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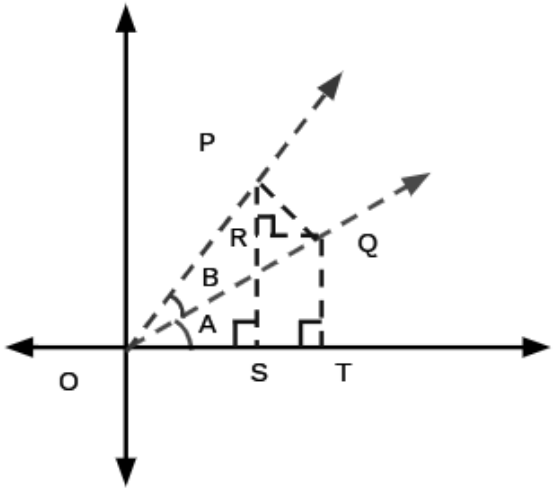
Multiple & Submultiple Angle Formulas

Trigonometry 7



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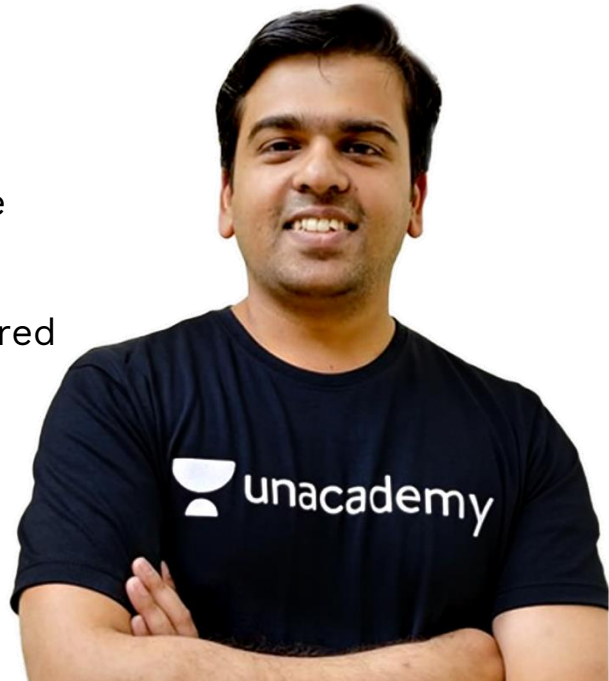
Sameer Chincholikar

B.Tech, M.Tech - IIT-Roorkee

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



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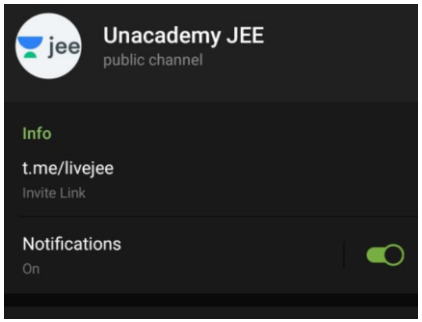

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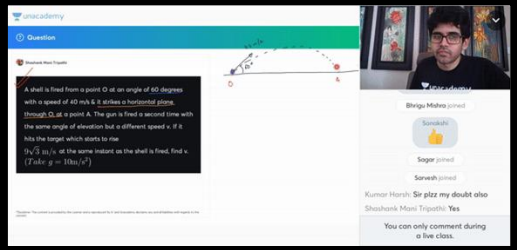

