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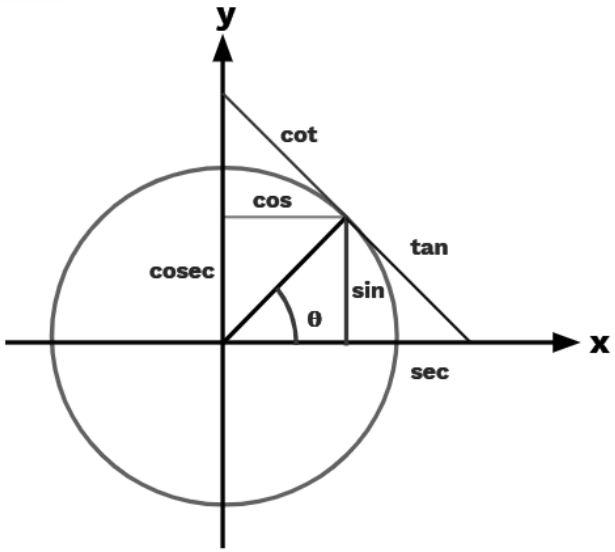
Trigonometric Equations

4



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Sameer Chincholikar

B.Tech, M.Tech - IIT-Roorkee

- **10+** years Teaching experience
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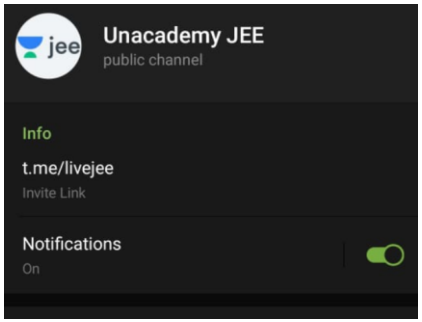

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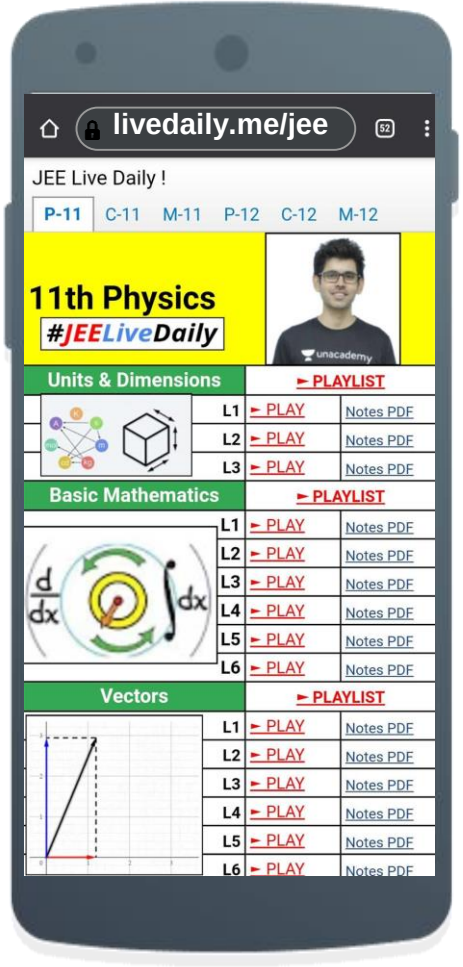

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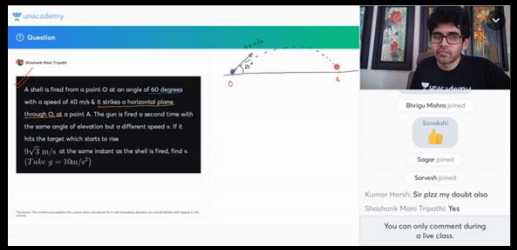

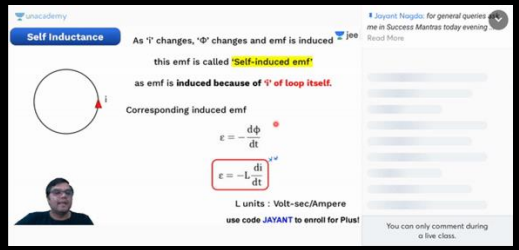

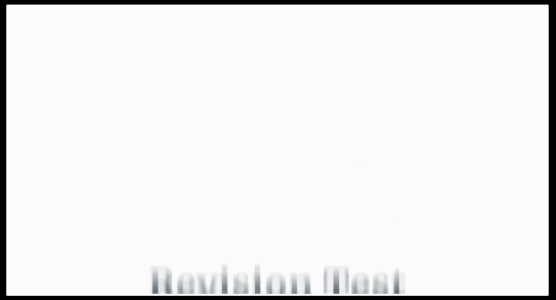

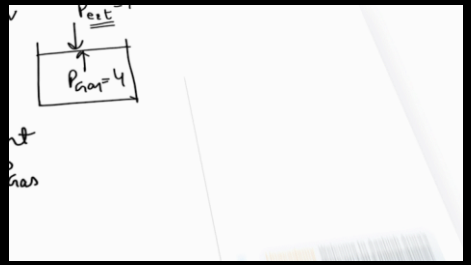

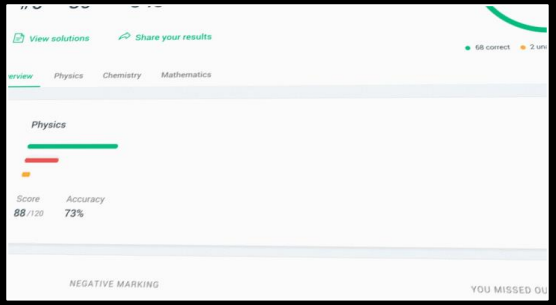

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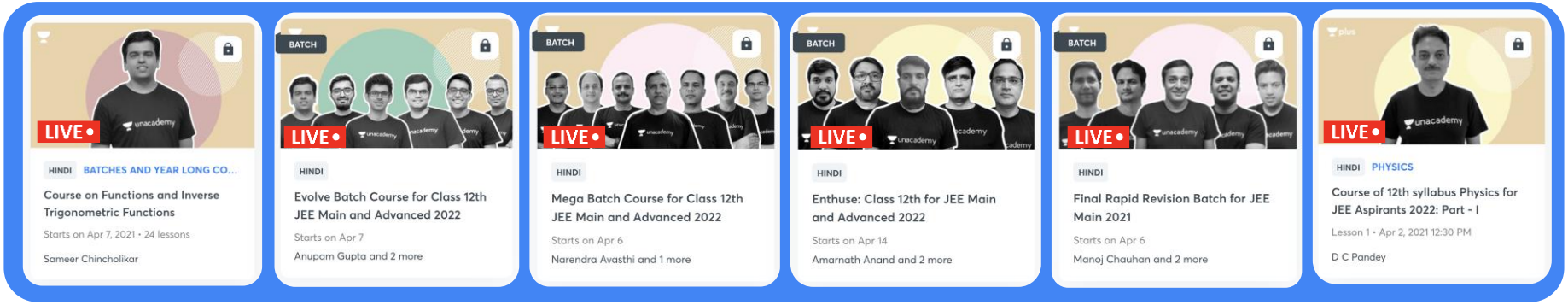

