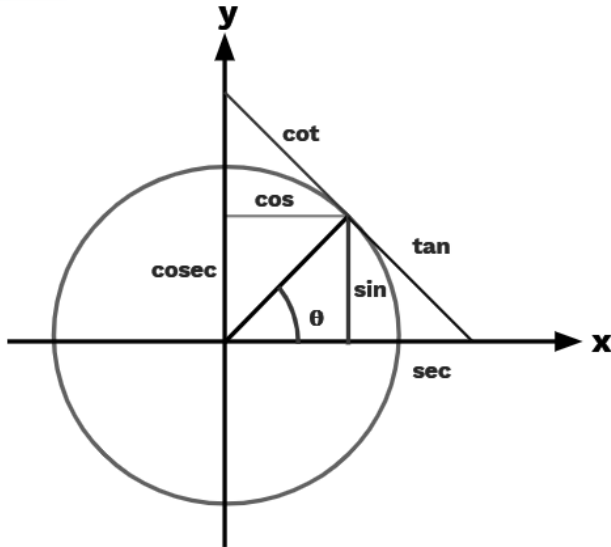


Trigonometric Equations

3



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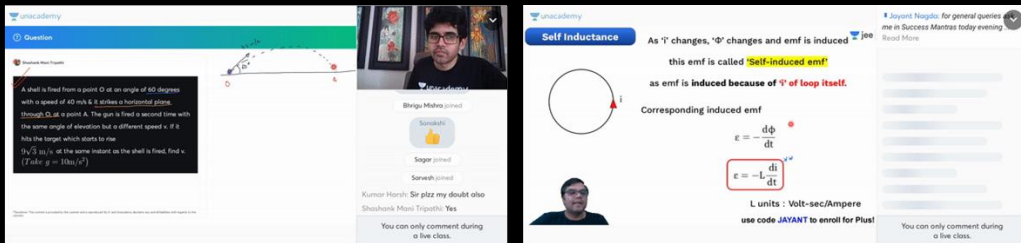
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Question: A shell is fired from a point O at an angle of 60 degrees with a speed of 40 m/s. It strikes a horizontal plane through O at a point A. The gun is fired a second time with the same angle of elevation but a different speed v . If it hits the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

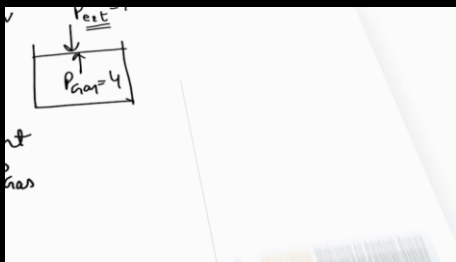
Self Inductance: As Φ changes, \mathcal{E} changes and emf is induced. This emf is called **Self-induced emf** as emf is induced because of Φ of loop itself.

Corresponding induced emf

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

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

Units: Volt-sec/Ampere
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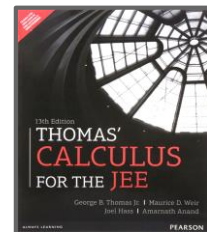
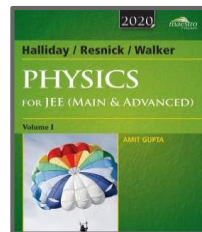
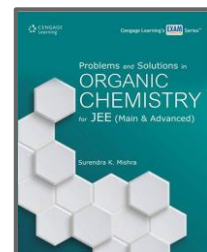
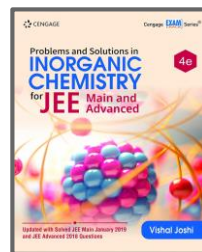
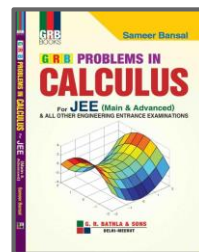
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LET'S BEGIN!!