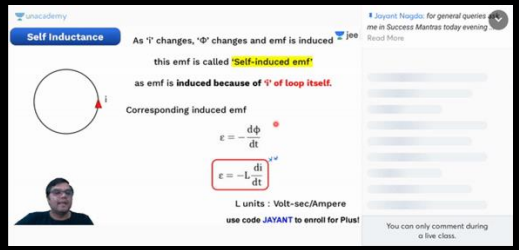

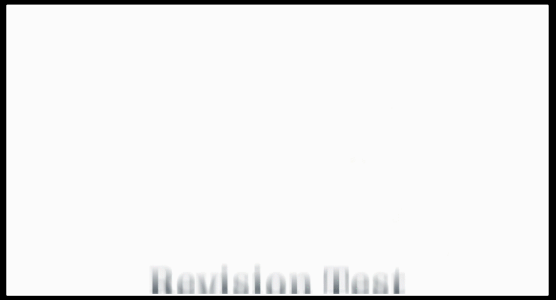

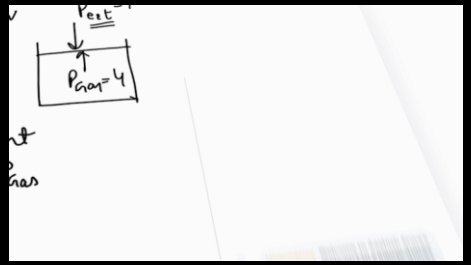

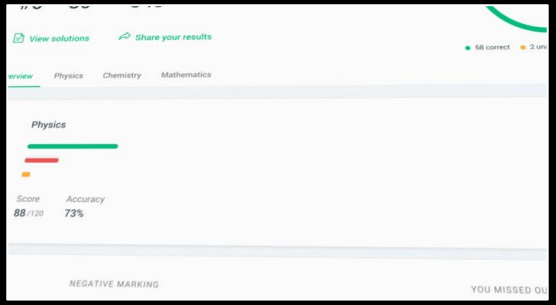

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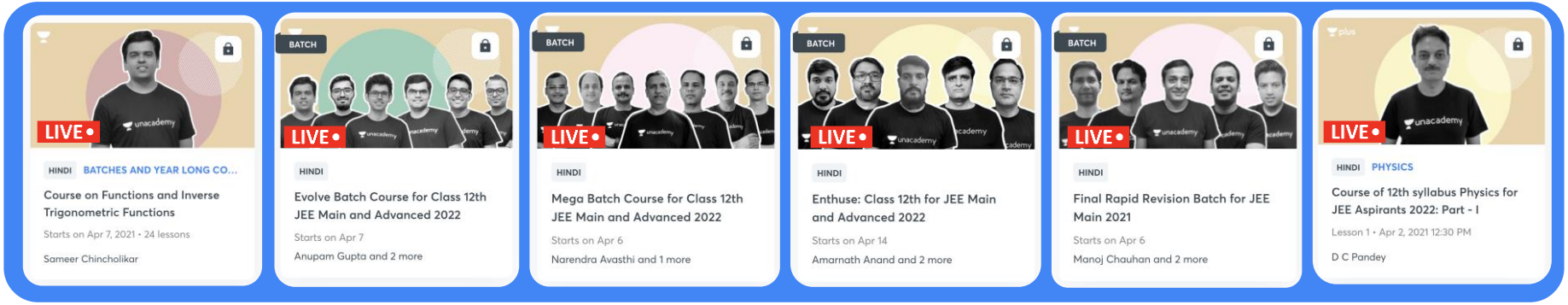

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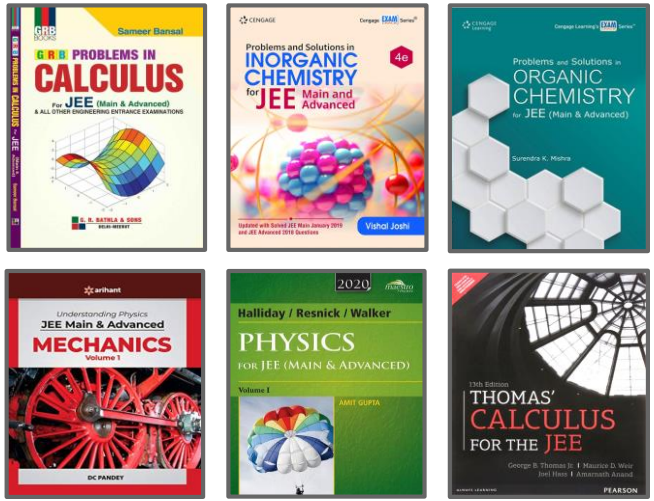

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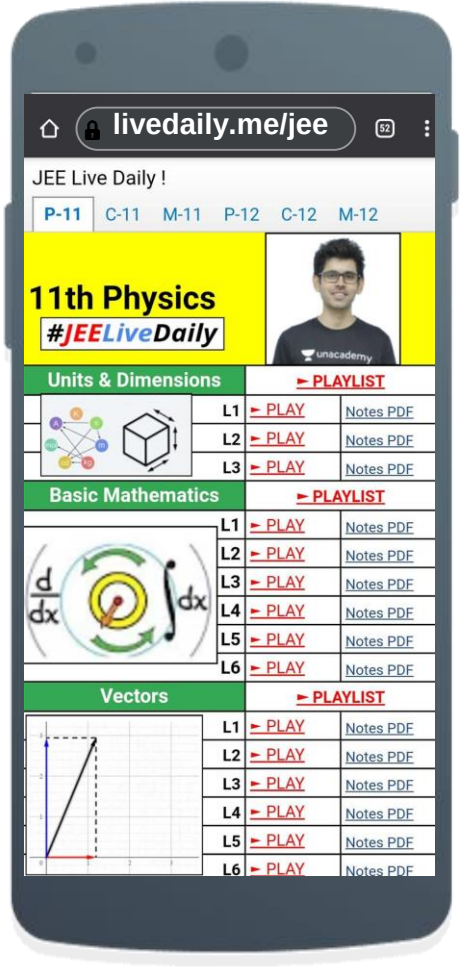