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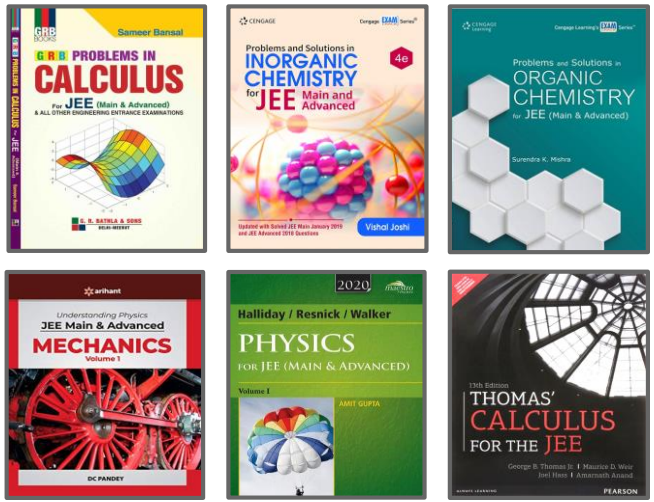

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Top Results

Bratin Mondal

100 %ile

Amaiya Singhal
99.97

Adnan
99.95

Ashwin Prasanth
99.94

Tanmay Jain
99.86

Kunal Lalwani
99.81

Utsav Dhanuka
99.75

Aravindan K Sundaram
99.69

Manas Pandey
99.69

Mihir Agarwal
99.63

Akshat Tiwari
99.60

Sarthak Kalankar
99.59

Vaishnovi Arun
99.58

Devashish Tripathi
99.52

Maroof
99.50

Tarun Gupta
99.50

Siddharth Kaushik
99.48

Mihir Kothari
99.39

Sahil
99.38

Vaibhav Dhanuka
99.34

Pratham Kadam
99.29

Shivam Gupta
99.46

Shrish
99.28

Yash Bhaskar
99.10

Subhash Patel
99.02

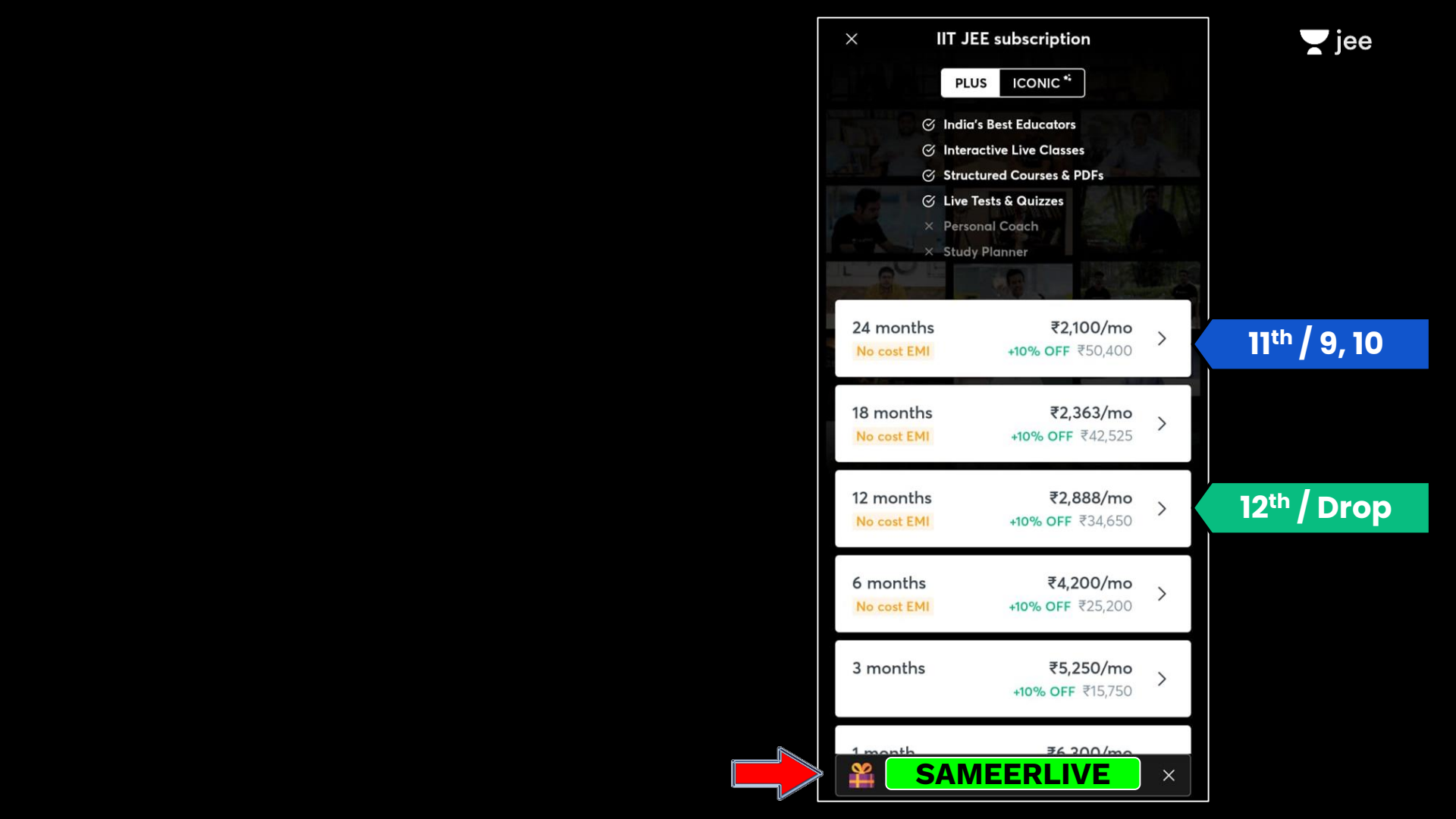
Ayush Kale
98.85

Ayush Gupta
98.67

Megh Gupta
98.59

Naman Goyal
98.48

MIHIR PRAJAPATI
98.16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6 months
No cost EMI
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+10% OFF ₹25,200
3 months
₹5,250/mo
+10% OFF ₹15,750
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12th / Drop

LET'S BEGIN!!

