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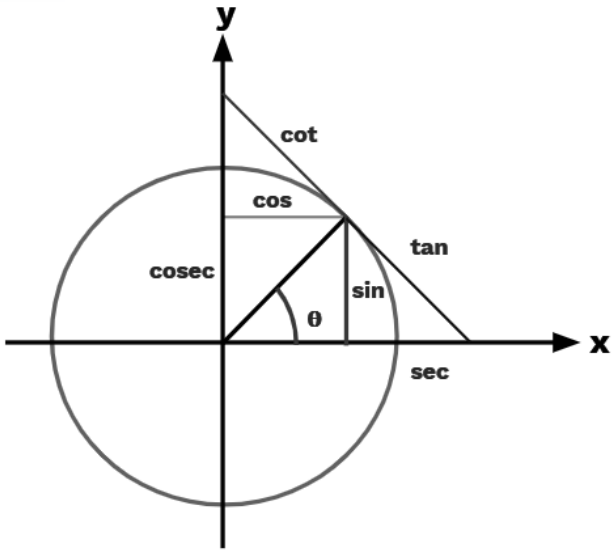
Trigonometric Equations

1



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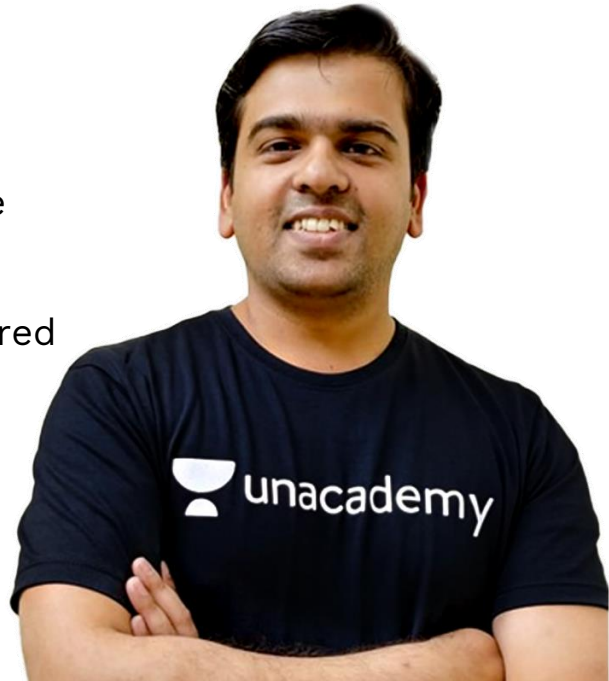
Sameer Chincholikar

B.Tech, M.Tech - IIT-Roorkee

- **10+** years Teaching experience
- Taught **1 Million+** Students
- **100+** Aspiring Teachers Mentored



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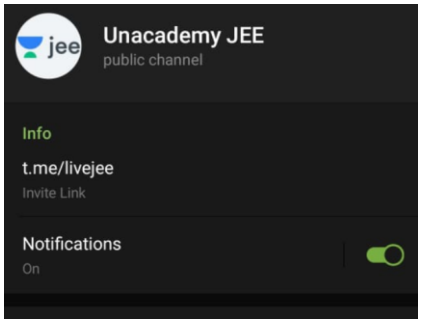

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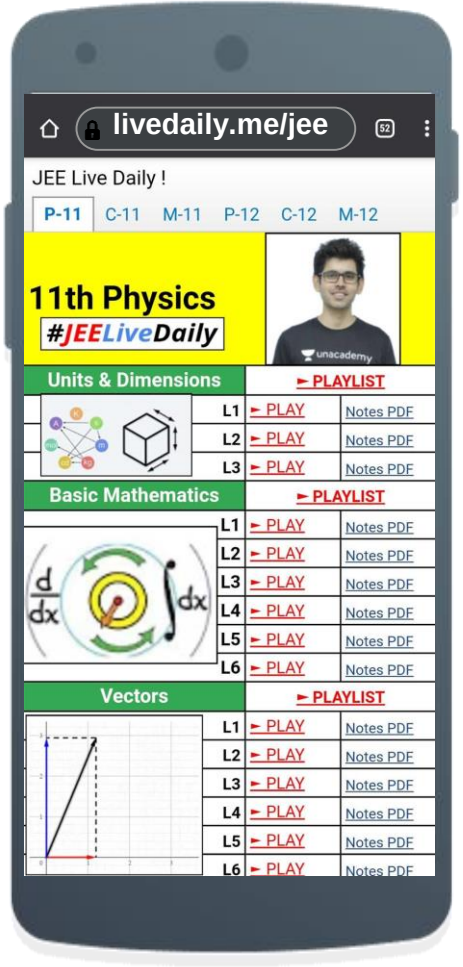

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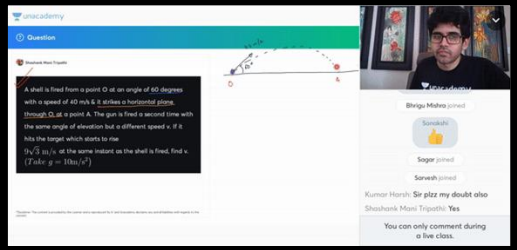

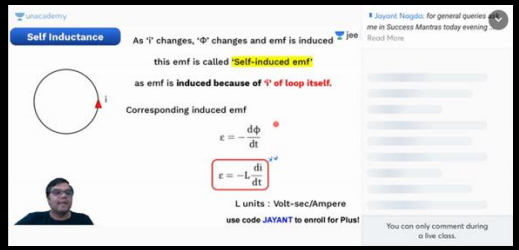

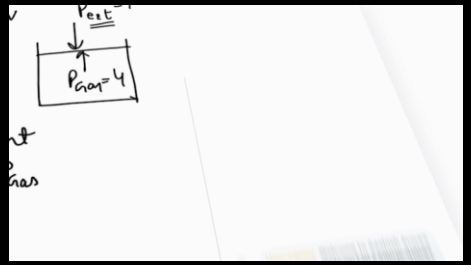

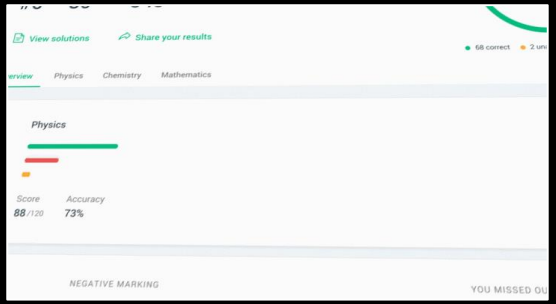

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- + **Weekly Test Series**
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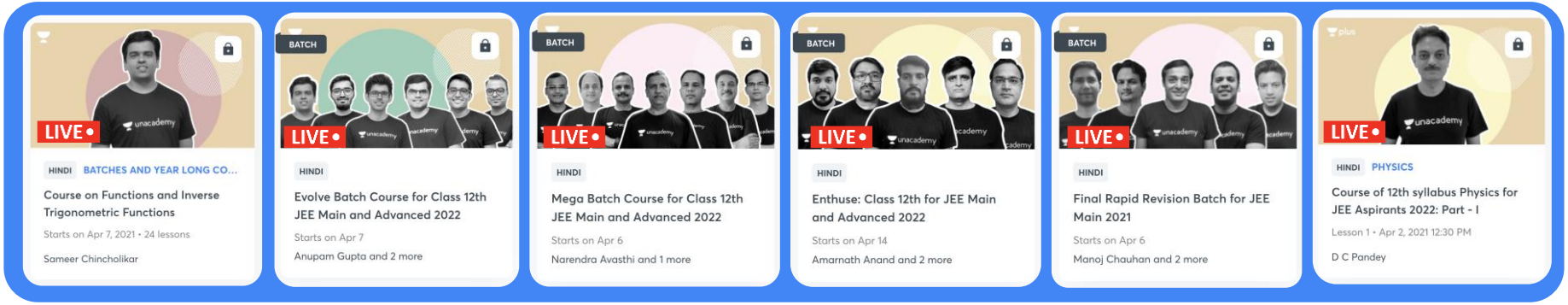

