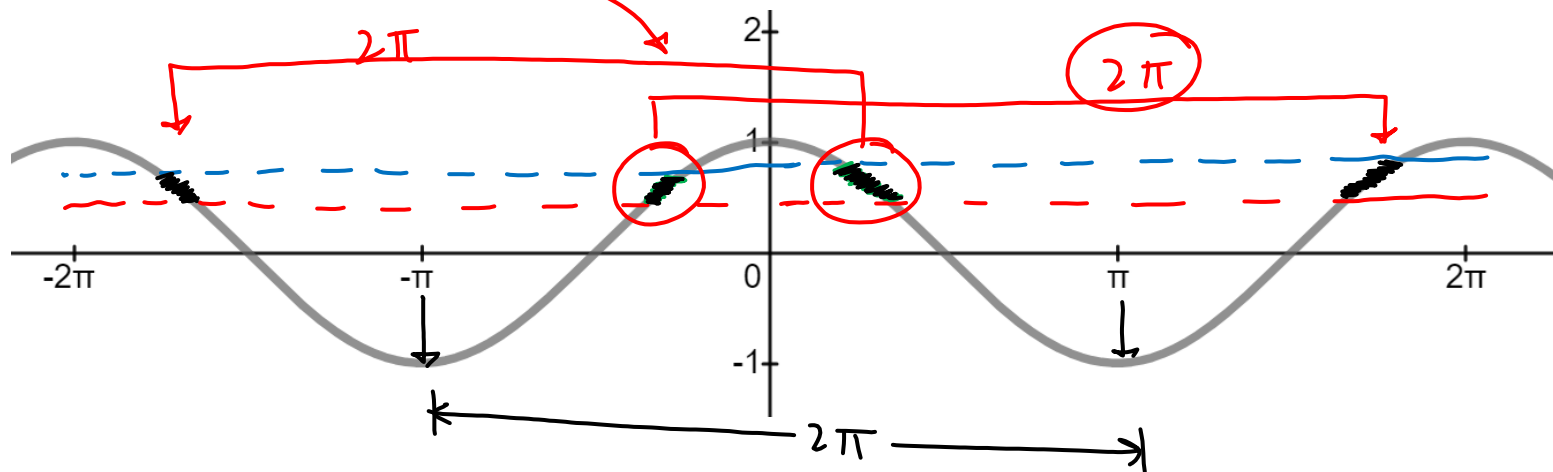
$\rightarrow \frac{5}{12}$

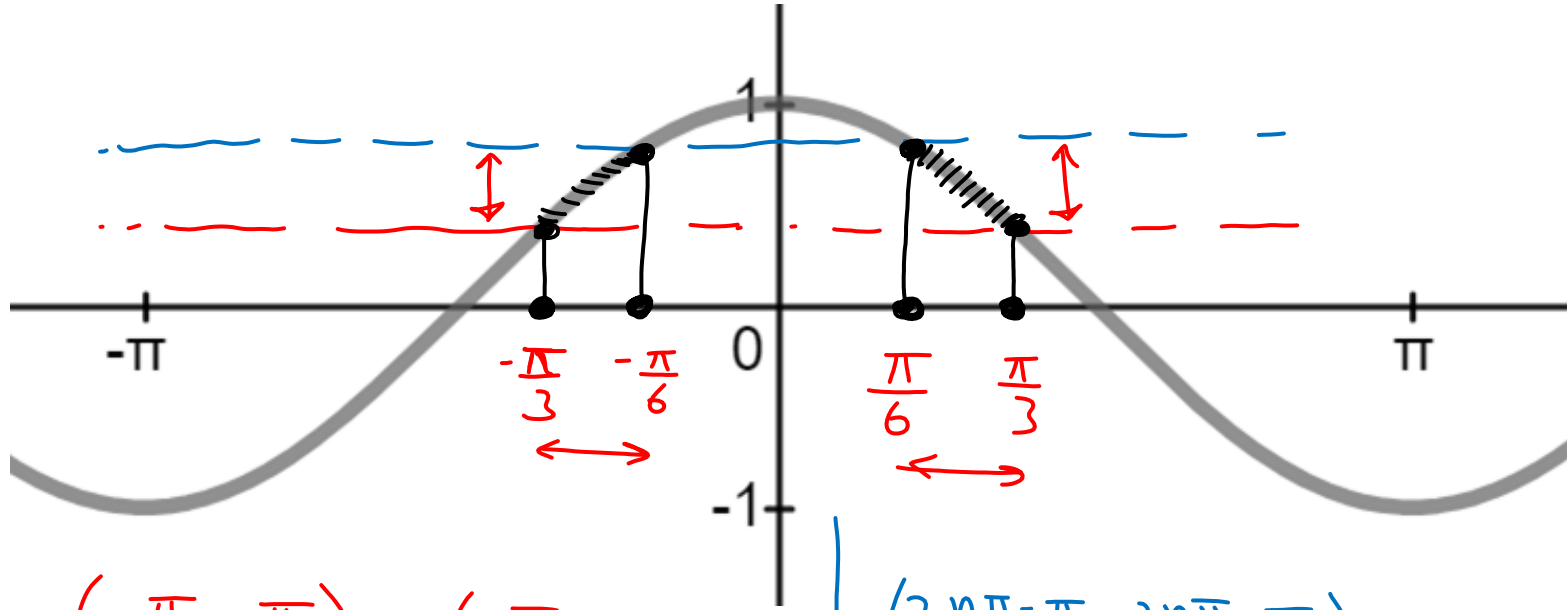
Trigonometric Inequalities





Solve for x : $1/2 < \cos x < \sqrt{3}/2$.





$$\left(-\frac{\pi}{3}, -\frac{\pi}{6}\right) \cup \left(\frac{\pi}{6}, \frac{\pi}{3}\right)$$

$$\left(2n\pi - \frac{\pi}{3}, 2n\pi - \frac{\pi}{6}\right)$$

$$\cup \left(2n\pi + \frac{\pi}{6}, 2n\pi + \frac{\pi}{3}\right)$$



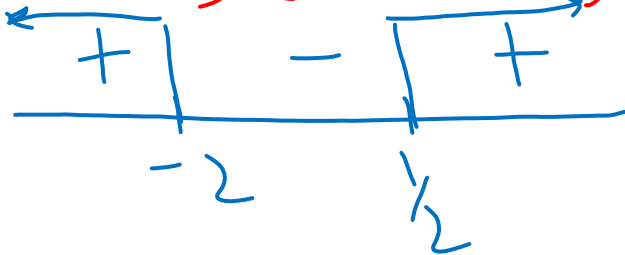
Let $2 \sin^2 x + 3 \sin x - 2 > 0$. Then find the general solution of x .