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Top Results

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

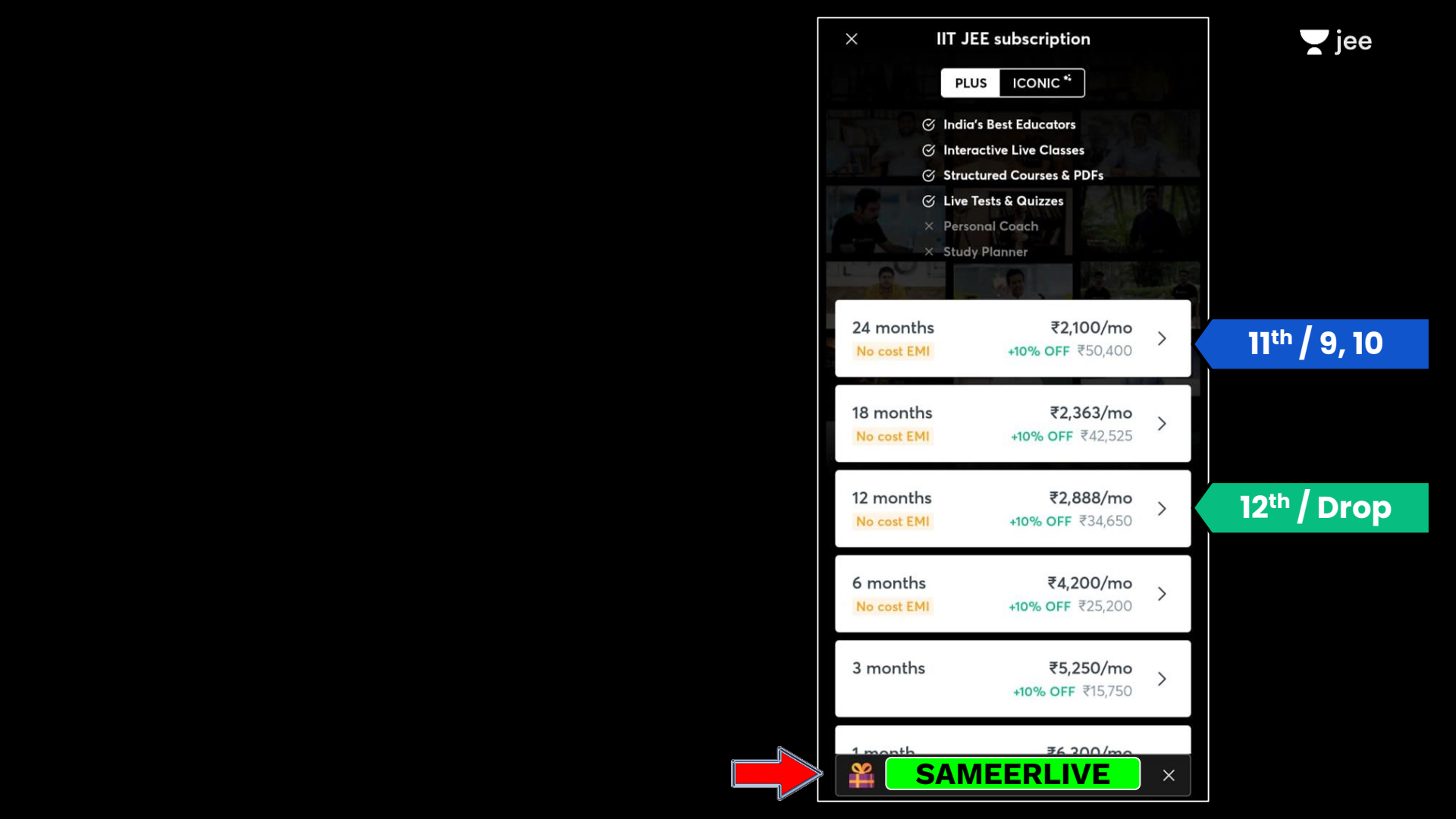
Ayush Kale
98.85

Ayush Gupta
98.67

Megh Gupta
98.59

Naman Goyal
98.48

MIHIR PRAJAPATI
98.16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+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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11th / 9, 10
12th / Drop

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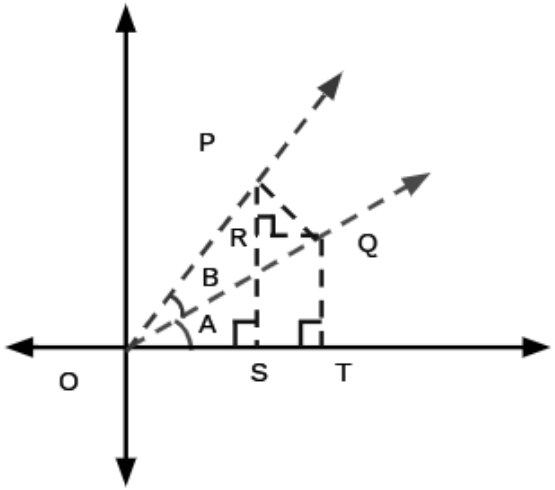
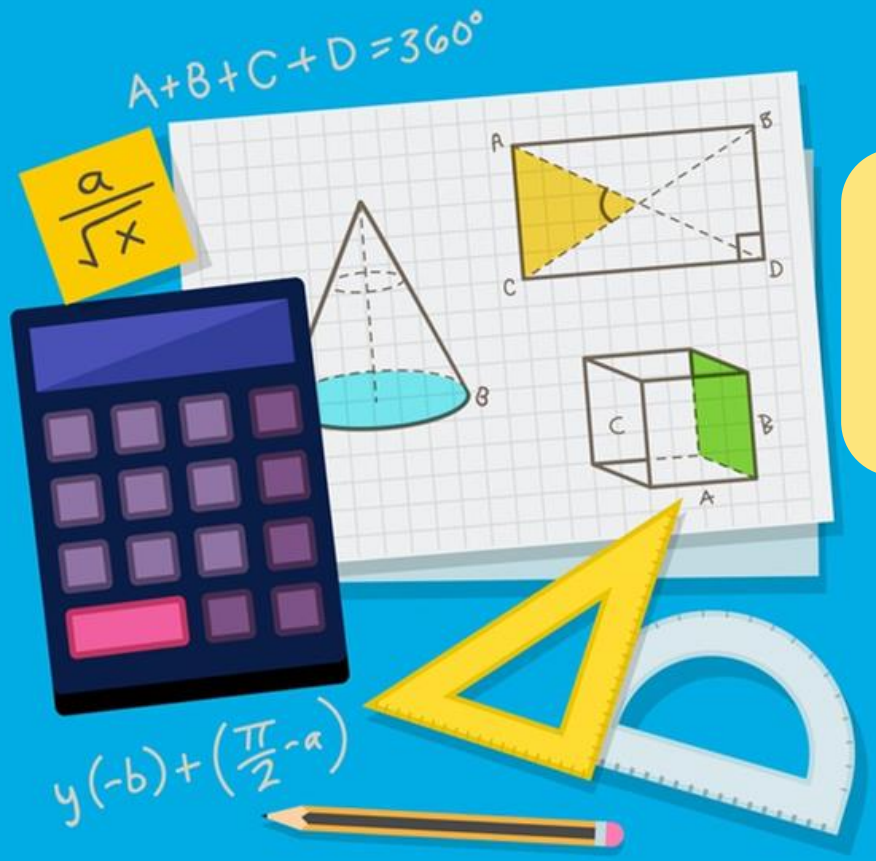
Multiple & Submultiple Angle Formulas

Trigonometry 7



LET'S BEGIN!!