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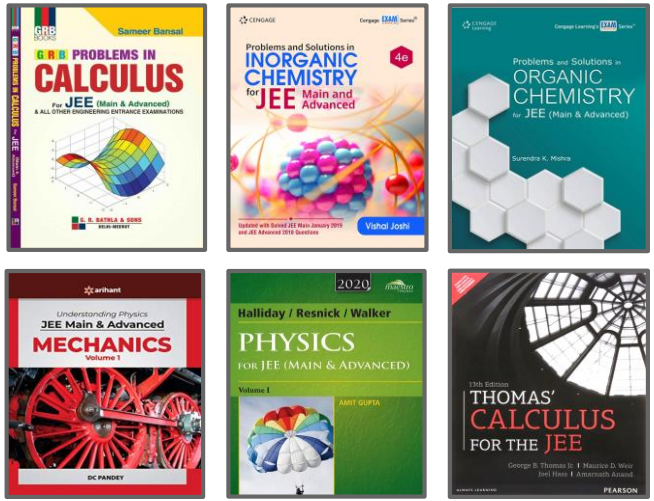

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Bratin Mondal

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
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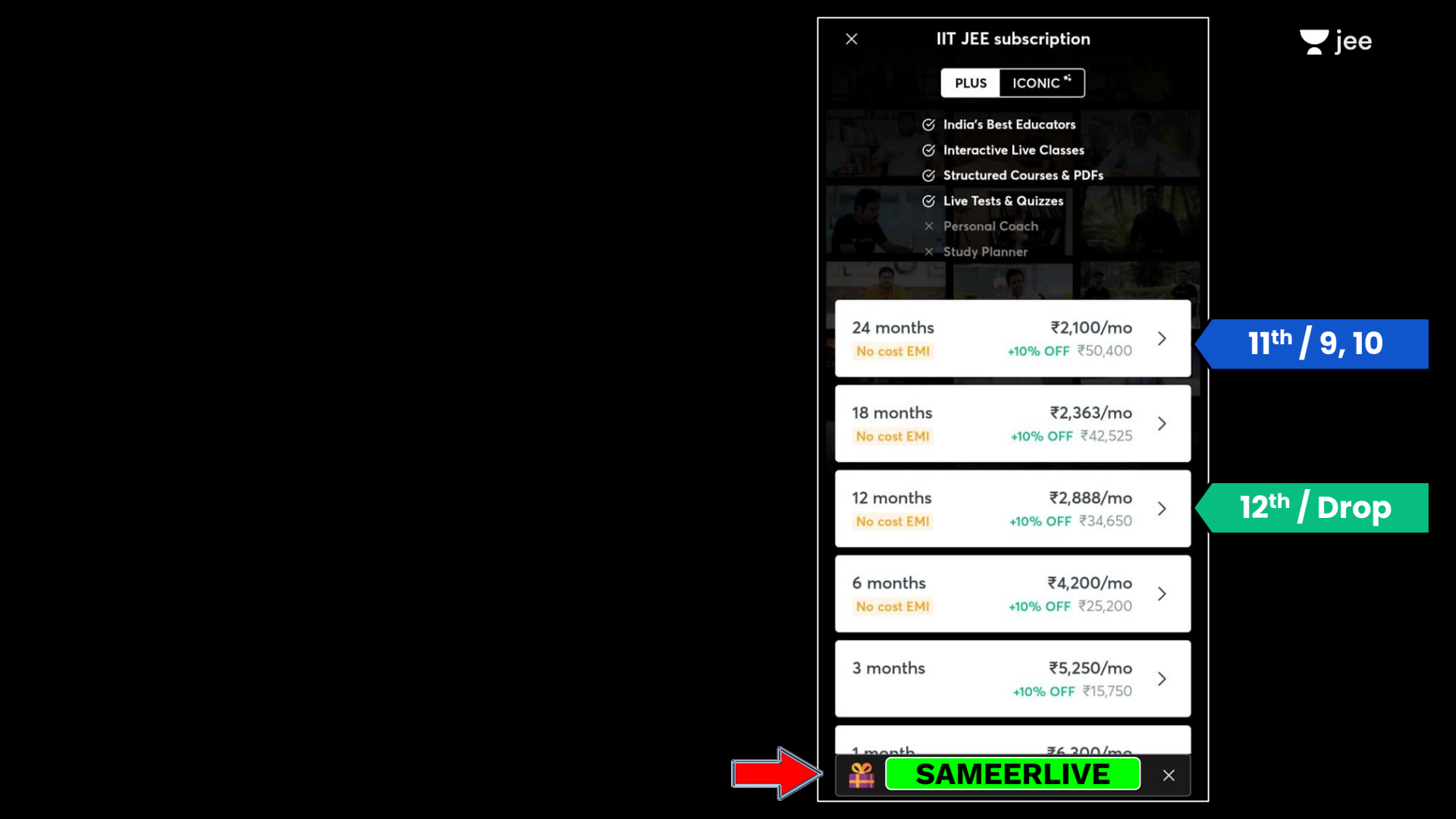
Ayush Gupta
98.67

Megh Gupta
98.59

Naman Goyal
98.48

MIHIR PRAJAPATI
98.16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+10% OFF ₹50,400
18 months
No cost EMI
₹2,363/mo
+10% OFF ₹42,525
12 months
No cost EMI
₹2,888/mo
+10% OFF ₹34,650
6 months
No cost EMI
₹4,200/mo
+10% OFF ₹25,200
3 months
₹5,250/mo
+10% OFF ₹15,750
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12th / Drop

LET'S BEGIN!!