Homework Question

Solve : 3cosx + 3sinx + sin3x - cos3x = 0

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

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

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

$$a^3+b^3=(a+b)^3-3ab(a+b)$$

Now: $\sin x+\cos x=t$

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

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

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

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

$$6t-4t^3+6t^3-6t=0$$

$$2t^3=0$$

$$\Rightarrow t=0$$

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

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

$$\tan x = -1$$

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

$$n \in I$$

7. Use of limited range of sinx and cosx

$[-1,1]$ $[-1,1]$

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

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

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

$x = \pi/2$ & $y = 0, 2\pi$

Case-2:

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

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

$x = \frac{3\pi}{2}$ & $y = \pi$

$$\left\{\left(\frac{\pi}{2}, 0\right)\right.$$

$$\left(\frac{\pi}{2}, 2\pi\right)$$

$$\left.\left(\frac{3\pi}{2}, \pi\right)\right.$$

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

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

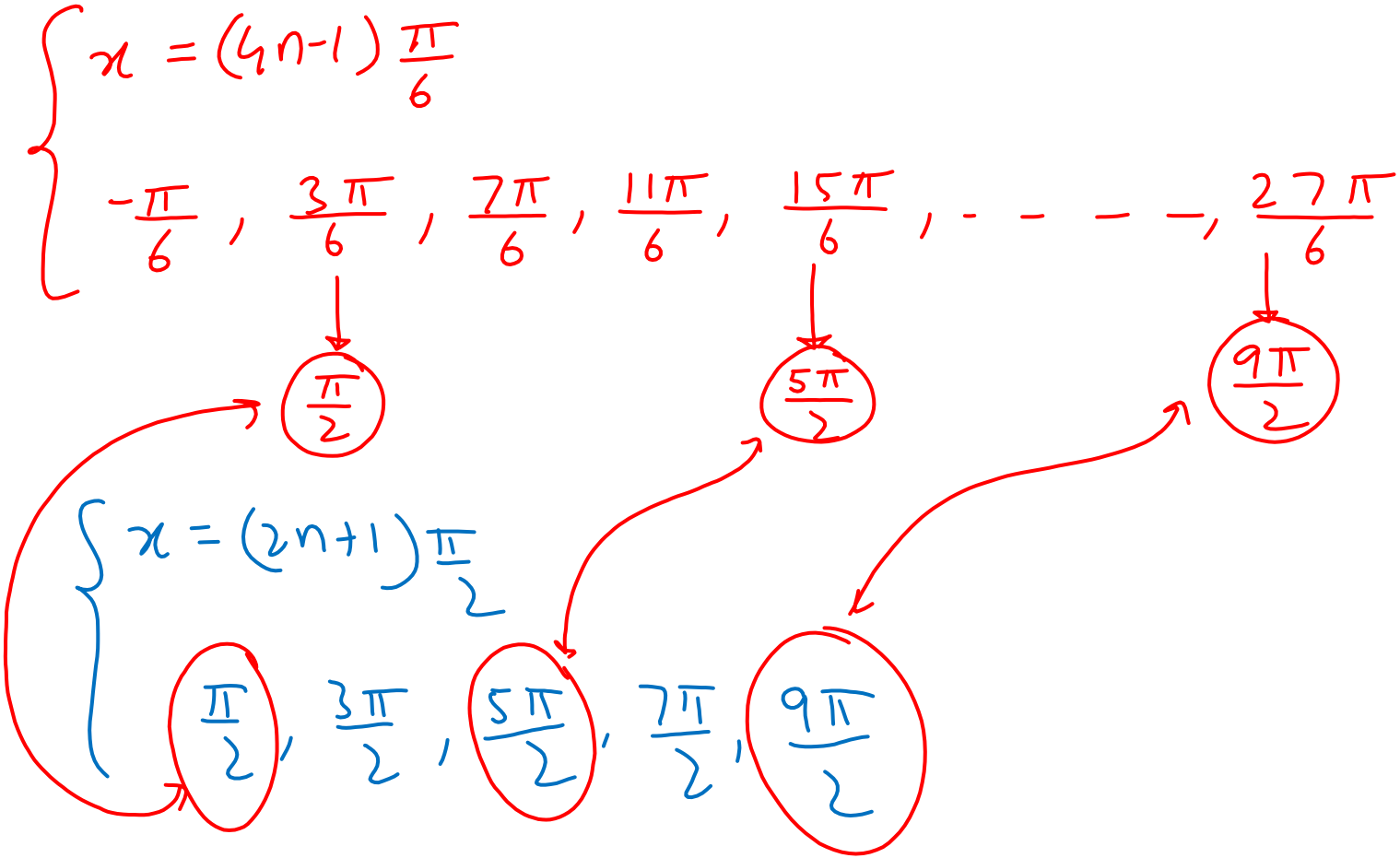
$$\sin 3x = -1 \quad \& \quad \cos 2x = -1$$

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

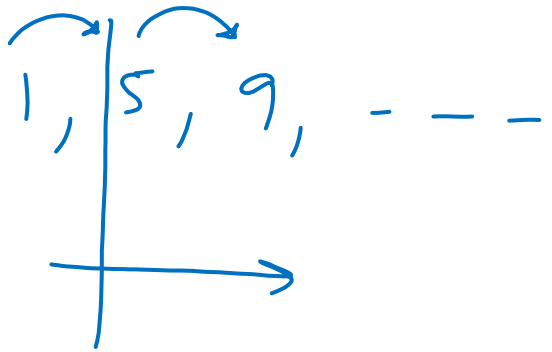
$$x = (4n-1)\frac{\pi}{6} \quad \& \quad x = (2n+1)\frac{\pi}{2}$$

$\cap$

(Common values)


x = (4n-1) π/6
-π/6, 3π/6, 7π/6, 11π/6, 15π/6, - - - -, 27π/6
π/2
5π/2
9π/2
x = (2n+1) π/2
π/2, 3π/2, 5π/2, 7π/2, 9π/2

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



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

$= (4n+1)$

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

is also correct

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

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

A. $x = (2n + 1)\pi, n \in I$

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

C. $x = (2n - 1)\pi, n \in I$

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)

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

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

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

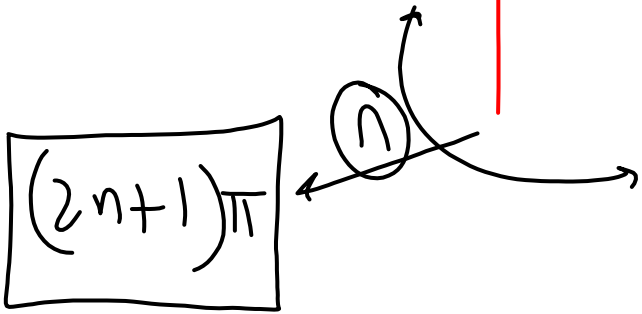
$x = \frac{n\pi}{3}$

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

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

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

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



8. Use of limited range trigonometric expressions

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

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

$\Rightarrow a^2 - 2a + \sec^2\pi(a+x) = 0$

$+1 \quad -1$

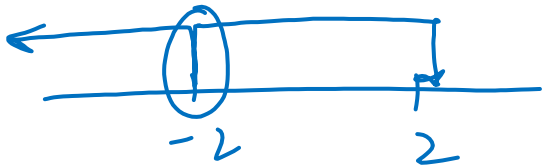
$\Rightarrow (a-1)^2 + \tan^2\pi(a+x) = 0$