Homework Question

If $A + B = \frac{\pi}{3}$, then find the value of

$\cos^2 A + \cos^2 B - \cos A.\cos B$

A. $\frac{1}{2}$ **B.** $\frac{3}{2}$ **C.** $\frac{3}{4}$ **D.** 1

M-1:

Shortcut: $A = B = \frac{\pi}{6}$

$\cos^2 \frac{\pi}{6} + \cos^2 \frac{\pi}{6} - \cos^2 \frac{\pi}{6}$

M-2

$\cos^2 A + \cos^2 B - \cos A \cos B$

$(1 - \sin^2 A) + \cos^2 B - \cos A \cos B$

$1 + \cos(A+B)\cdot\cos(A-B) - \cos A \cos B$

$\pi/3$

$1 + \frac{1}{2}(\cos A \cos B + \sin A \sin B) - \cos A \cos B$

$1 + \frac{1}{2}(\sin A \sin B - \cos A \cos B)$

$1 - \frac{1}{2}(\cos A \cos B - \sin A \sin B)$

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

$1 - \frac{1}{4}$

$= 3/4$

The value of $\cos^2 10^0 - \cos 10^0 . \cos 50^0 + \cos^2 50^0$ is:

JEE Main 2019 (April)

A. $\frac{3}{4} + \cos 20°$

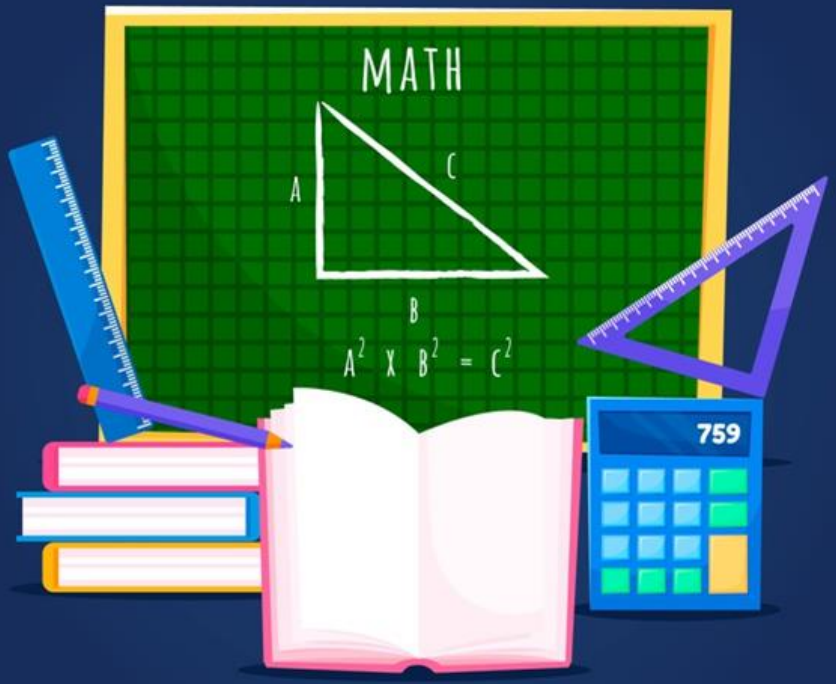
B. 3/4

C. $\frac{3}{2}(1 + \cos 20°)$

D. 3/2

$\cos^2 10° - \cos 10° \cos 50° + \cos^2 50°$

T-Ratios of Multiple Angles



T-Ratios of multiple angles

1 **sin 2A = 2 sin A cos A**

$\because \sin(A+B) = \sin A\cos B + \cos A \sin B$

$B \rightarrow A$

$\sin 2A = \sin A \cos A + \cos A \sin A$

$$\boxed{\sin 2A = 2\sin A \cos A}$$

$\cot\theta + \tan\theta =$

A. $\tan 2\theta$ **B.** $2\cos 2\theta$ **C.** $2\operatorname{cosec} 2\theta$ **D.** $\cot 2\theta$

$$\cot\theta + \tan\theta$$

$$\frac{\cos\theta}{\sin\theta} + \frac{\sin\theta}{\cos\theta}$$

$$= \frac{1}{\sin\theta\cos\theta}$$

$$= \frac{2}{2\sin\theta\cos\theta}$$

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

$$= \boxed{2\operatorname{cosec} 2\theta}$$

T-Ratios of multiple angles

2

$$\cos 2A = \cos^2 A - \sin^2 A$$
$$= 2\cos^2 A - 1$$
$$= 1 - 2\sin^2 A$$

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

$B \rightarrow A$

$$\cos(2A) = \boxed{\cos^2 A - \sin^2 A}$$

$$= 1 - \sin^2 A - \sin^2 A$$
$$= \boxed{1 - 2\sin^2 A}$$

$$= \cos^2 A - (1 - \cos^2 A)$$
$$= \boxed{(2\cos^2 A - 1)}$$

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$$\cos 2A = 2\cos^2 A - 1$$

$$\boxed{1 + \cos 2A = 2\cos^2 A}$$

$$\cos 2A = 1 - 2\sin^2 A$$

$$\boxed{2\sin^2 A = 1 - \cos 2A}$$

$$\frac{\sin\theta + \sin 2\theta}{1 + \cos\theta + \cos 2\theta}$$ is equal to

A. $\tan\theta$ B. $\cot\theta$ C. $\cos\theta - \cot\theta$ D. $\cos\theta + \cot\theta$

$$\frac{\sin\theta + 2\sin\theta\cos\theta}{1 + \cos\theta + (2\cos^2\theta - 1)}$$

$$= \frac{\sin\theta(1 + 2\cos\theta)}{\cos\theta(1 + 2\cos\theta)} = \tan\theta$$