$$2 \sin^2 x + 3 \sin x - 2 > 0$$

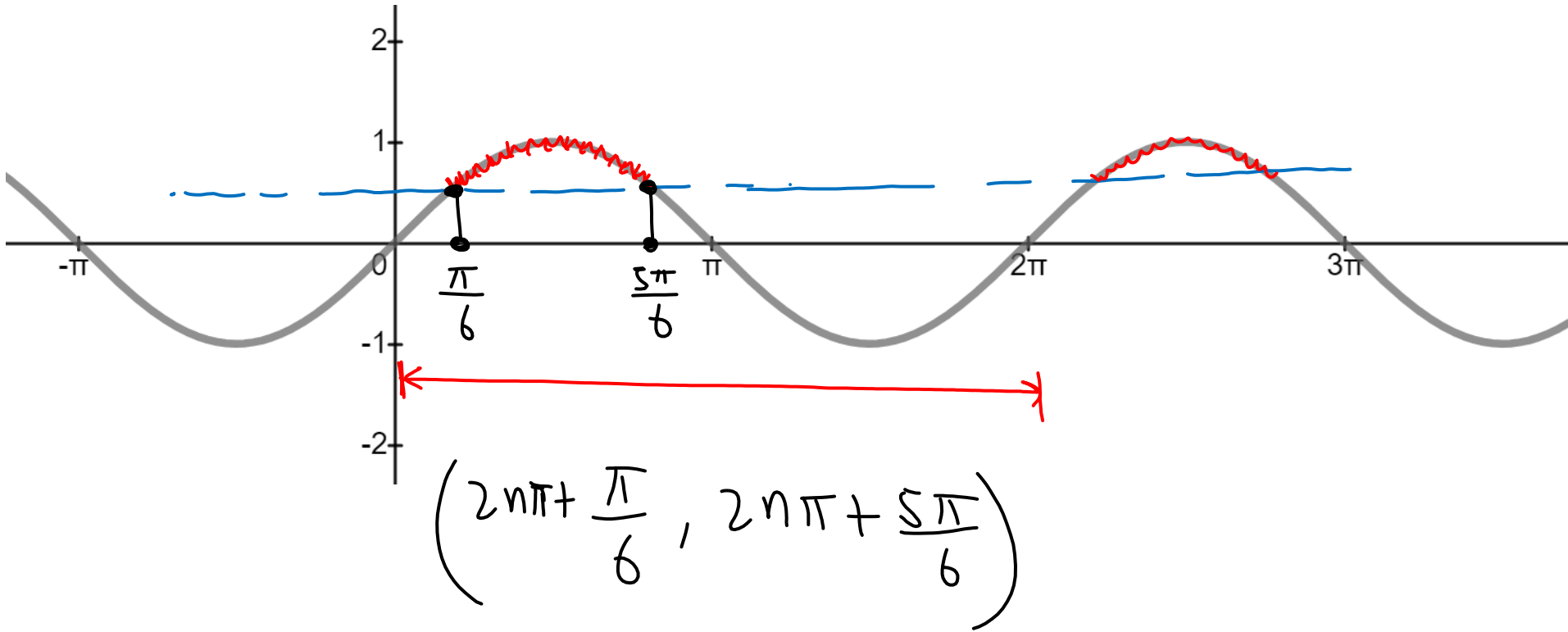
$$\Rightarrow 2 \sin^2 x + 4 \sin x - \sin x - 2 > 0$$

$$\Rightarrow 2 \sin x (\sin x + 2) - 1 (\sin x + 2) > 0$$

$$\Rightarrow (\sin x + 2)(2 \sin x - 1) > 0$$



$$\Rightarrow \boxed{\sin x > \frac{1}{2}}$$





The solution of inequality $\cos 2x \leq \cos x$ is

A. $x \in \left[2n\pi - \frac{\pi}{3}, 2n\pi + \frac{\pi}{3}\right]$ **B.** $x \in \left[2n\pi - \frac{2\pi}{3}, 2n\pi + \frac{2\pi}{3}\right]$