$= 0 \qquad = 0$

$\Rightarrow a = 1$

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

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

$\sin\theta + \sqrt{3}\cos\theta = -(x^2 - 6x + 11)$

$-(x^2 - 6x + 9 + 2)$

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

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

$[-2, 2]$

LHS : $[-2, 2]$

RHS : $(-\infty, -2]$

only possibility is

$\begin{cases} \text{LHS} = -2 \\ \& \ \text{RHS} = -2 \end{cases}$

For RHS $= -2$

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

$\Rightarrow \boxed{x = 3}$

For LHS $= -2$

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

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

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

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

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

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 sol^n :

RHS = 13 $\Rightarrow$ y = 2

LHS = 13

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

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

$[-13, 13]$

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

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

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

$2(y-2)^2 + 13$

$[13, \infty)$

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

$\downarrow \sin\alpha \qquad \downarrow \cos\alpha$

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

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

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

Now:

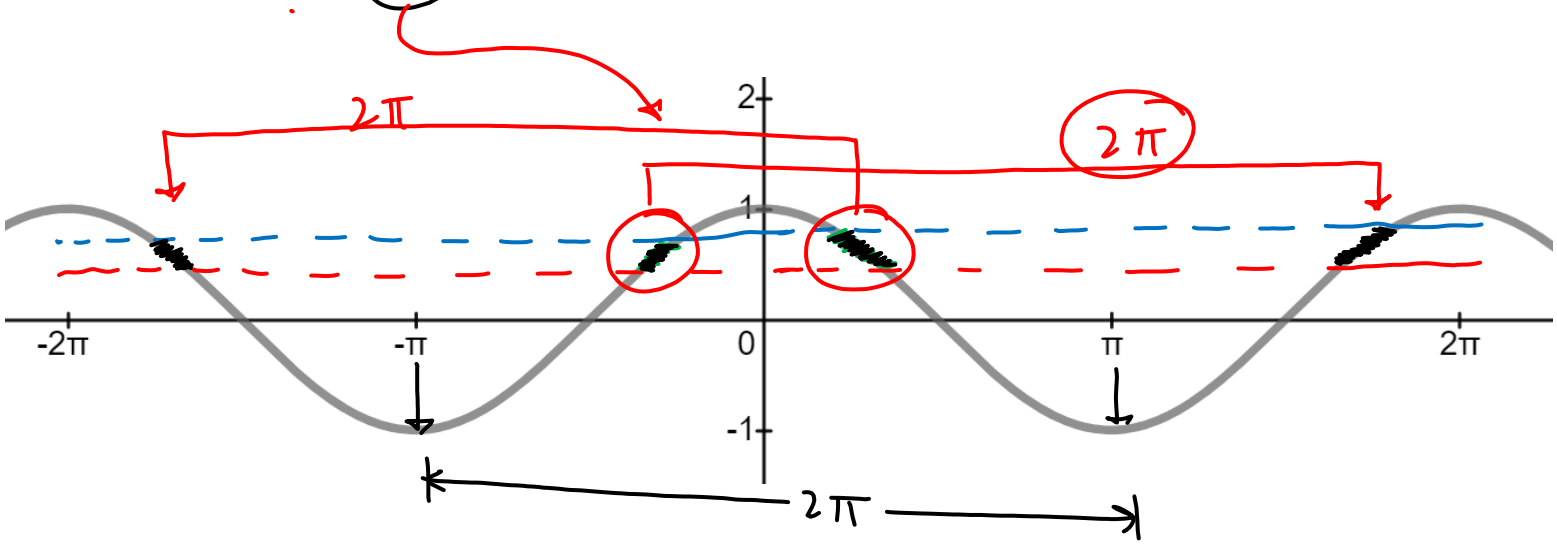
$\frac{24}{5}\cot\left(\frac{x}{2}\right)$

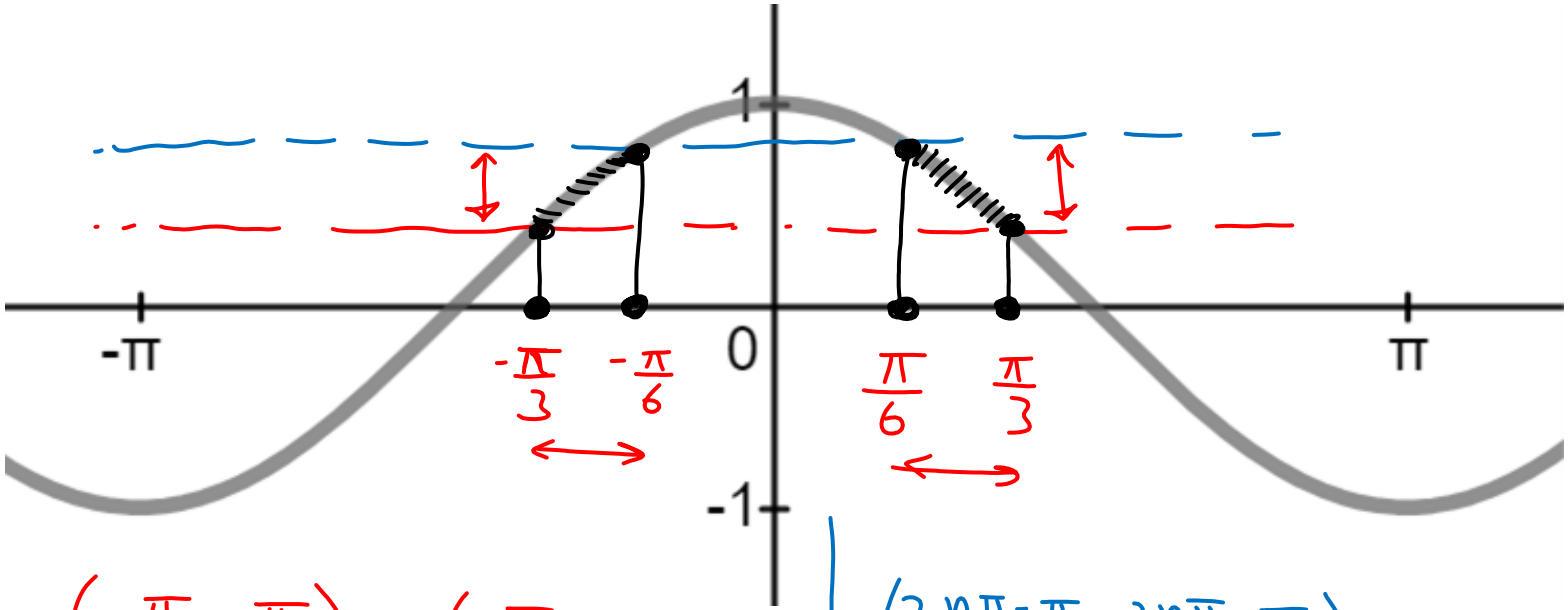
$\frac{24}{5}\cot\left(\frac{(2n\pi+\alpha)}{2}\right)$

$\boxed{\frac{24}{5}\cot\alpha} \rightarrow \frac{5}{12}$

Trigonometric Inequalities

Solve for x: 1/2 < cosx < √3/2.