T-Ratios of multiple angles

3

$$\tan 2A = \frac{2\tan A}{1-\tan^2 A}$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$B \to A$:

$$\tan 2A = \frac{2\tan A}{1-\tan^2 A}$$

T-Ratios of multiple angles

4

$$\sin 2A = \frac{2\tan A}{1+\tan^2 A} \qquad \cos 2A = \frac{1-\tan^2 A}{1+\tan^2 A}$$

$= 2\left(\frac{\sin A}{\cos A}\right)\cos A \cos A$

$= \frac{2\tan A}{\sec^2 A}$

$\cos^2 A - \sin^2 A$

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

$= \frac{1-\tan^2 A}{\sec^2 A}$

T-Ratios of multiple angles

5

$\sin 3A = 3\sin A - 4\sin^3 A$

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

$B \to A$; $C \to A$:

$$\sin 3A = 3\sin A\cos^2 A - \sin^3 A$$

$$= 3\sin A(1-\sin^2 A) - \sin^3 A$$

T-Ratios of multiple angles

6 $\cos 3A = 4\cos^3 A - 3\cos A$

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

$B \to A$; $C \to A$:

$$\cos 3A = \cos^3 A - 3\cos A\sin^2 A$$

$$= \cos^3 A - 3\cos A(1-\cos^2 A)$$

T-Ratios of multiple angles

7

$$\tan 3A = \frac{3\tan A - \tan^3 A}{1 - 3\tan^2 A}$$

$$\tan(A+B+C) = \frac{\tan A + \tan B + \tan C - \tan A \tan B \tan C}{1 - \tan A\tan B - \tan B\tan C - \tan C\tan A}$$

$B \to A$; $C \to A$:

$$\tan 3A = \frac{3\tan A - \tan^3 A}{1 - 3\tan^2 A}$$

$$\frac{\sin^3\theta + \sin 3\theta}{\cos^3\theta - \cos 3\theta}$$ is equal to

A. $\tan\theta$ **B.** $\cot\theta$ **C.** $\sin 2\theta$ **D.** $\cos 2\theta$

$$\frac{\sin^3\theta + \sin 3\theta}{\cos^3\theta - \cos 3\theta}$$

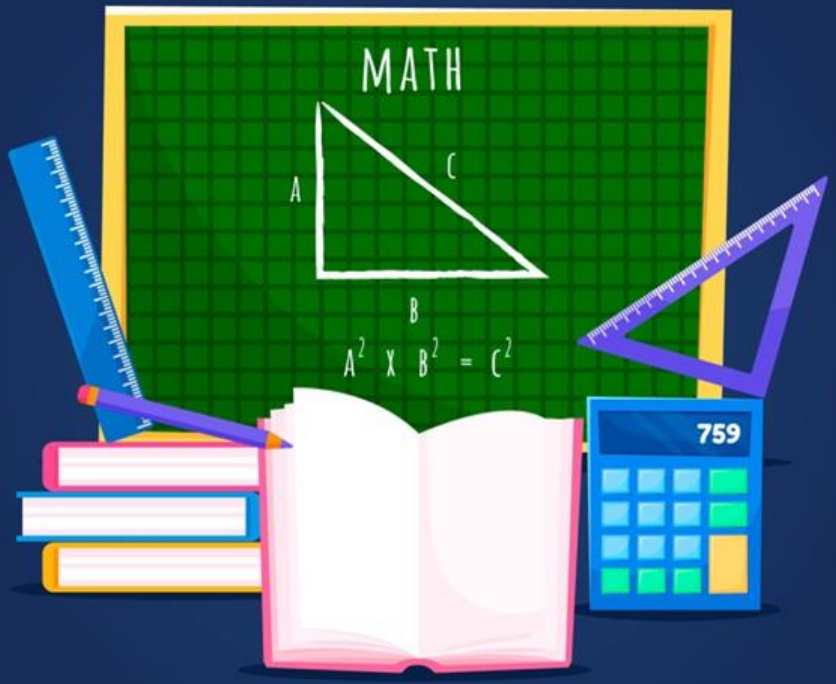
$$= \frac{\sin^3\theta + 3\sin\theta - 4\sin^3\theta}{\cos^3\theta - (4\cos^3\theta - 3\cos\theta)}$$