Homework Question





Solve: $5\sin x + 6\sin 2x + 5\sin 3x + \sin 4x = 0$

$$5(\sin x + \sin 3x) + 6\sin 2x + \sin 4x = 0$$

$$5(2 \sin 2x \cos x) + 6 \sin 2x + 2 \sin 2x \cos 2x = 0$$

$$(2 \sin 2x)(5 \cos x + 3 + \cos 2x) = 0$$

$$(2 \sin 2x)(5 \cos x + 3 + 2\cos^2 x - 1) = 0$$

$$(2 \sin 2x)(2 \cos^2 x + 5 \cos x + 2) = 0$$

$$\Rightarrow (2 \sin 2x)(2 \cos^2 x + 4 \cos x + \cos x + 2) = 0$$

$$\Rightarrow (2 \sin 2x)(2 \cos x (\cos x + 2) + 1 (\cos x + 2)) = 0$$

$$\Rightarrow (2 \sin 2x)(2 \cos x + 1)(\cos x + 2) = 0$$

Case-1: $\sin 2x = 0$

$$2x = n\pi$$

$$\boxed{x = \frac{n\pi}{2}}$$

Case-2: $\cos x = -\frac{1}{2}$

$$\boxed{x = 2n\pi \pm \frac{2\pi}{3}}$$

Case-3: $\cos x = -2$

X Reject



4. Converting product to sum or difference

1

$$\sin(A + B) + \sin(A - B) = \underline{\underline{2 \sin A \cos B}}$$

2

$$\sin(A + B) - \sin(A - B) = 2 \cos A \sin B$$

3

$$\cos(A + B) + \cos(A - B) = 2 \cos A \cos B$$

4

$$\cos(A - B) - \cos(A + B) = 2 \sin A \sin B$$



Solve: $\sin 5x$. $\cos 3x$ = $\sin 6x$. $\cos 2x$

$$2 \sin 5x \cdot \cos 3x = 2 \sin 6x \cos 2x$$

$$\cancel{\sin(8x)} + \sin(2x) = \cancel{\sin(8x)} + \sin(4x)$$

$$\sin 2x - \sin 4x = 0$$

$$\underbrace{\sin 2x} - 2 \underbrace{\sin 2x \cos 2x} = 0$$

$$(\sin 2x)(1 - 2\cos 2x) = 0$$

Case-1: $\sin 2x = 0$

$$2x = n\pi$$

$$\boxed{x = \frac{n\pi}{2}}, n \in \mathbb{I}$$

Case-2: $\cos 2x = \frac{1}{2}$

$$2x = 2n\pi \pm \frac{\pi}{3}$$

$$\boxed{x = n\pi \pm \frac{\pi}{6}}$$

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



Solve: $\cos x \cdot \cos 2x \cdot \cos 3x = 1/4$

$$\cos x \cdot \cos 2x \cdot \cos 3x = \frac{1}{4}$$

$$(2 \cos 2x) (2 \cos x \cos 3x) = 1$$

$$(2 \cos 2x) (\cos 4x + \cos 2x) = 1$$

$$2 \cos 2x \cos 4x + \underbrace{2 \cos^2 2x - 1}_{0} = 0$$

$$2 \cos 2x \cos 4x + \cos 4x = 0$$

$$\Rightarrow (\cos 4x)(2 \cos 2x + 1) = 0$$

Case-1: $\cos 4x = 0$

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

$$\boxed{x = (2n+1)\frac{\pi}{8}}$$

$n \in \mathbb{I}$

Case-2: $\cos 2x = -\frac{1}{2}$

$$\Rightarrow 2x = 2n\pi \pm \frac{2\pi}{3}$$

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

$n \in \mathbb{I}$



Important Results

1

$$\sin(A + B).\sin(A - B) = \sin^2 A - \sin^2 B = \cos^2 B - \cos^2 A$$

2

$$\cos(A + B)\cos(A - B) = \cos^2 A - \sin^2 B = \cos^2 B - \sin^2 A$$



Solve: $\cos^2 x + \cos^2 2x + \cos^2 3x + \cos^2 4x = 2$

$$(\cos^2 x - 1) + (\cos^2 2x - 1) + \cos^2 3x + \cos^2 4x = 0$$