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

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

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

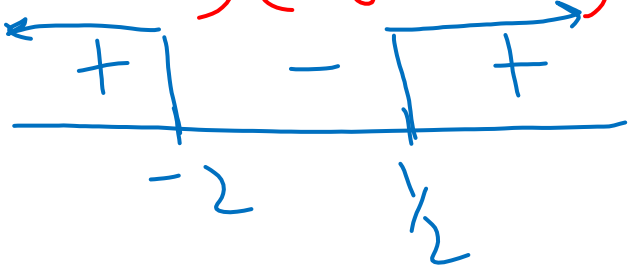
Let $2\sin^2 x + 3\sin x - 2 > 0$. Then find the general solution of x.

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

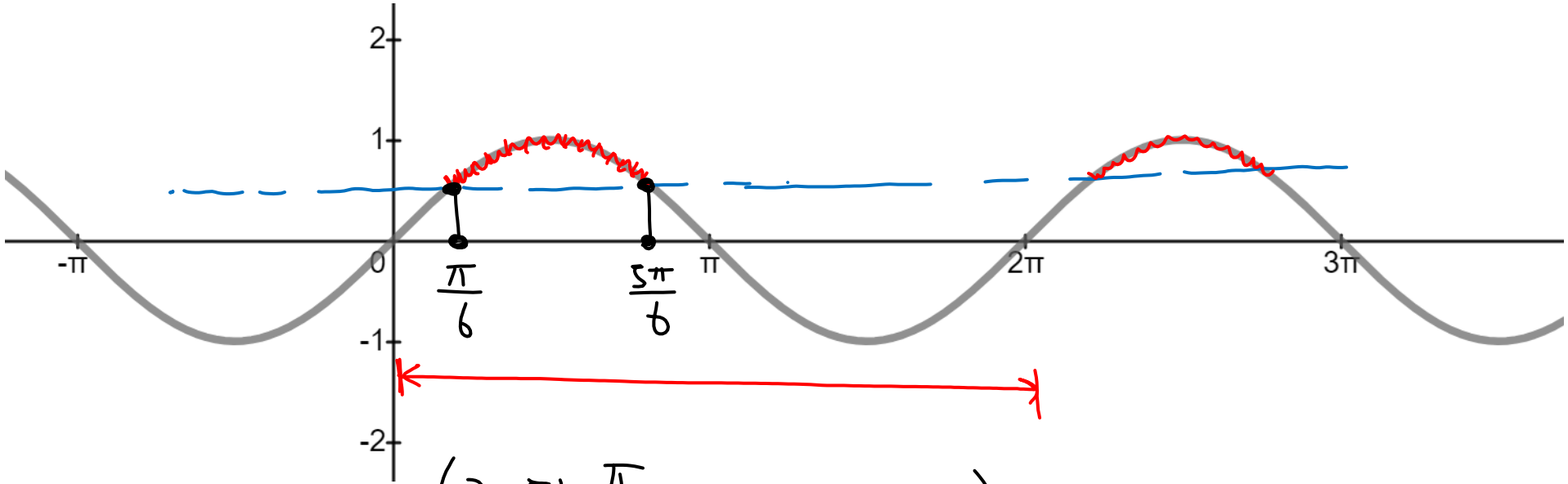
$$\Rightarrow 2\sin^2 x + 4\sin x - \sin x - 2 > 0$$

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

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



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



$$\left(2n\pi+\frac{\pi}{6},\ 2n\pi+\frac{5\pi}{6}\right)$$

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

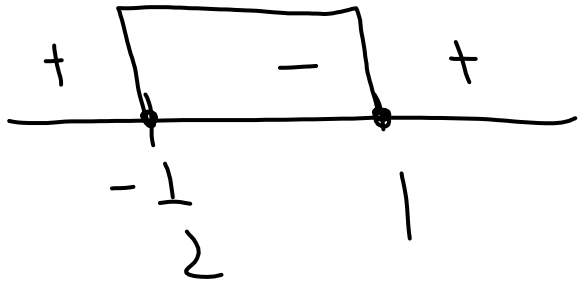
$\cos 2x \leq \cos x$

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

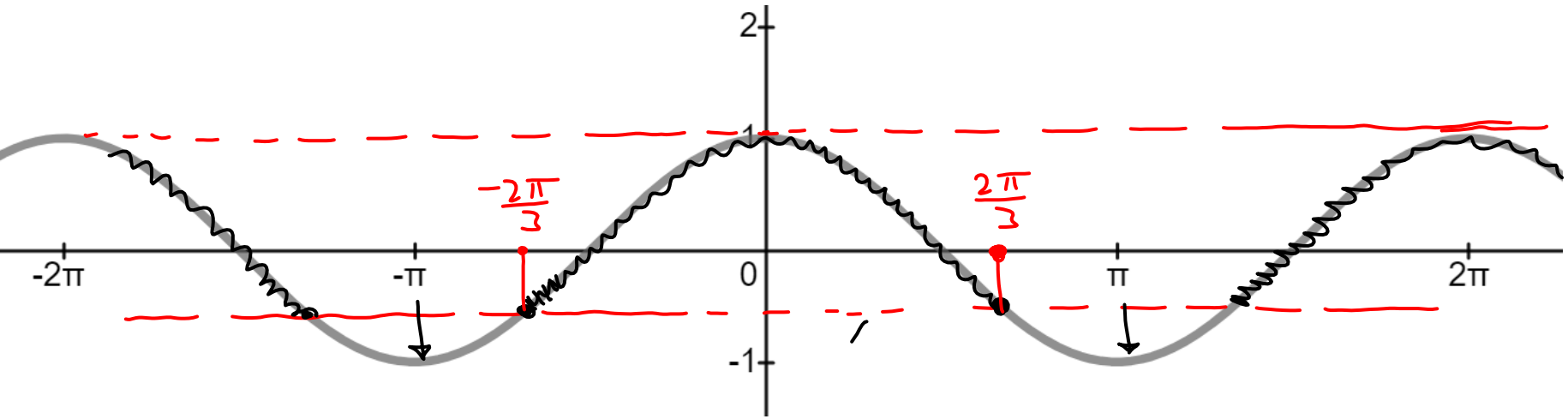
$2\cos^2 x - \cos x - 1 \leq 0$

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

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



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



Which of the following set of values of x satisfy the inequation

$\tan^2 x - (1 + \sqrt{3})\tan x + \sqrt{3} < 0$

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

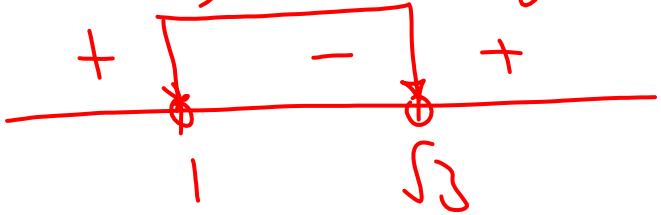
B. $\left(\frac{(2n+1)\pi}{4}, \frac{(2n+1)\pi}{3}\right), (n \in Z)$