$$= \frac{3\sin\theta - 3\sin^3\theta}{3\cos\theta - 3\cos^3\theta}$$

$$= \frac{3\sin\theta(1 - \sin^2\theta)}{3\cos\theta(1 - \cos^2\theta)}$$

$$= \cot\theta$$

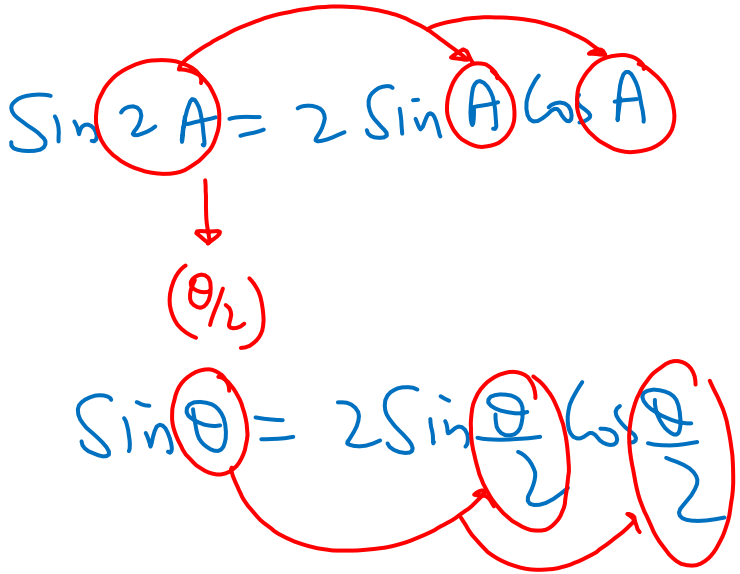
T-Ratios of Submultiple Angles



T-Ratios of submultiple angles

1

$$\sin\theta = 2\sin\frac{\theta}{2}\cos\frac{\theta}{2}$$



T-Ratios of submultiple angles

2

$$2\cos^2\frac{\theta}{2} = 1 + \cos\theta$$

$\cos 2A = 2\cos^2 A - 1$

$A \rightarrow \theta/2$

$\cos\theta = 2\cos^2\frac{\theta}{2} - 1$

T-Ratios of submultiple angles

3

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

$\cos 2A = 1 - 2\sin^2 A$

$A \rightarrow \theta/2$

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

T-Ratios of submultiple angles

4

$$\tan\theta = \frac{2\tan\frac{\theta}{2}}{1-\tan^2\frac{\theta}{2}}$$

Half Angle Formulas !!!

1. $\boxed{\sin 2A = 2 \sin A \cos A}$
2. $\sin A = 2 \sin \frac{A}{2} \cos \frac{A}{2}$
3. $\sin 4A = 2 \sin 2A \cos 2A$
4. $\sin 3A = 2 \sin \left(\frac{3A}{2}\right) \cos \left(\frac{3A}{2}\right)$

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(5) $\sin\theta = 3\sin\frac{\theta}{3} - 4\sin^3\frac{\theta}{3}$

$\sin 3\theta = 3\sin\theta - 4\sin^3\theta$

Simplify: $\left(\frac{1+\sin\theta-\cos\theta}{1+\sin\theta+\cos\theta}\right)$

A. $1+\tan\frac{\theta}{2}$ **B.** $1-\cot\frac{\theta}{2}$ **C.** $\tan\frac{\theta}{2}$ **D.** $\cot\frac{\theta}{2}$

$$\frac{(1-\cos\theta)+\sin\theta}{(1+\cos\theta)+\sin\theta}$$

$$= \frac{(2\sin^2\theta/2)+2\sin\theta/2\cos\theta/2}{(2\cos^2\theta/2)+2\sin\frac{\theta}{2}\cos\frac{\theta}{2}}$$

$\cos 2A = 2\cos^2 A - 1$

$\cos 2A = 1 - 2\sin^2 A$

$$= \frac{2\sin\theta/2\left(\sin\theta/2 + \cos\theta/2\right)}{2\cos\theta/2\left(\cos\theta/2 + \sin\theta/2\right)}$$

$$= \tan\frac{\theta}{2}$$

If $0 < \theta < \frac{\pi}{16}$, then $\sqrt{2+\sqrt{2+\sqrt{2+2\cos 8\theta}}}$ is equal to

A. $2\sin\theta$ **B.** $2\tan\theta$ **C.** $2\cot\theta$ **D.** $2\cos\theta$ ✓

$$= \sqrt{2+\sqrt{2+\sqrt{2(1+\cos 8\theta)}}}$$

$$= \sqrt{2+\sqrt{2+\sqrt{2(2\cos^2 4\theta)}}}$$

$\sqrt{x^2} = |x|$

If $x \geq 0$

$\sqrt{x^2} = x$

$\cos 2A = 2\cos^2 A - 1$

$(1+\cos 2A) = 2\cos^2 A$

$$= \sqrt{2 + \sqrt{2 + 2\cos 4\theta}}$$

$$= \sqrt{2 + \sqrt{2(1 + \cos 4\theta)}}$$

$$= \sqrt{2 + \sqrt{2(2\cos^2 2\theta)}}$$

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

$$= \sqrt{2(1 + \cos 2\theta)}$$

$$= \sqrt{2(2\cos^2 \theta)}$$

$$= 2\cos\theta$$

$$\left(\frac{\sin 3\theta}{\sin \theta}\right)^2 - \left(\frac{\cos 3\theta}{\cos \theta}\right)^2 = a \cos 2\theta$$, wherever it is defined.

Then the value of a is

A. 1 **B.** 0 **C.** 2 **D.** 8 ✓

$$LHS = \left(\frac{3\sin\theta - 4\sin^3\theta}{\sin\theta}\right)^2 - \left(\frac{4\cos^3\theta - 3\cos\theta}{\cos\theta}\right)^2$$

$$= (3 - 4\sin^2\theta)^2 - (4\cos^2\theta - 3)^2$$

$$= (9 + 16\sin^4\theta - 24\sin^2\theta)$$

$$- (16\cos^4\theta + 9 - 24\cos^2\theta)$$

$$= 16(\sin^4\theta - \cos^4\theta) + 24(\cos^2\theta - \sin^2\theta)$$

$$= 16(\sin^2\theta + \cos^2\theta)(\sin^2\theta - \cos^2\theta) + 24(\cos^2\theta - \sin^2\theta)$$

$$= 24\cos 2\theta - 16\cos 2\theta \longrightarrow \boxed{8\cos 2\theta}$$

If $2\cos\theta = x + \frac{1}{x}$, find the values of the following in terms of cosine of the multiple angle of θ.