Trigonometric Equations

Examples of Trigonometric Equations

1

$$\sin\theta = \frac{\sqrt{3}}{2}$$

2

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

Examples of Trigonometric Equations

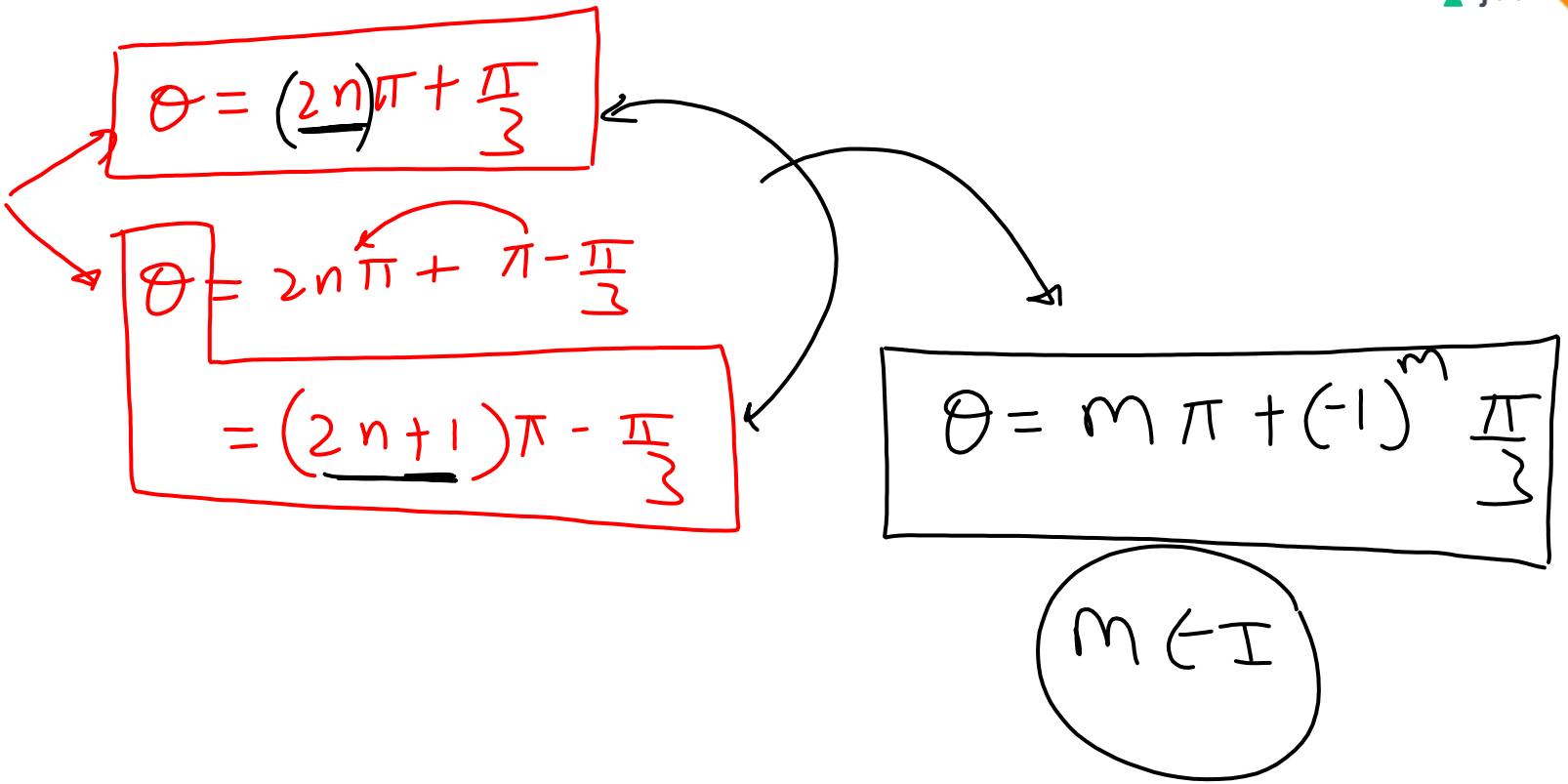
1 $\sin\theta = \frac{\sqrt{3}}{2}$

$\theta = \frac{\pi}{3}, \frac{2\pi}{3}, \left(2\pi+\frac{\pi}{3}\right), \left(2\pi+\frac{2\pi}{3}\right)$ - - - - .

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

* $\sin(2n\pi+\theta) = \sin\theta$

  - $\theta = 2n\pi + \frac{\pi}{3}$, $n \in I$
  - $\theta = 2n\pi + \frac{2\pi}{3}$; $n \in I$


θ = (2n)π + π/3
θ = 2nπ + π − π/3
= (2n+1)π − π/3
θ = mπ + (−1)^m π/3
m ∈ I

Principle solution and General Solution

(Eg. $\sin\theta = \frac{\sqrt{3}}{2}$)