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

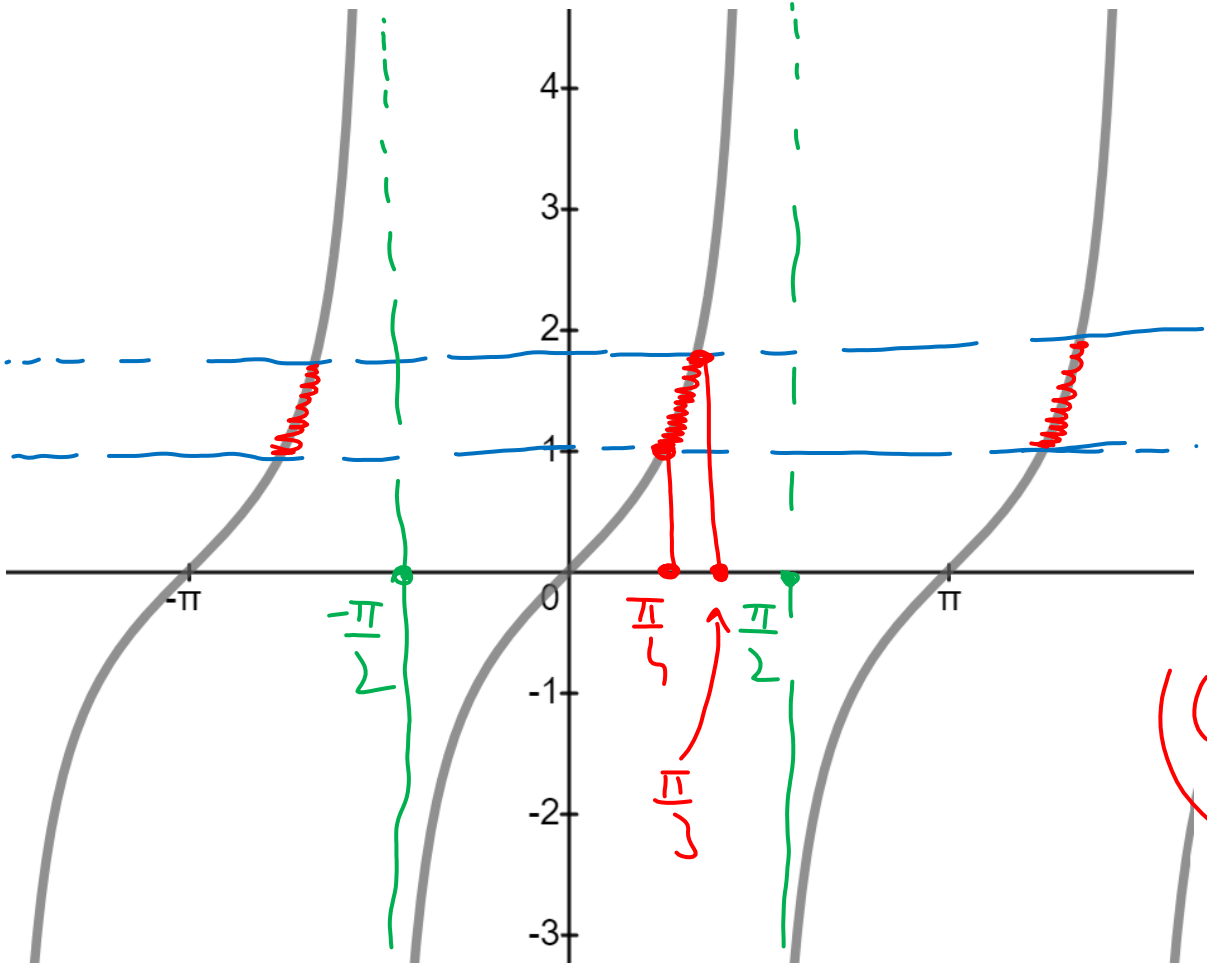
D. $x \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right]$

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

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



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


4
3
2
1
0
-1
-2
-3
-π
π
-π/2
π/2
π/3
π/2
(nπ+π/4, nπ+π/3)
((4n+1)π/4, (3n+1)π/3)

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11th

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

4:30 - 6:00 PM

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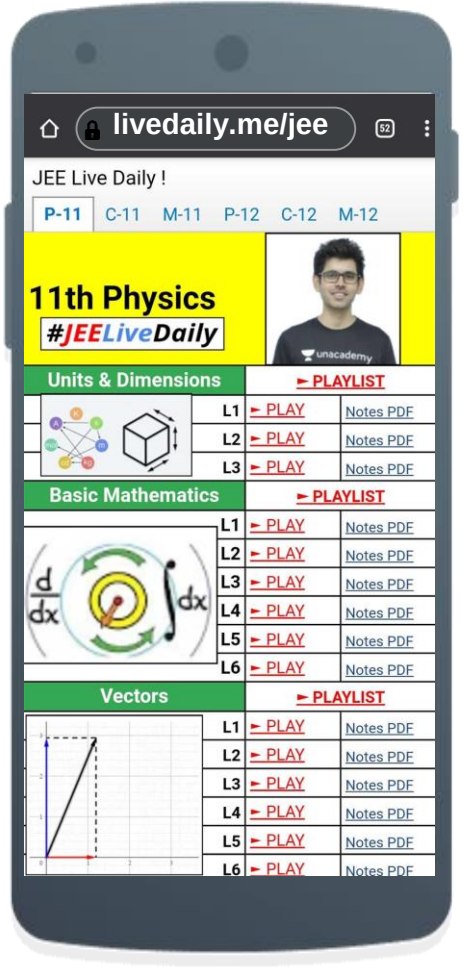

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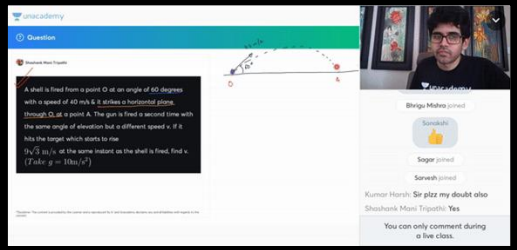