$$-\sin^2 x - \sin^2 2x + \cos^2 3x + \cos^2 4x = 0$$

$$(\cos^2 3x - \sin^2 x) + (\cos^2 4x - \sin^2 2x) = 0$$

$$\cos(4x) \cos(2x) + \cos(6x) \cos(2x) = 0$$

$$(\cos 2x) [\cos 4x + \cos 6x] = 0$$

$$(\cos 2x) (2 \cos(5x) \cos(x)) = 0$$

$$2 \cos x \cos 2x \cos 5x = 0$$

Case-1: $\cos x = 0$

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

Case-2: $\cos 2x = 0$

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

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

Case-3: $\cos 5x = 0$

$$5x = (2n+1) \frac{\pi}{2}$$

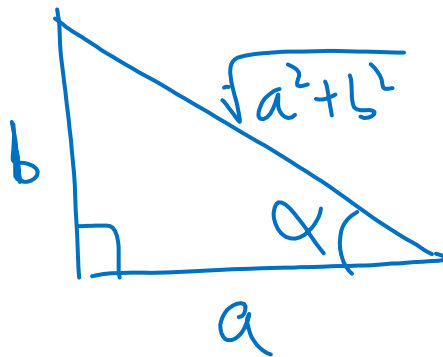
$$x = (2n+1) \frac{\pi}{10}$$



5. Use of form $a \cos x \pm b \sin x$

$$\frac{a \cos x + b \sin x}{\sqrt{a^2 + b^2}} = \frac{C}{\sqrt{a^2 + b^2}}$$

Diagram illustrating the transformation of the expression $a \cos x + b \sin x$ into a single trigonometric function. The terms $a \cos x$ and $b \sin x$ are grouped and divided by $\sqrt{a^2 + b^2}$. Below the first group, an arrow points to $\cos \alpha$. Below the second group, an arrow points to $\sin \alpha$.



$$\cos x \cos \alpha + \sin x \sin \alpha = \frac{c}{\sqrt{a^2 + b^2}}$$

$$\cos(x - \alpha) = \frac{c}{\sqrt{a^2 + b^2}}$$



Solve: $\sin 2x + \cos 2x = 1$

$$\frac{(1) \sin 2x}{\sqrt{2}} + \frac{(1) \cos 2x}{\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$(\cos 2x) \left(\cos \frac{\pi}{4} \right) + (\sin 2x) \left(\sin \frac{\pi}{4} \right) = \frac{1}{\sqrt{2}}$$

$$\cos \left(2x - \frac{\pi}{4} \right) = \cos \frac{\pi}{4}$$

$$2x - \frac{\pi}{4} = 2n\pi \pm \frac{\pi}{4}$$

$$\textcircled{+} : 2x - \frac{\pi}{4} = 2n\pi + \frac{\pi}{4} \Rightarrow \boxed{x = n\pi + \frac{\pi}{4}}$$

$$\textcircled{-} : 2x - \cancel{\frac{\pi}{4}} = 2n\pi - \cancel{\frac{\pi}{4}} \Rightarrow \boxed{x = n\pi}$$



Solve: $\sqrt{2} \sec \theta + \tan \theta = 1$

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

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

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

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

$$\cos\left(\theta + \frac{\pi}{4}\right) = 1$$

$$\Rightarrow \left(\theta + \frac{\pi}{4}\right) = 2n\pi$$

$$\boxed{\theta = 2n\pi - \frac{\pi}{4}}$$



Find the number of solution of the equation in $[0, 2\pi]$,
 $\tan(5\pi \cos \alpha) = \cot(5\pi \sin \alpha)$

$$\tan(5\pi \cos \alpha) = \tan\left(\frac{\pi}{2} - (5\pi \sin \alpha)\right)$$

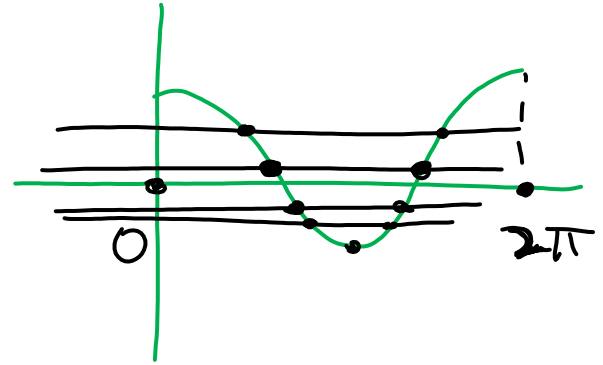
$$5\pi \cos \alpha = n\pi + \left(\frac{\pi}{2} - 5\pi \sin \alpha\right)$$