$\theta \in [0, 2\pi]$

$\left\{\frac{\pi}{3}, \frac{2\pi}{3}\right\}$

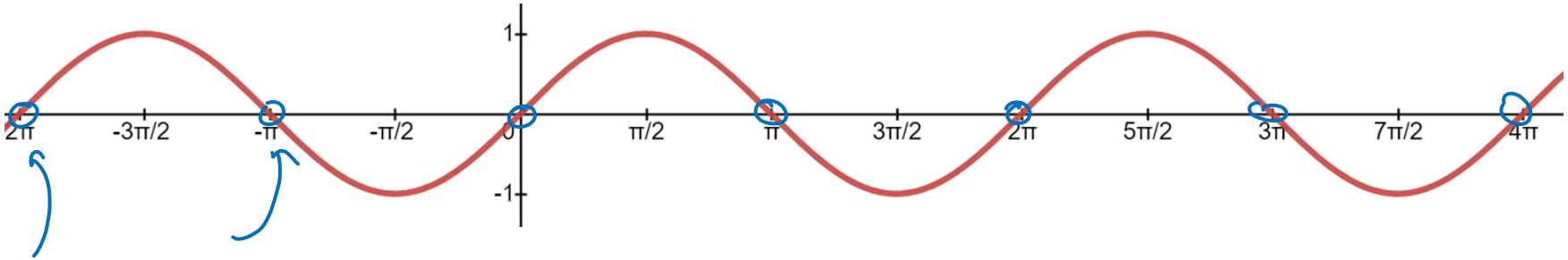
$\theta = n\pi + (-1)^n \frac{\pi}{3}$

$n \in I$

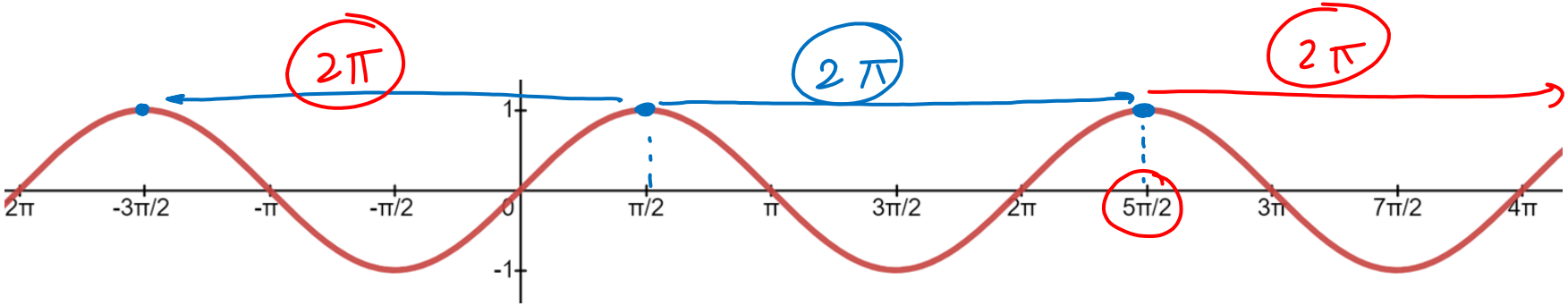
Simple T-Equations

jee

1. $\sin\theta = 0 \Rightarrow \theta = n\pi,\ n \in I$

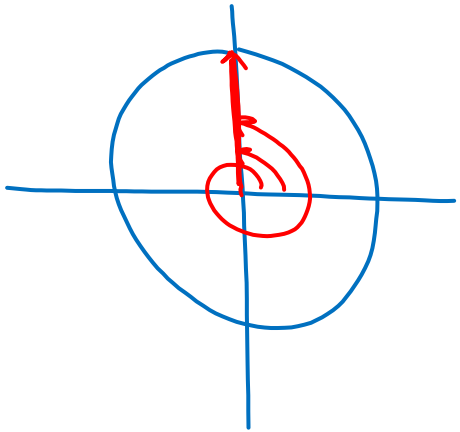


2. $\sin\theta = 1 \Rightarrow \theta = (4n+1)\frac{\pi}{2}, n \in I$



$2n\pi + \frac{\pi}{2}$

$(4n+1)\frac{\pi}{2}$ $n \in I$



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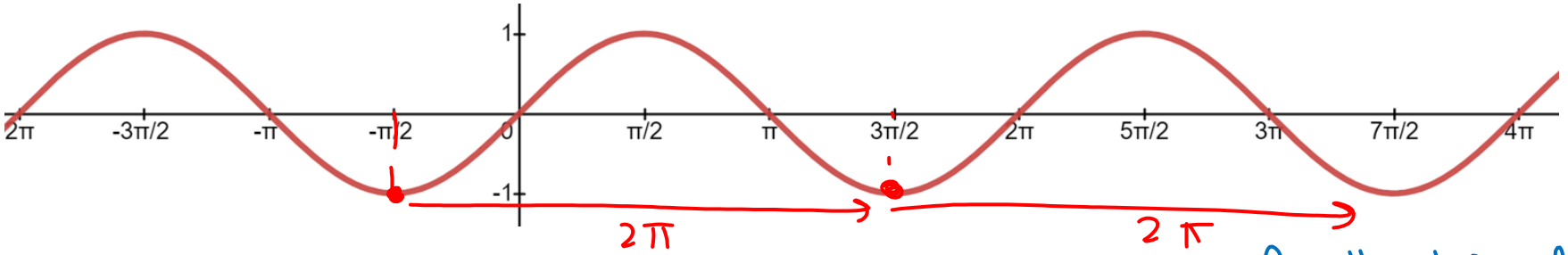
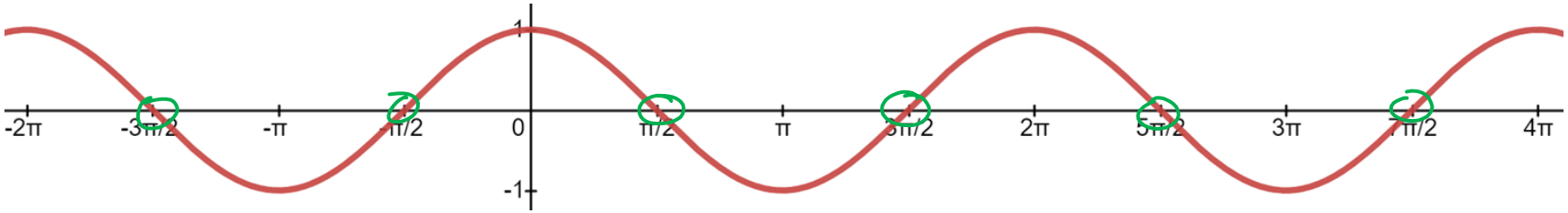
3. $\sin\theta = -1 \Rightarrow \theta = (4n-1)\frac{\pi}{2}, n \in I$



$$\left\{\begin{array}{l} 2n\pi - \frac{\pi}{2} \; ; n \in I \\ (4n-1)\frac{\pi}{2} \; ; n \in I \end{array}\right. \quad \| \quad \left\{\begin{array}{l} 2n\pi + \frac{3\pi}{2} \; ; n \in I \\ (4n+3)\frac{\pi}{2} \; ; n \in I \end{array}\right.$$

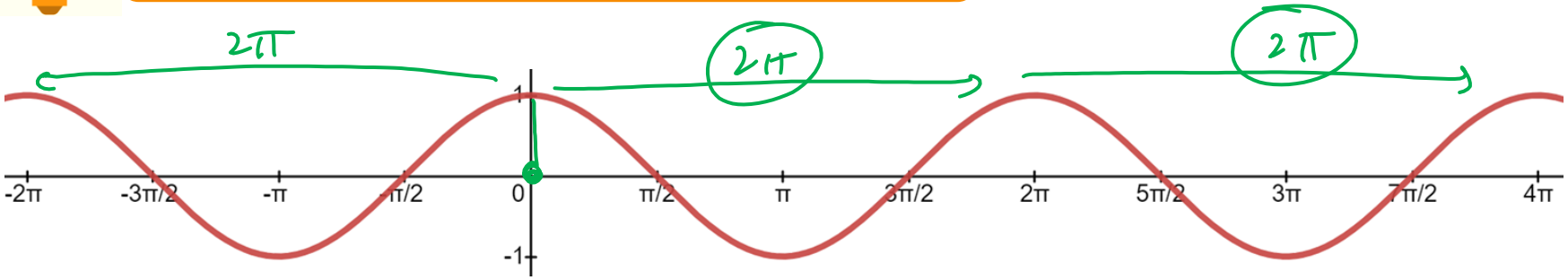
Another format

4. $\cos\theta = 0 \Rightarrow \theta = (2n+1)\frac{\pi}{2}, n \in I$



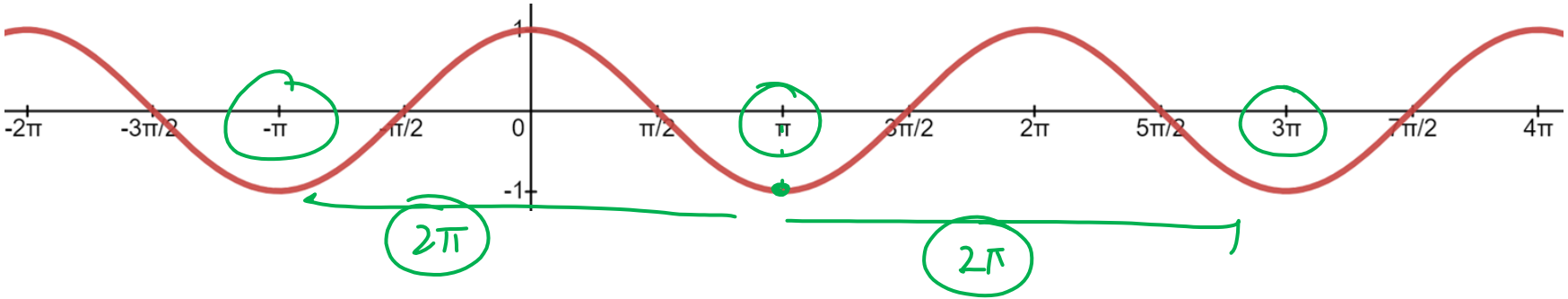
odd multiples of "$\frac{\pi}{2}$"

5. $\cos\theta = 1 \Rightarrow \theta = 2n\pi,\ n \in I$



$2n\pi + 0, \quad n \in I$

6. $\cos\theta = -1 \Rightarrow \theta = (2n + 1)\pi,\ n \in I$



$2n\pi + \pi \quad ; n \in I$

$(2n+1)\pi \quad ; n \in I$

General Solution of Standard T-Equations

1. $\sin\theta = \sin\alpha$

$$\Rightarrow \theta = n\pi + (-1)^n\alpha \quad \text{where } \alpha \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right], n \in I$$