C. $x \in \left[2n\pi, 2n\pi + \frac{2\pi}{3}\right]$ **D.** $x \in \left[2n\pi - \frac{2\pi}{3}, 2n\pi\right]$

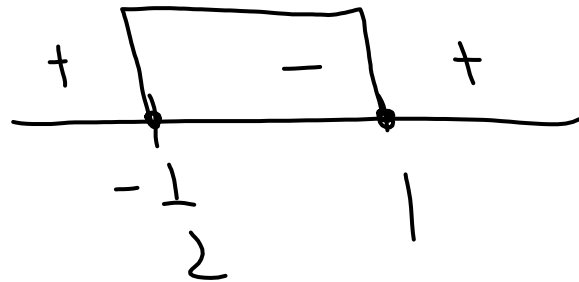
$$\cos 2x \leq \cos x$$

$$2\cos^2 x - 1 \leq \cos x$$

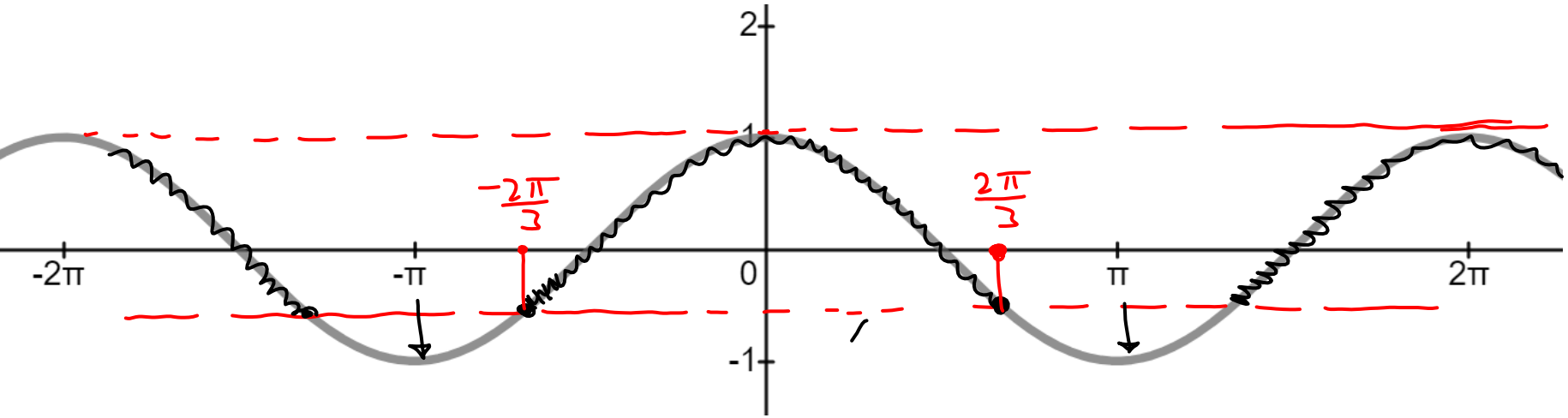
$$2\cos^2 x - \cos x - 1 \leq 0$$

$$2\cos^2 x - 2\cos x + \cos x - 1 \leq 0$$

$$(2\cos x + 1)(\cos x - 1) \leq 0$$



$$-\frac{1}{2} \leq \cos x \leq 1$$





Which of the following set of values of x satisfy the inequation $\tan^2 x - (1 + \sqrt{3}) \tan x + \sqrt{3} < 0$

✓ **A.** $\left(\frac{(4n+1)\pi}{4}, \frac{(3n+1)\pi}{3} \right), (n \in \mathbb{Z})$

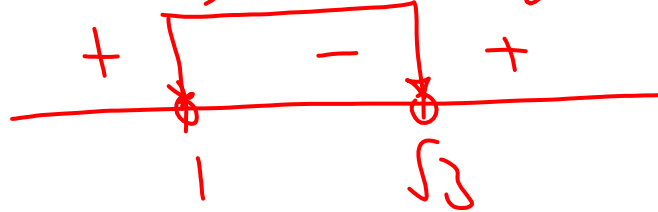
B. $\left(\frac{(2n+1)\pi}{4}, \frac{(2n+1)\pi}{3} \right), (n \in \mathbb{Z})$