$$5\pi (\cos \alpha + \sin \alpha) = (2n+1)\frac{\pi}{2}$$

$$\cos \alpha + \sin \alpha = \frac{(2n+1)}{10}$$

$$\frac{1}{\sqrt{2}} \cos \alpha + \frac{1}{\sqrt{2}} \sin \alpha = \frac{(2n+1)}{10\sqrt{2}}$$

$$\cos\left(\alpha - \frac{\pi}{4}\right) = \underbrace{\left(\frac{(2n+1)}{10\sqrt{2}}\right)}_{\substack{\downarrow \downarrow \\ [-1, 1]}}$$



$$n = 0, \pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 6, -7$$

$$\therefore \text{Total sol}^n = \textcircled{28}$$



6. Use of substitution $\sin x \pm \cos x = t$.

①

Let

$$\boxed{\sin x + \cos x = t}$$

$$(\sin x + \cos x)^2 = t^2$$

$$1 + 2 \sin x \cos x = t^2$$

$$\boxed{\sin x \cos x = \left(\frac{t^2 - 1}{2} \right)}$$

②

Let

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

$$1 - 2 \sin x \cos x = t^2$$

$$\sin x \cos x = \left(\frac{1 - t^2}{2} \right)$$



Solve: $\sin 2x + 5 \sin x + 1 + 5 \cos x = 0$



$$5(\sin x + \cos x) + 2(\sin x \cos x) + 1 = 0$$

$$\left\{ \begin{array}{l} \text{Let } \sin x + \cos x = t \\ \Rightarrow \sin x \cos x = \left(\frac{t^2 - 1}{2} \right) \end{array} \right\}$$