Eg: $\sin\theta = \frac{\sqrt{3}}{2}$

$\sin\theta = \sin\frac{\pi}{3}$

$\Rightarrow \boxed{\theta = n\pi + (-1)^n \frac{\pi}{3}}$

$n \in I$

Proof:

$\sin\theta = \sin\alpha$

$\sin\theta - \sin\alpha = 0$

$\sin\left(\frac{\theta-\alpha}{2}\right) \cdot \cos\left(\frac{\theta+\alpha}{2}\right) = 0$

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Case-1 : $\sin\left(\frac{\theta-\alpha}{2}\right)=0$

$\frac{\theta-\alpha}{2}=n\pi$

$\theta=2n\pi+\alpha$

Case-2: $\cos\left(\frac{\theta+\alpha}{2}\right)=0$

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

$\theta=(2n+1)\pi-\alpha$

$\theta=n\pi+(-1)^n\alpha$

$n\in I$

Solve: $\sin\theta = \frac{1}{2}$

$\sin\theta = \sin\frac{\pi}{6}$

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

$n \in I$

$\left\{\frac{\pi}{6}, \frac{5\pi}{6}\right\}$

Solve: $\sin\left(\theta + \frac{\pi}{6}\right) = -\frac{1}{\sqrt{2}}$

$$\sin\left(\theta + \frac{\pi}{6}\right) = \sin\left(-\frac{\pi}{4}\right)$$

$$\left(\theta + \frac{\pi}{6}\right) = n\pi + (-1)^n\left(-\frac{\pi}{4}\right)$$

$$\theta = n\pi + (-1)^n\left(-\frac{\pi}{4}\right) - \frac{\pi}{6}$$ where: $n \in I$

2. $\cos\theta = \cos\alpha$

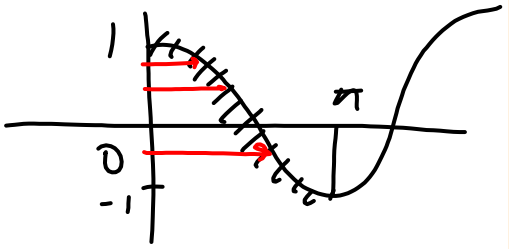
$\Rightarrow \theta = 2n\pi \pm \alpha$ where $\alpha \in [0, \pi]$, $n \in I$

$\cos\theta - \cos\alpha = 0$

$-2\sin\left(\frac{\theta+\alpha}{2}\right)\sin\left(\frac{\theta-\alpha}{2}\right) = 0$

Case-1 : $\sin\left(\frac{\theta+\alpha}{2}\right) = 0$

$\frac{\theta+\alpha}{2} = n\pi$



$\theta = 2n\pi - \alpha$; $n \in I$

Case-2 : $\sin\left(\frac{\theta-\alpha}{2}\right) = 0$

$\frac{\theta-\alpha}{2} = n\pi$

$\theta = 2n\pi + \alpha$, $n \in I$

Solve: $\cos 3\theta = \frac{\sqrt{3}}{2}$

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

$$3\theta = 2n\pi \pm \left(\frac{\pi}{6}\right)$$

$$\theta = \frac{2n\pi}{3} \pm \frac{\pi}{18} \quad n \in I$$

Solve: sec 2x = -2

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

$\cos 2x = \cos\left(\frac{2\pi}{3}\right)$

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

$x = n\pi \pm \frac{\pi}{3}$; $n \in I$

$\alpha \in [0, \pi]$

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

(−) $\left(\frac{\pi}{2}, \pi\right)$

$\cos\frac{\pi}{3} = \frac{1}{2}$

$\cos\left(\pi - \frac{\pi}{3}\right) = -\cos\frac{\pi}{3} = -\frac{1}{2}$

Solve: $\cos 2\theta = \frac{1}{3}$

Let: $\cos\alpha = \frac{1}{3} \Rightarrow \boxed{\alpha = \cos^{-1}\frac{1}{3}}$

$\cos 2\theta = \cos\alpha$

$2\theta = 2n\pi \pm \alpha$

$\boxed{\theta = n\pi \pm \frac{\alpha}{2}}$, where: $\alpha = \cos^{-1}\frac{1}{3}$ & $n \in I$

3. $\tan\theta = \tan\alpha$

$\Rightarrow \theta = n\pi + \alpha$ where $\alpha \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right), n \in I$

$$\frac{\sin\theta}{\cos\theta} = \frac{\sin\alpha}{\cos\alpha}$$

$$\sin\theta\cos\alpha = \sin\alpha\cos\theta$$

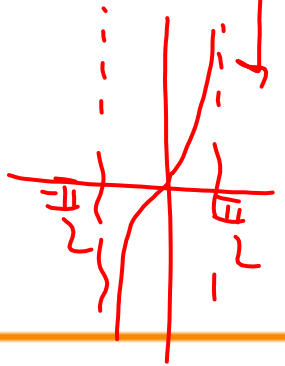
$$\sin\theta\cos\alpha - \sin\alpha\cos\theta = 0$$

$$\sin(\theta - \alpha) = 0$$

$$\theta - \alpha = n\pi$$

$$\theta = n\pi + \alpha$$

$n \in I$



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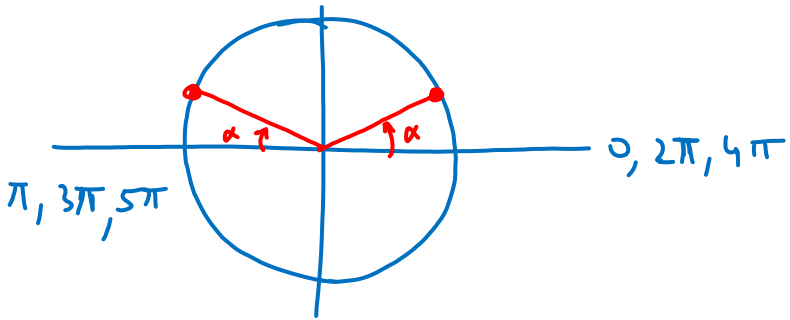
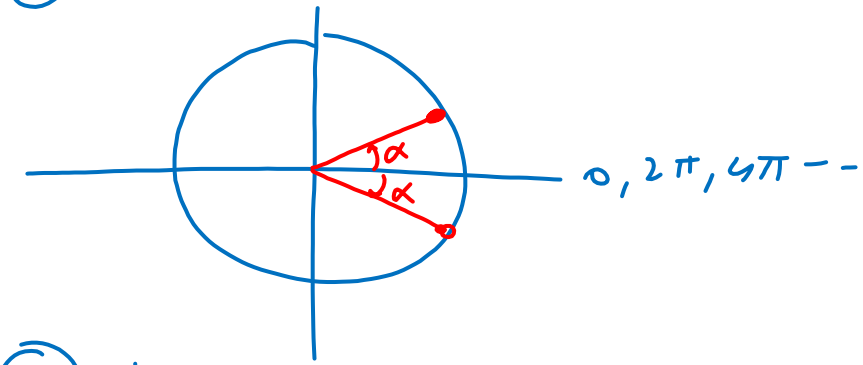
* Location:

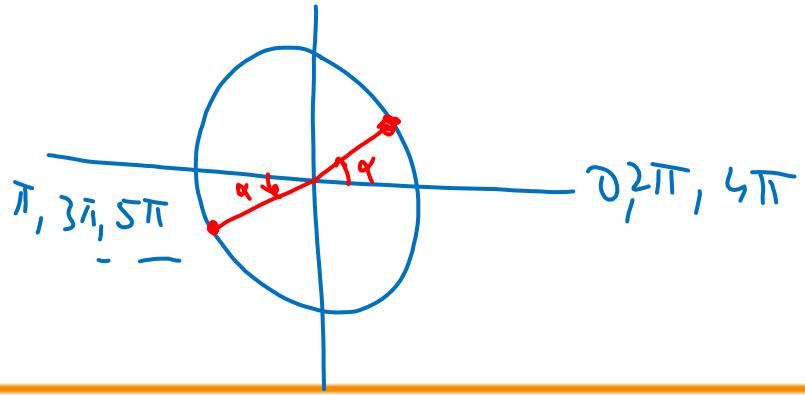
① $\sin\theta = \sin\alpha$



② $\cos\theta = \cos\alpha$



③ $\tan\theta = \tan\alpha$



Solve: $\tan 3x = -\cot\left(x + \frac{\pi}{6}\right)$

$$\tan\left(\frac{\pi}{2} + \theta\right) = -\cot\theta$$

$$\tan 3x = \tan\left(\frac{\pi}{2} + \left(x + \frac{\pi}{6}\right)\right)$$

$$\tan 3x = \tan\left(x + \frac{2\pi}{3}\right)$$

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

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

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

; $n \in I$

4

If $\sin^2\theta = \sin^2\alpha$

$\Rightarrow \theta = n\pi \pm \alpha,\ n \in I$

$\sin^2\theta - \sin^2\alpha = 0$

$\sin(\theta+\alpha)\sin(\theta-\alpha) = 0$

Case-1. $\sin(\theta+\alpha) = 0$

$\theta + \alpha = n\pi$

$\theta = n\pi - \alpha$

Case-2. $\sin(\theta-\alpha) = 0$

$\theta - \alpha = n\pi$

$\theta = n\pi + \alpha$

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5 If $\cos^2\theta = \cos^2\alpha$

$\Rightarrow \theta = n\pi \pm \alpha,\ n \in I$

$1 - \sin^2\theta = 1 - \sin^2\alpha$

$\sin^2\theta = \sin^2\alpha$

6

If $\tan^2\theta = \tan^2\alpha$

$\Rightarrow \theta = n\pi \pm \alpha,\ n \in I$

$\sec^2\theta - 1 = \sec^2\alpha - 1$

$\cos^2\theta = \cos^2\alpha$

Solve: $\cos^2\frac{\theta}{2} = \frac{1}{2}$

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

$$\cos^2\frac{\theta}{2} = \cos^2\left(\frac{\pi}{4}\right)$$

$$\frac{\theta}{2} = n\pi \pm \frac{\pi}{4}$$

$$\theta = 2n\pi \pm \frac{\pi}{2}$$

; $n \in I$

Solve: $7\sin^2\theta + 3\cos^2\theta = 4$

$7\sin^2\theta + 3(1 - \sin^2\theta) = 4$

$4\sin^2\theta = 1$

$\sin^2\theta = \frac{1}{4}$

$\sin^2\theta = \sin^2\frac{\pi}{6}$

$\theta = n\pi \pm \frac{\pi}{6}$

; $n \in I$

Solve: $\cos^2\left(x+\frac{\pi}{3}\right)=\sin^2\left(\frac{\pi}{3}-x\right)$

HW

#JEELiveDaily Schedule

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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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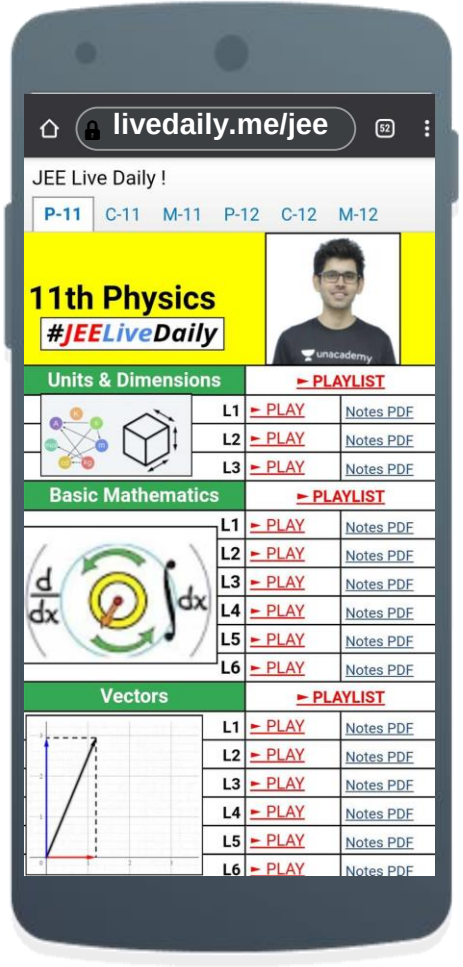

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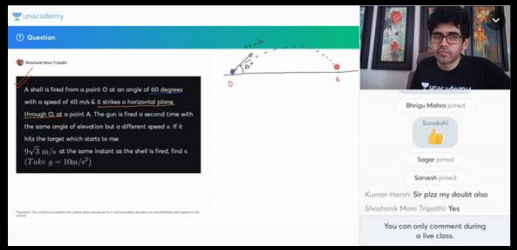

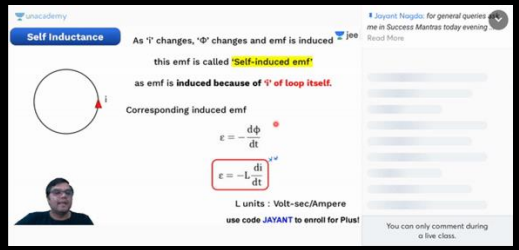

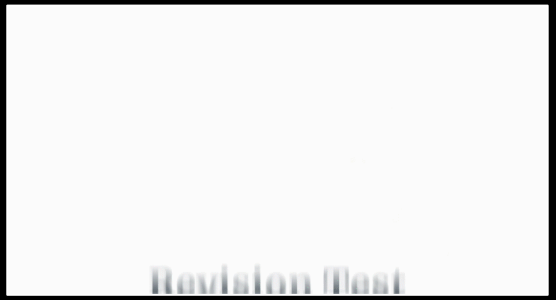

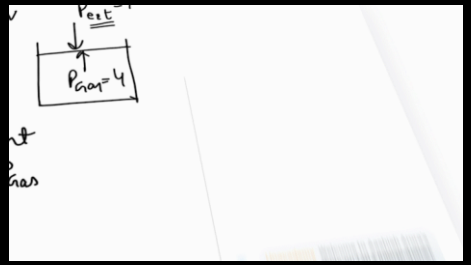

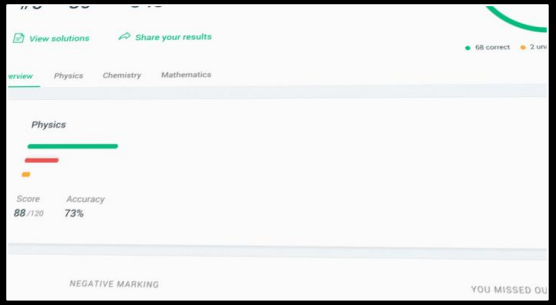

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- **LIVE Doubt** Solving
- **LIVE** Interaction