C. $\left(\frac{(4n+1)\pi}{4}, \frac{(4n+1)\pi}{3} \right), (n \in \mathbb{Z})$

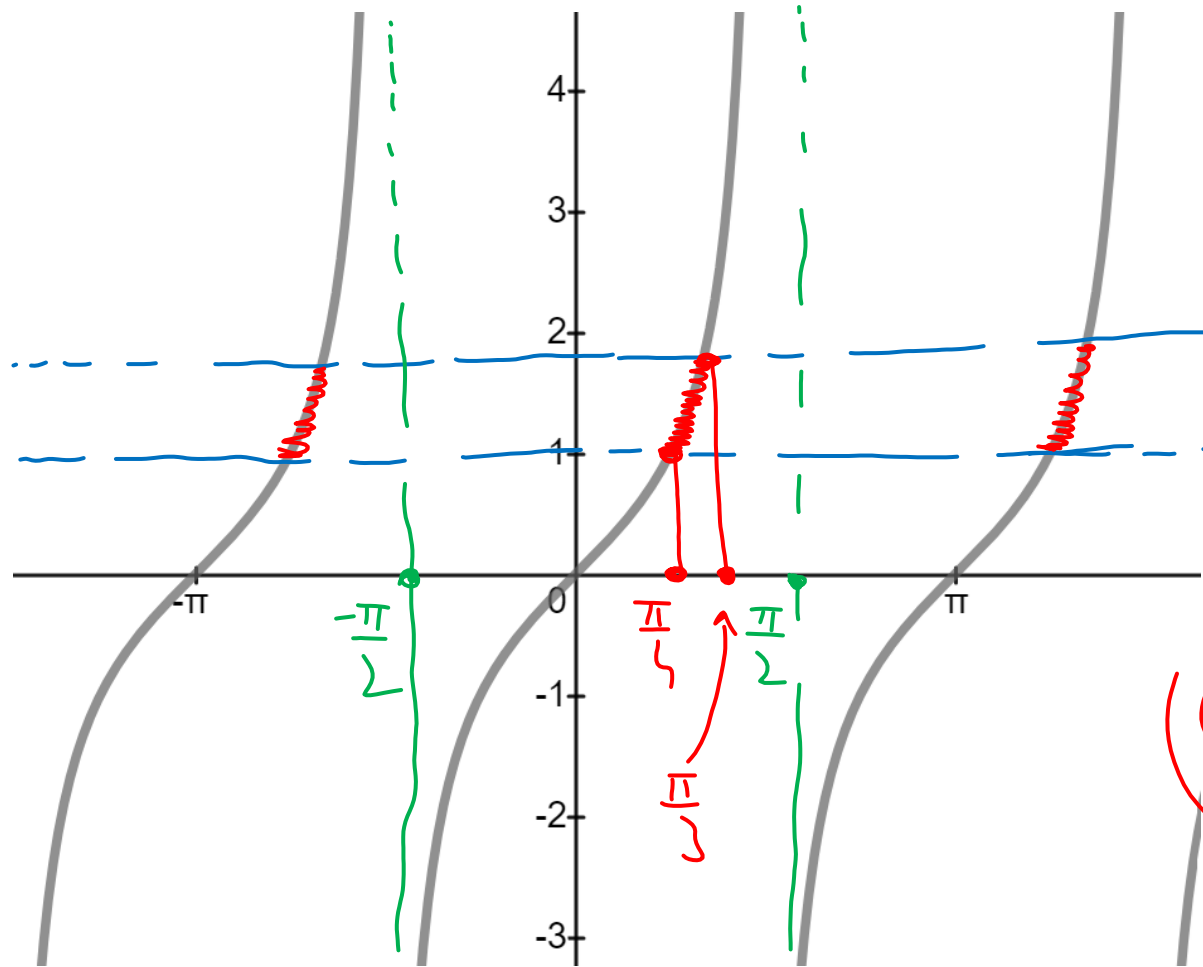
D. $x \in \left(\frac{\pi}{4}, \frac{\pi}{2} \right]$

$$\tan^2 x - \tan x - \sqrt{3} \tan x + \sqrt{3} < 0$$

$$(\tan x - \sqrt{3})(\tan x - 1) < 0$$



$$1 < \tan x < \sqrt{3}$$



$$\left(n\pi + \frac{\pi}{4}, n\pi + \frac{\pi}{3}\right)$$

$$\left((4n+1)\frac{\pi}{4}, (3n+1)\frac{\pi}{3}\right)$$



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1:30 - 3:00 PM



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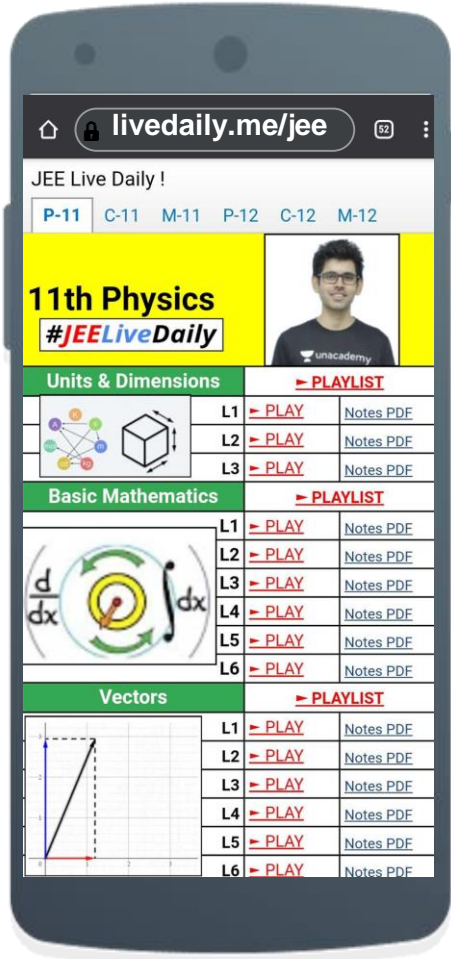
3:00 - 4:30 PM