More than one correct

A. $x^2 + \frac{1}{x^2} = 2\cos 2\theta$

B. $x^2 + \frac{1}{x^2} = 3\cos 2\theta$

C. $x^3 + \frac{1}{x^3} = 2\cos 3\theta$

D. $x^3 + \frac{1}{x^3} = 3\cos 3\theta$

$2\cos\theta = x + \frac{1}{x}$

Square both sides.

$\Rightarrow 4\cos^2\theta = x^2 + \frac{1}{x^2} + 2$

$x^2 + \frac{1}{x^2} = 4\cos^2\theta - 2$

$= 2(2\cos^2\theta - 1)$

$= 2\cos 2\theta$

Now,

$$x + \frac{1}{x} = 2\cos\theta$$

Cube both sides.

$$x^3 + \frac{1}{x^3} + 3(x)\left(\frac{1}{x}\right)\left(x + \frac{1}{x}\right) = 8\cos^3\theta$$

$$\Rightarrow x^3 + \frac{1}{x^3} = 8\cos^3\theta - 6\cos\theta$$

$$= 2\left(4\cos^3\theta - 3\cos\theta\right) = 2\cos 3\theta$$

The value of $\cos^3\left(\frac{\pi}{8}\right).\cos\left(\frac{3\pi}{8}\right)+\sin^3\left(\frac{\pi}{8}\right).\sin\left(\frac{3\pi}{8}\right)$ is

JEE Main 2020 (Jan)

A. $\frac{1}{\sqrt{2}}$

B. $\frac{1}{2\sqrt{2}}$

C. $\frac{1}{2}$

D. $\frac{1}{4}$

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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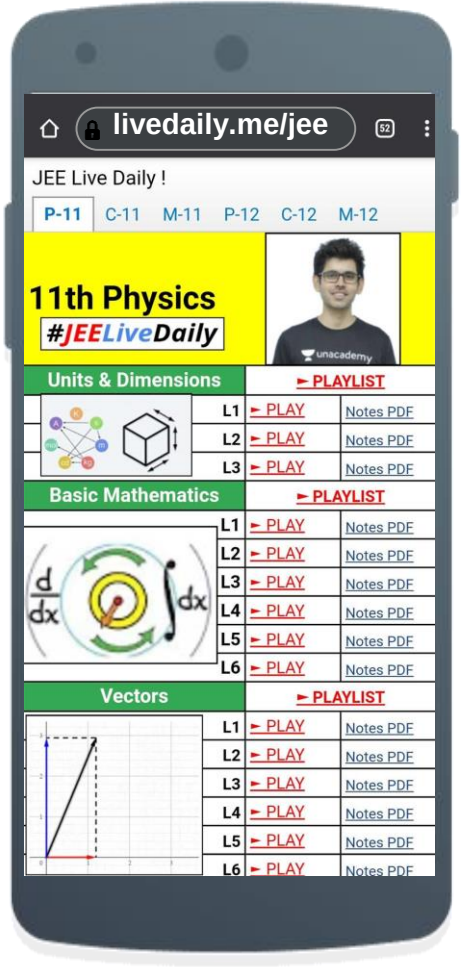

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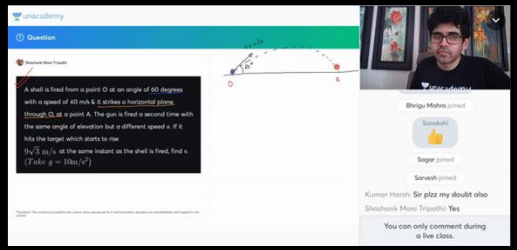

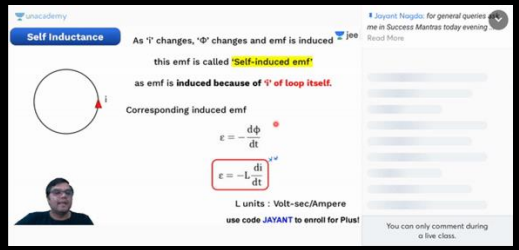

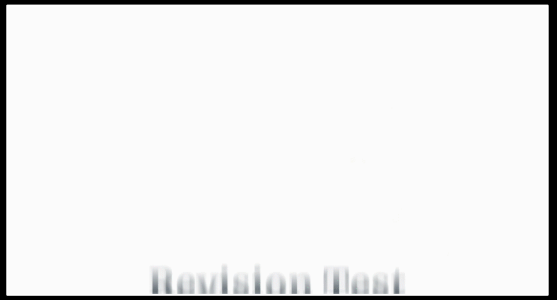

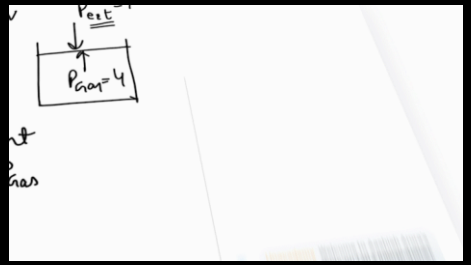

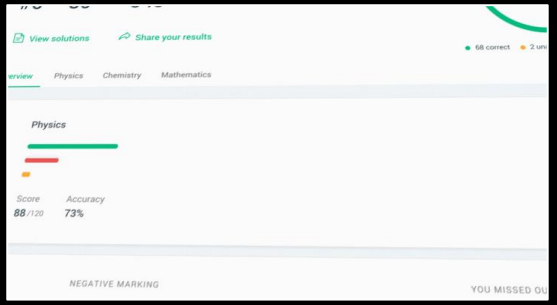

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- + **LIVE Doubt** Solving
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+ Performance Analysis