+ Performance Analysis

- **Weekly Test Series**
- **DPPs** & **Quizzes**

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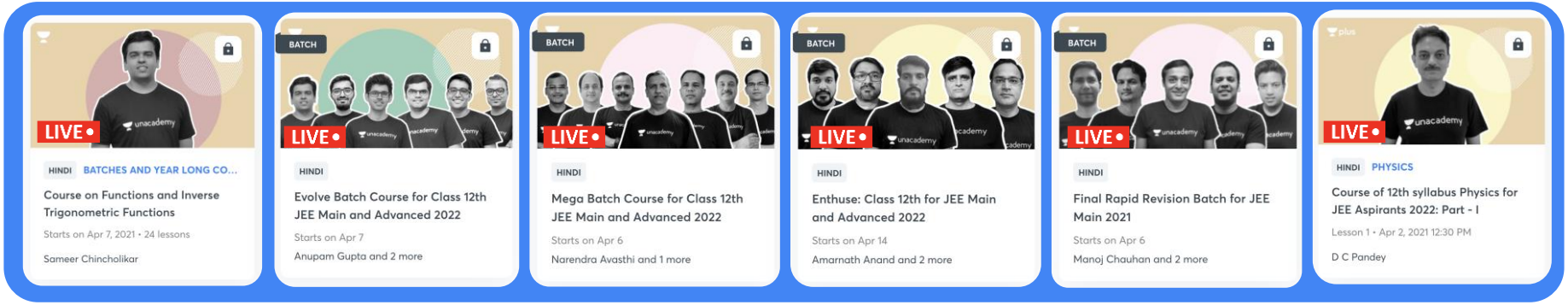

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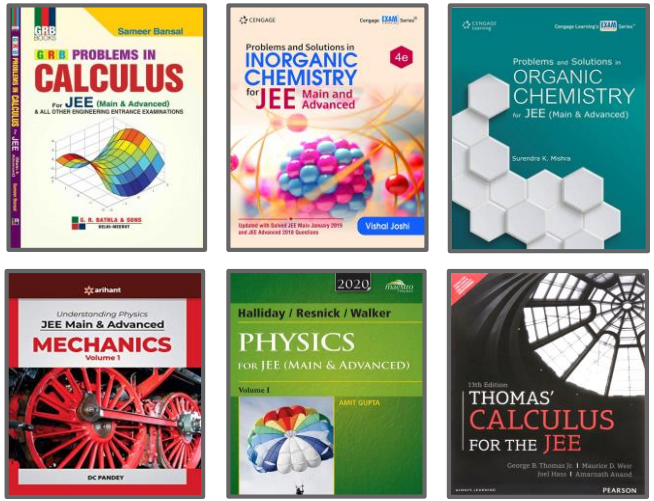
"Learn" from the **BEST**



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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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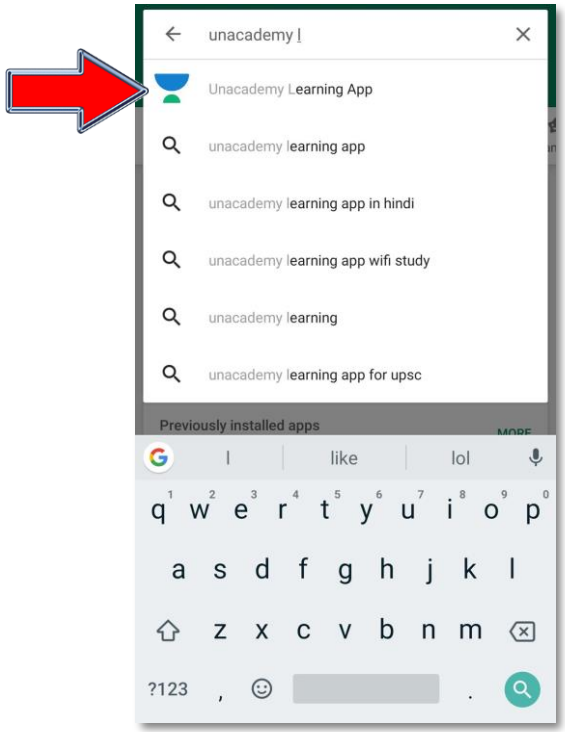
Step 1



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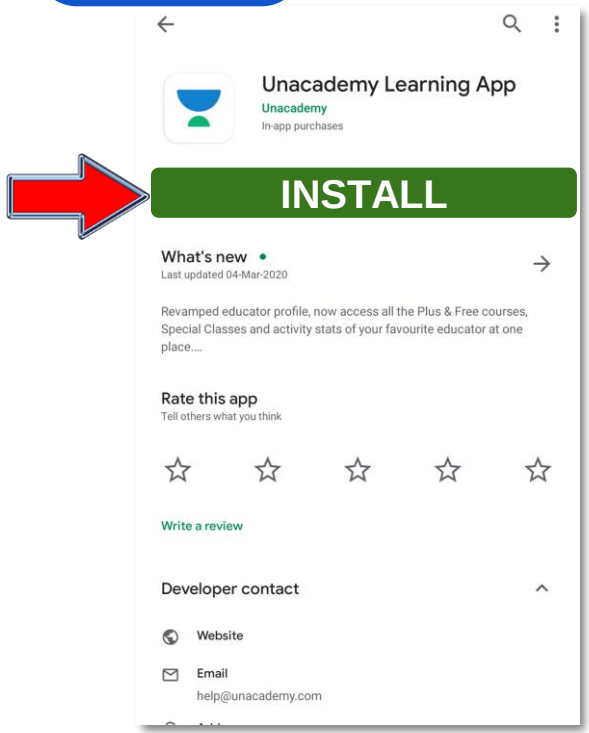