$$5t + 2\left(\frac{t^2 - 1}{2}\right) + 1 = 0$$

$$t^2 + 5t = 0$$

$$t(t+5) = 0$$

Case-1: $t = 0$

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

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

$$\tan x = -1$$

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

Case-2: $t = -5$

$$\sin x + \cos x = -5$$

$$[-\sqrt{2}, \sqrt{2}]$$

X Reject



Solve : $3\cos x + 3\sin x + \sin 3x - \cos 3x = 0$

H.W



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Namo Sir | Physics

6:00 - 7:30 PM



Ashwani Sir | Chemistry

7:30 - 9:00 PM



Sameer Sir | Maths

9:00 - 10:30 PM

12th



Jayant Sir | Physics

1:30 - 3:00 PM



Anupam Sir | Chemistry

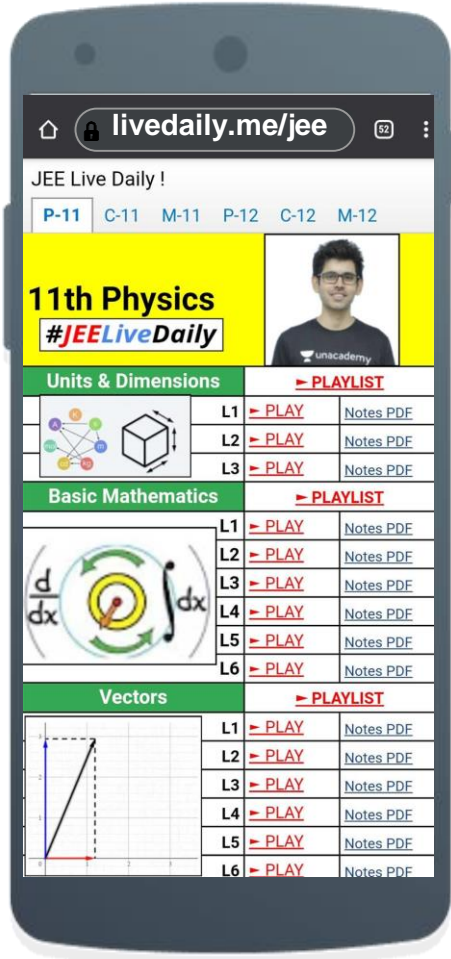
3:00 - 4:30 PM



Nishant Sir | Maths

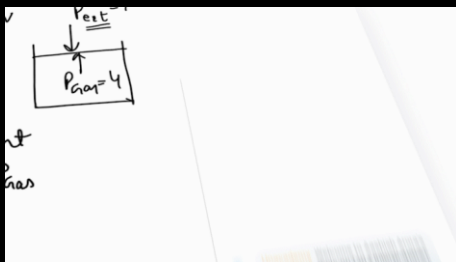
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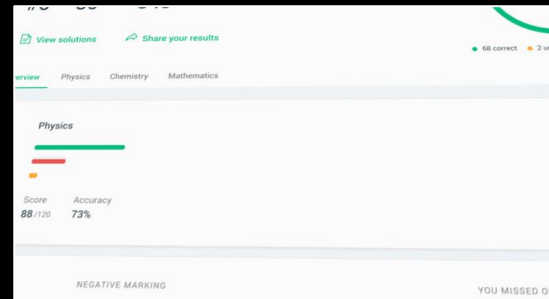
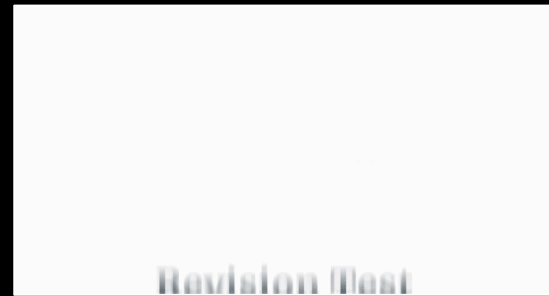
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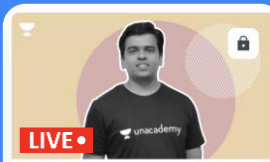


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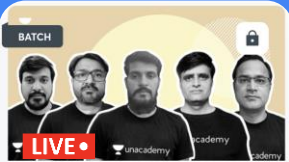
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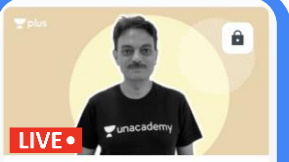
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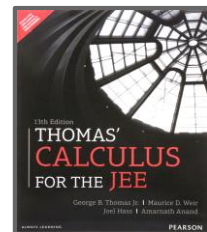
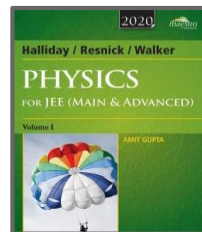
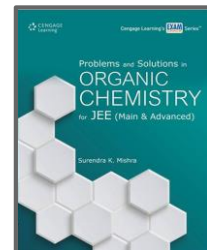
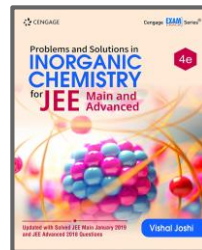
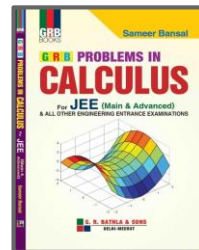
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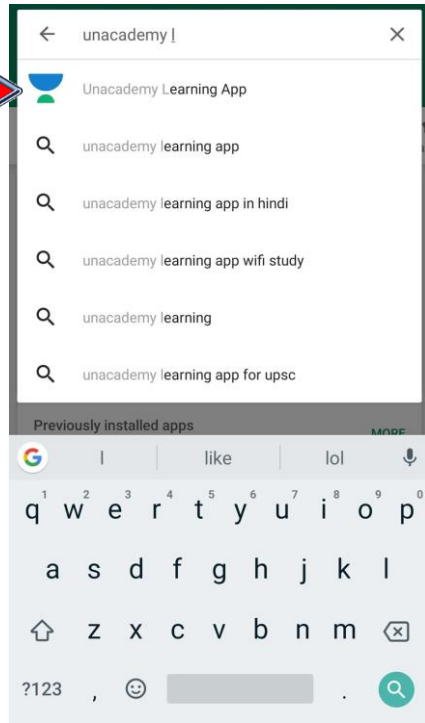