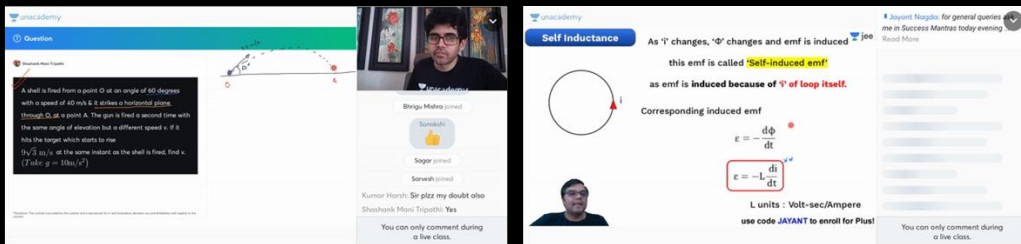
Nishant Sir | Maths

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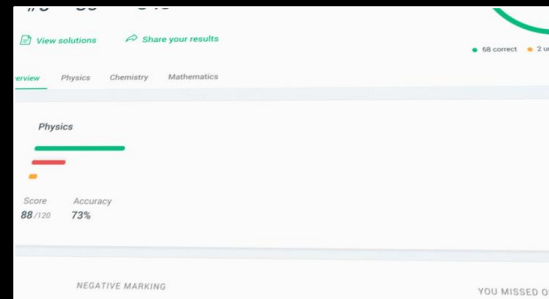
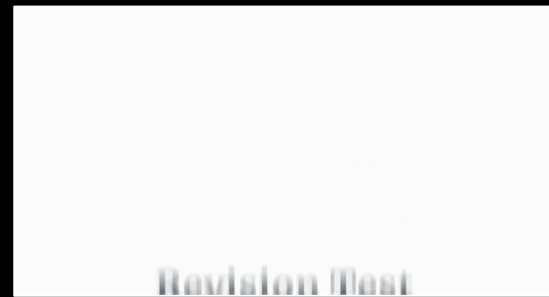


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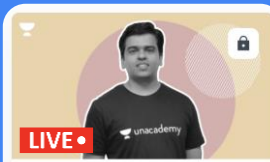