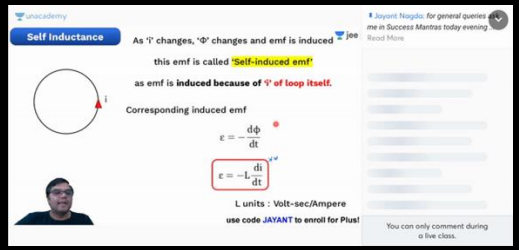

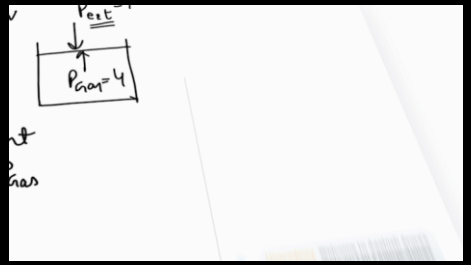

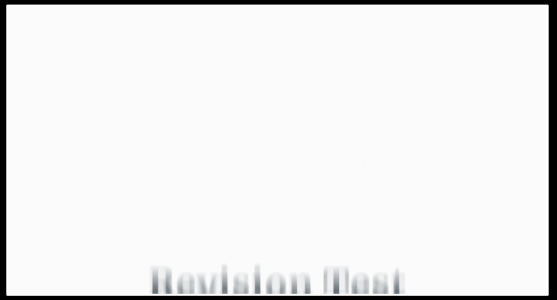

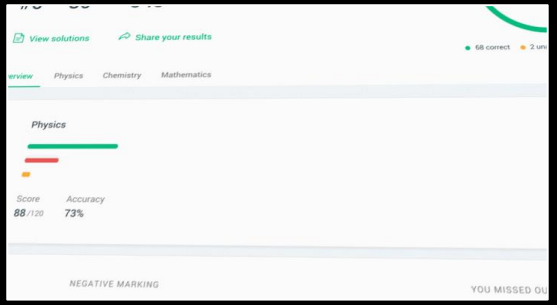

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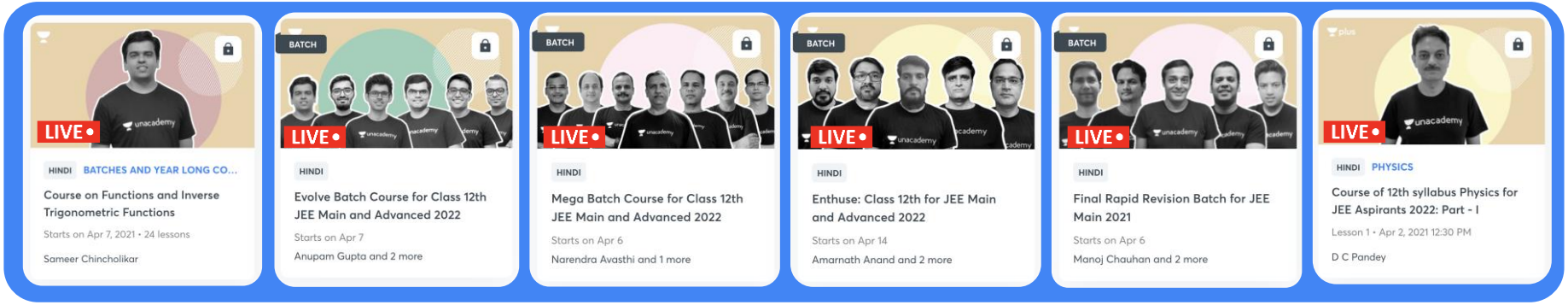

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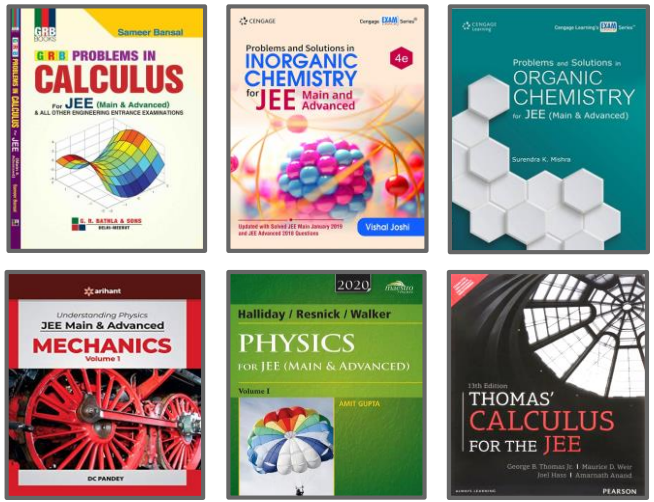

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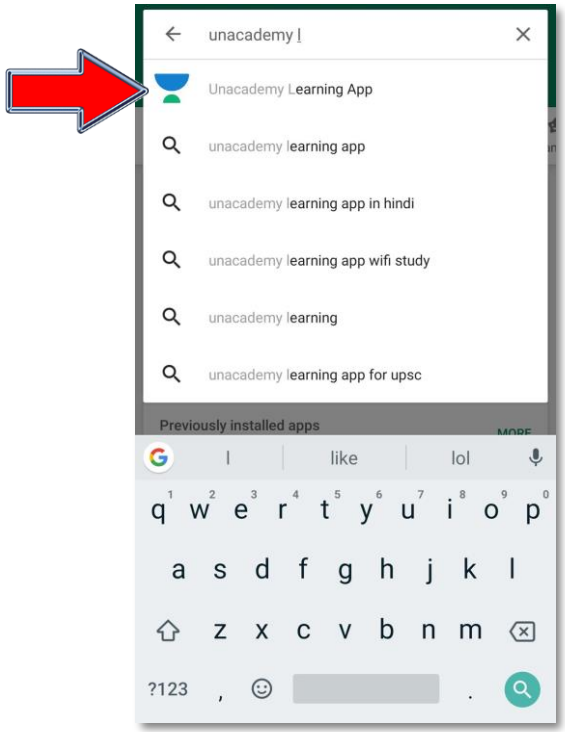
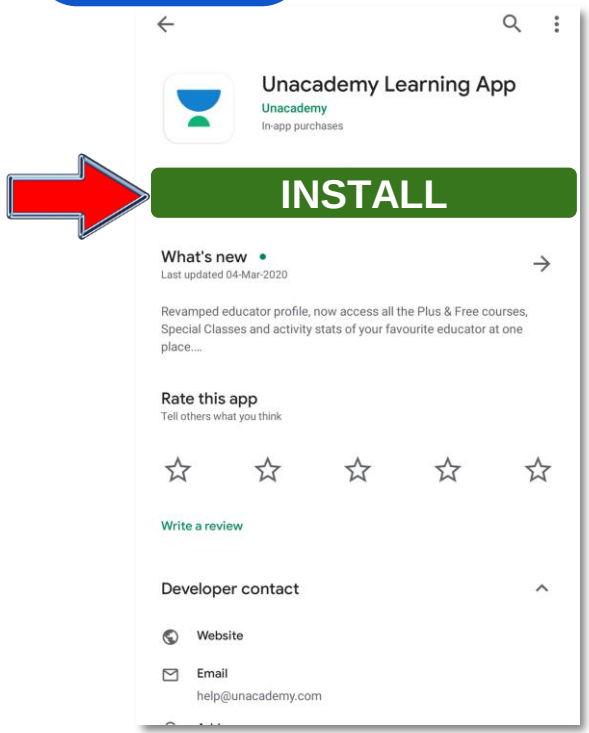
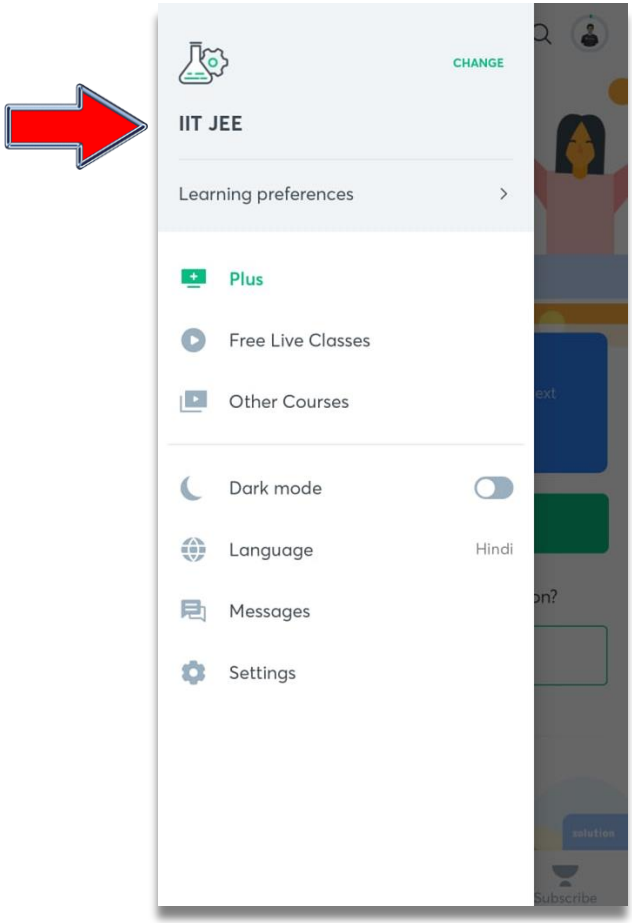
Step 1