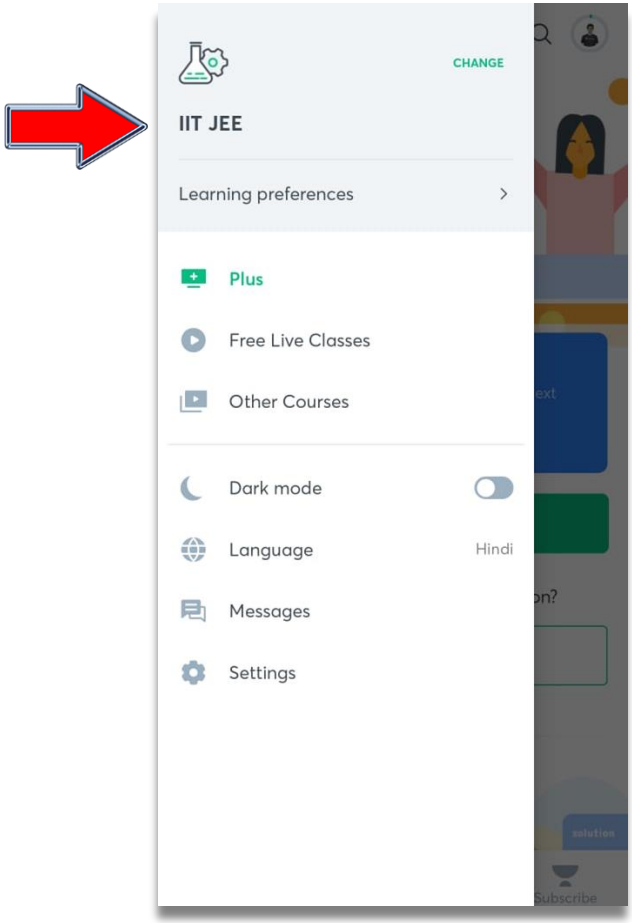
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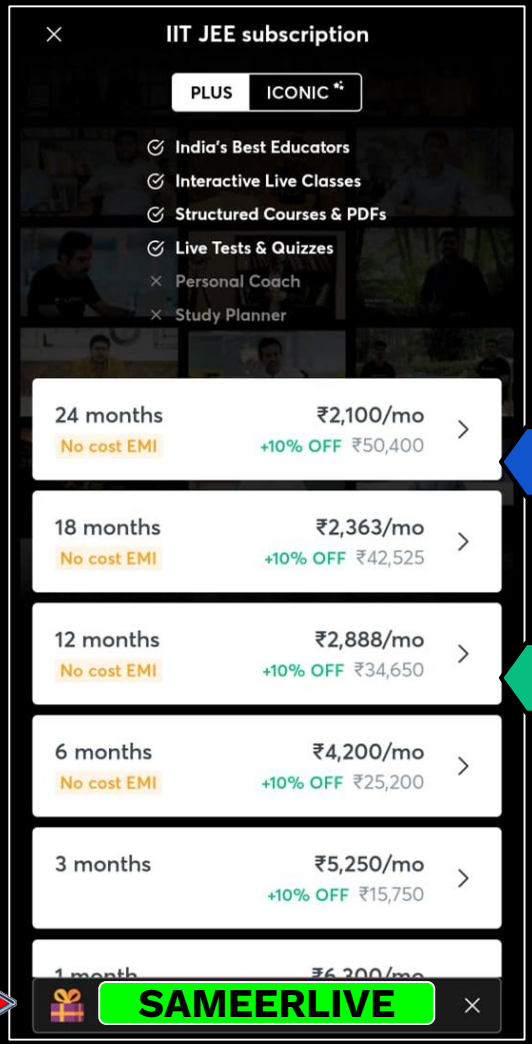

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Upcoming Batches in May

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Evolve Batch (Class 12th) : JEE Main & Advanced 2022 — Starts on 19th May 2021

Micro Batch : JEE Main & Advanced 2023 — Starts on 19th May 2021

Legend 3.0 Batch : JEE Main & Advanced 2022 — Starts on 19th May 2021

Emerge Batch (Class 11th) : JEE Main & Advanced 2023 — Starts on 20th May 2021

Spark 3.0 Batch : JEE Main & Advanced 2023 — Started on 26th May 2021

Upcoming Tests in May

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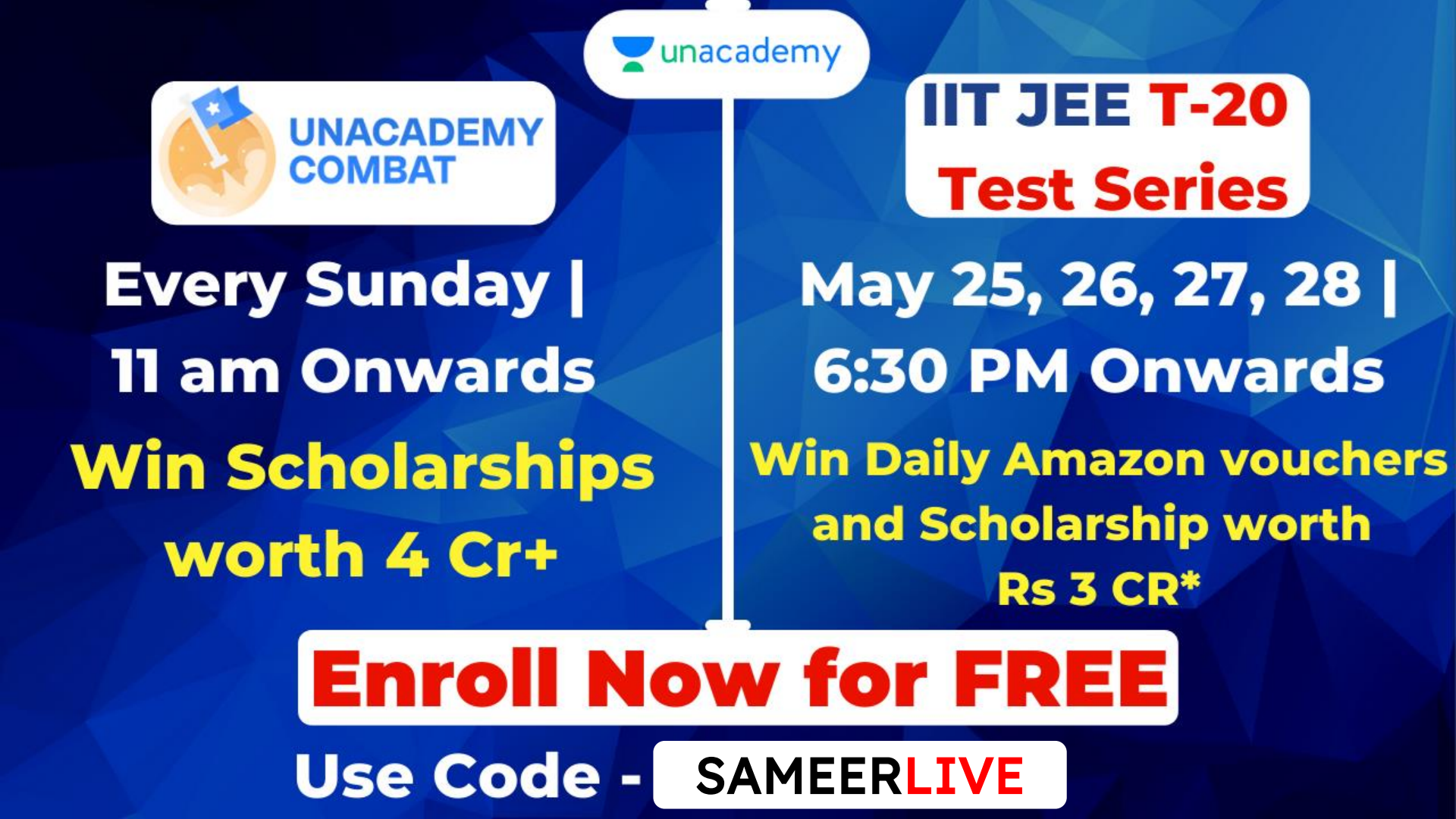
- **Unacademy COMBAT** - 23rd May
- **T 20 Test Series - Target JEE 2022** - 18, 19, 20, 21, 22nd May
- **T 20 Test Series - Target JEE 2023** - 18, 19, 20, 21, 22nd May
- **JEE Live Daily Test Series - 2022** - 19th May
- **JEE Live Daily Test Series - 2023** - 19th May
- **Chem-O-Legends by Kashif Alam** - 24th May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