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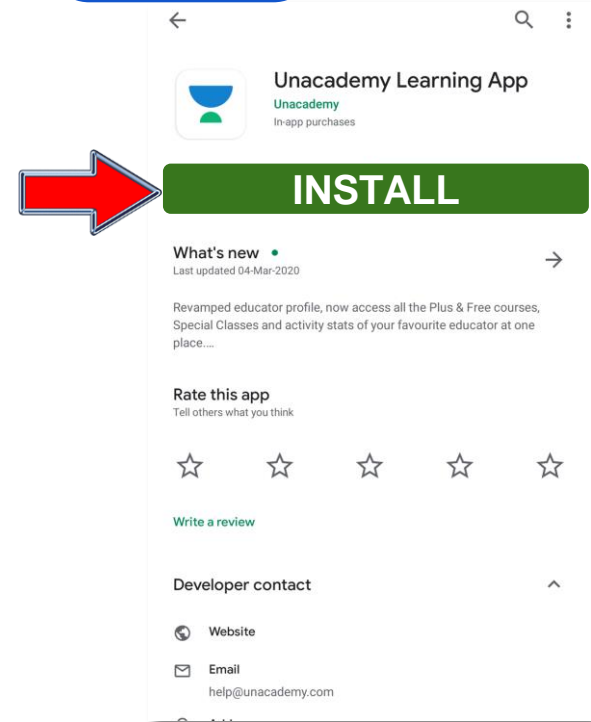


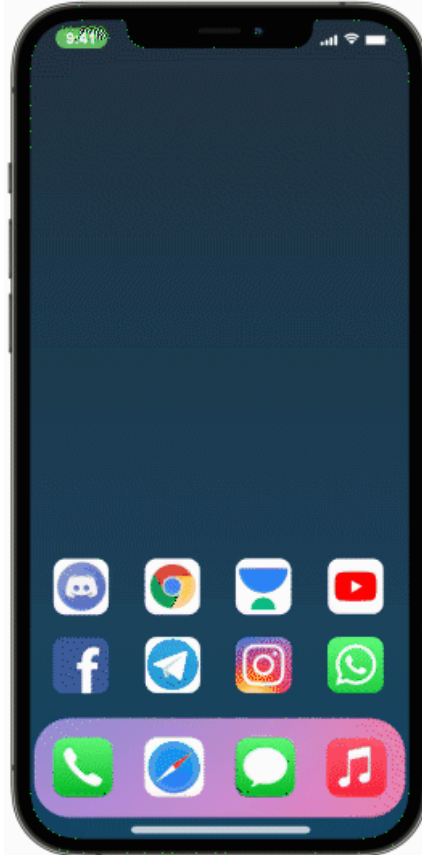
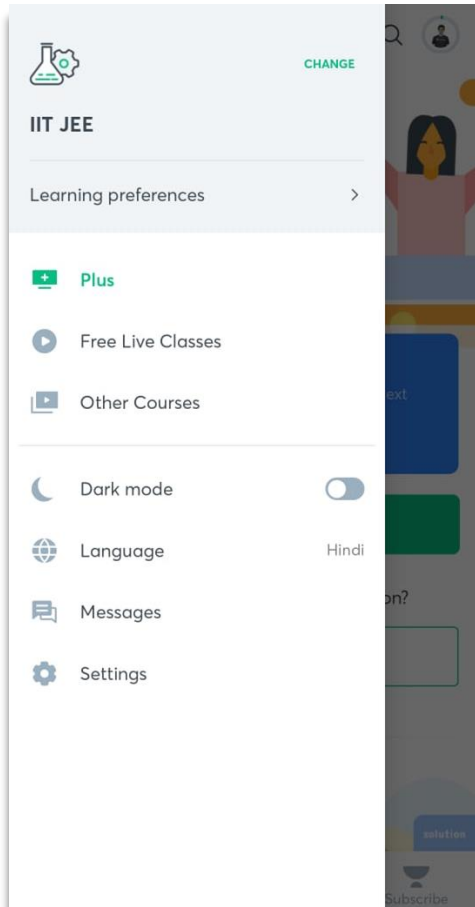
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Emerge Batch (Class 11th) : JEE Main & Advanced 2023

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