Step 2

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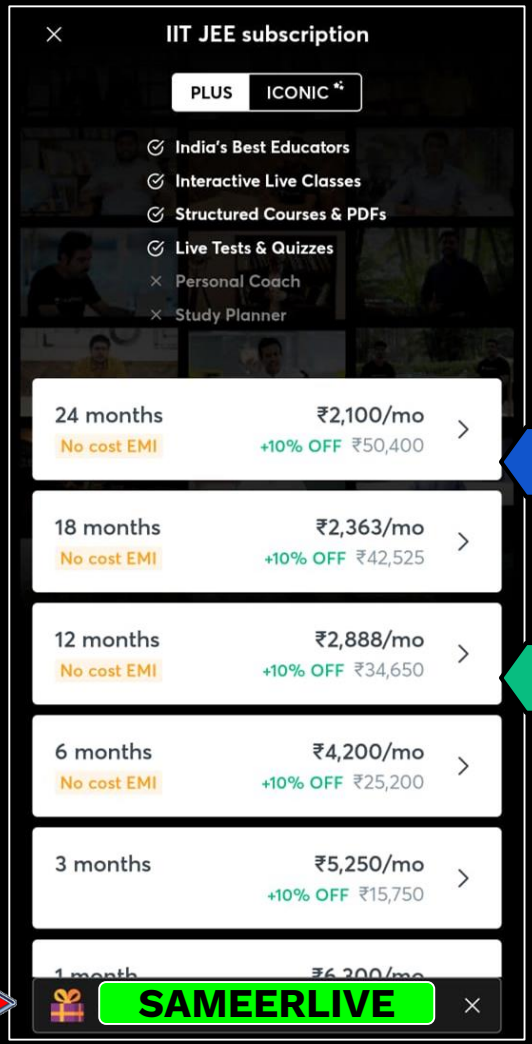

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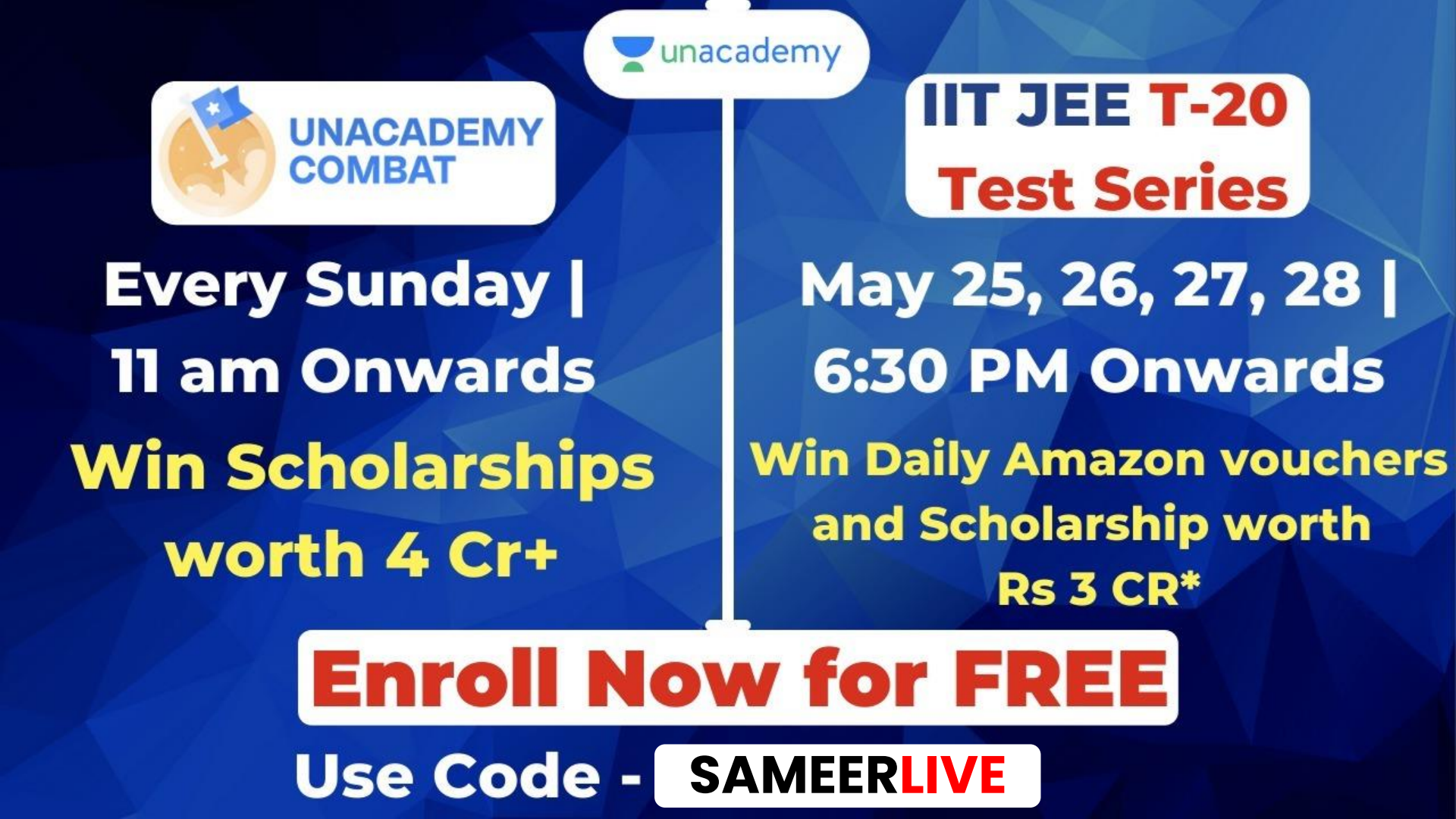
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