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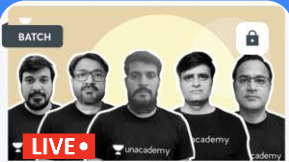
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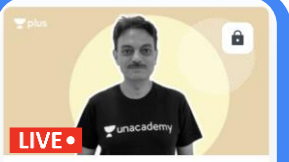
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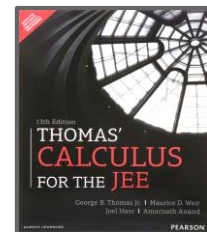
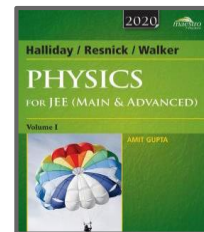
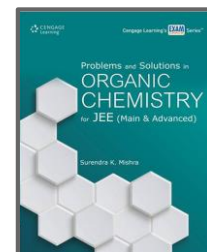
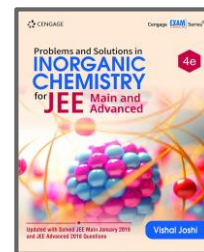
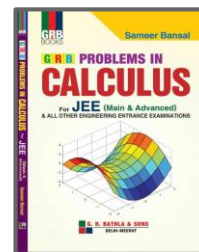
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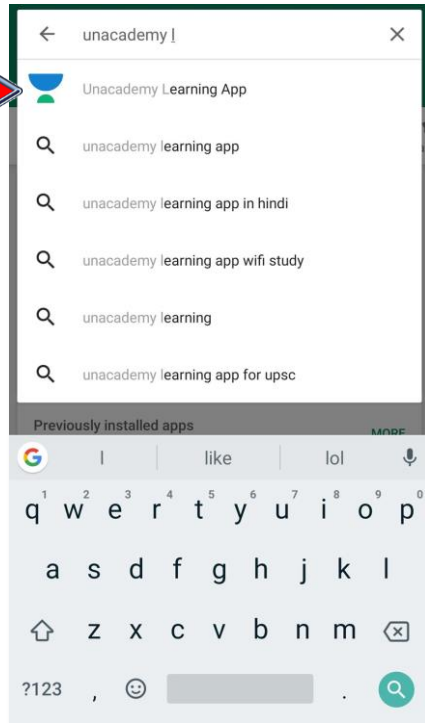


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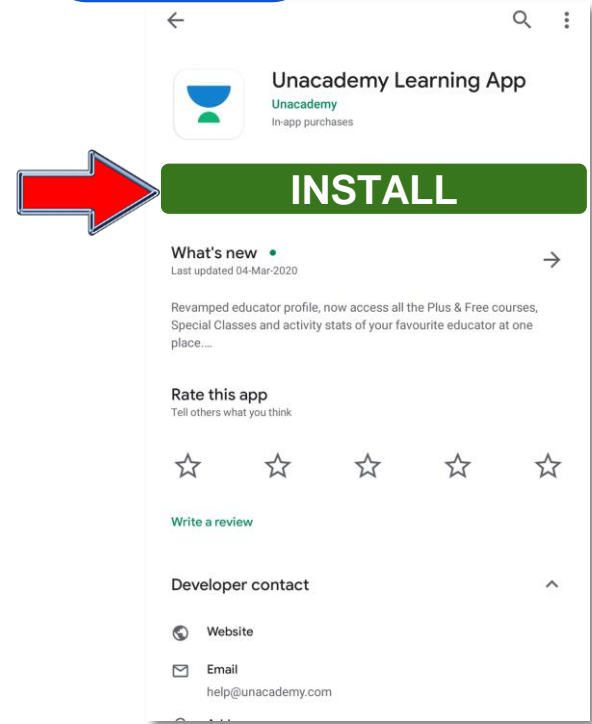


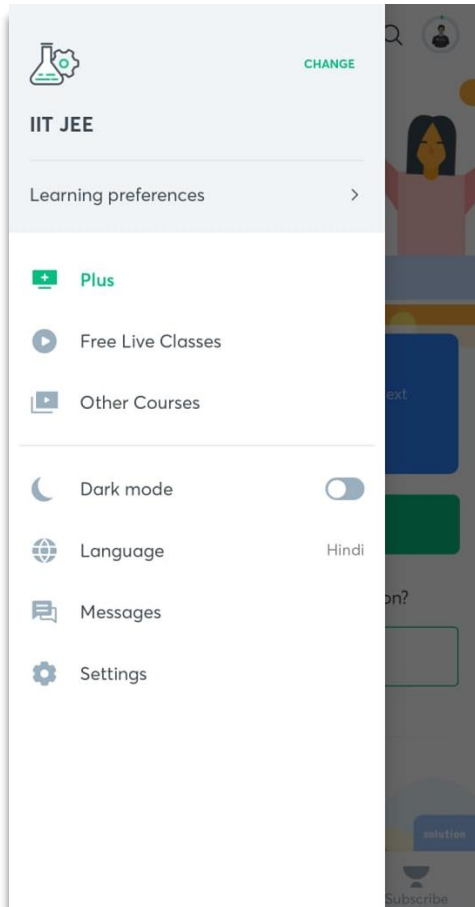
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