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

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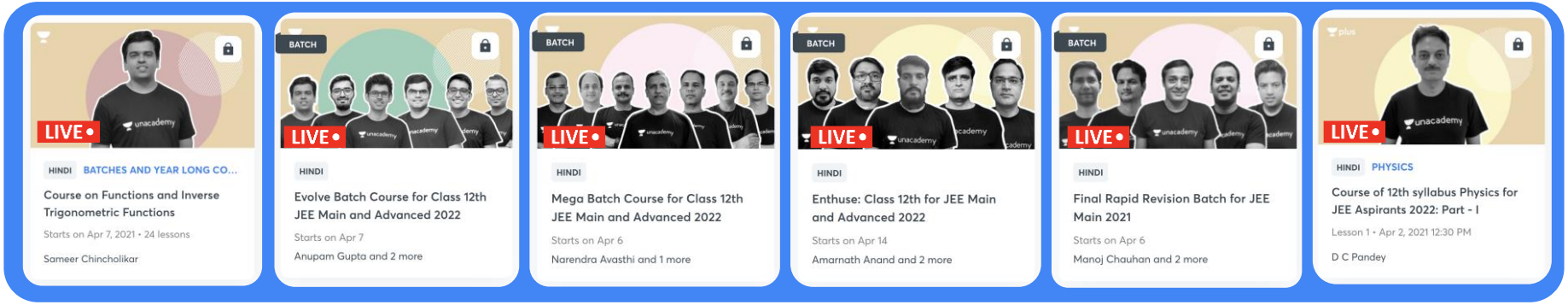

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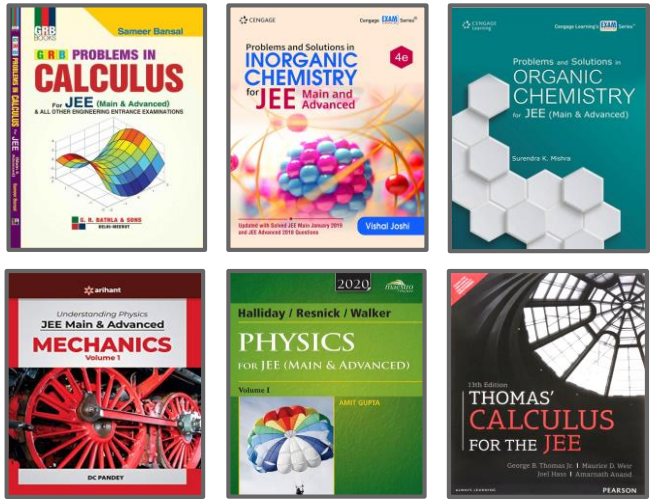

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Top Results

Bratin Mondal

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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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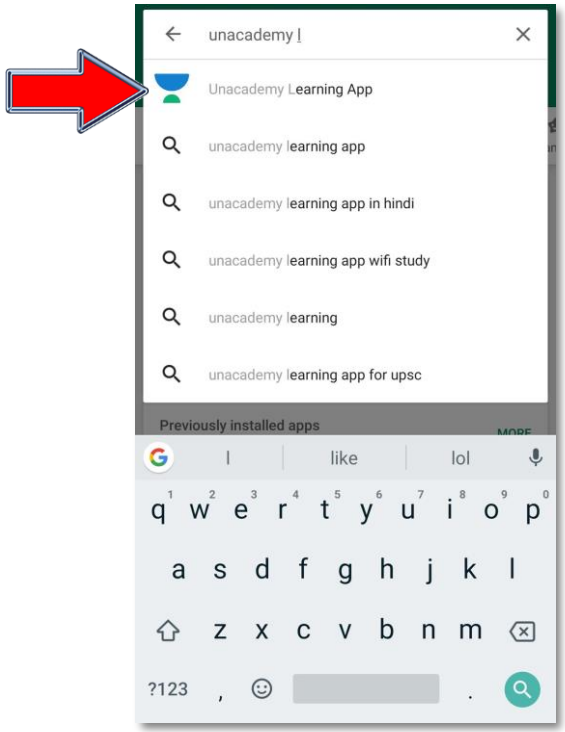
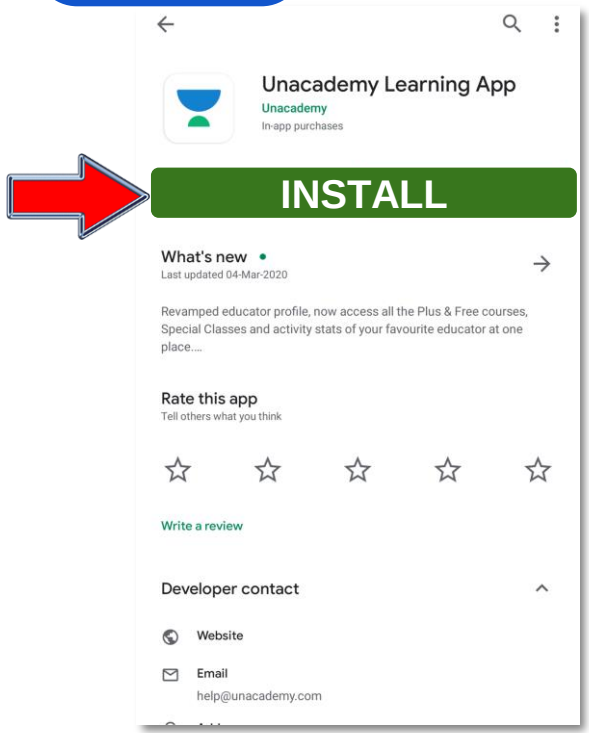
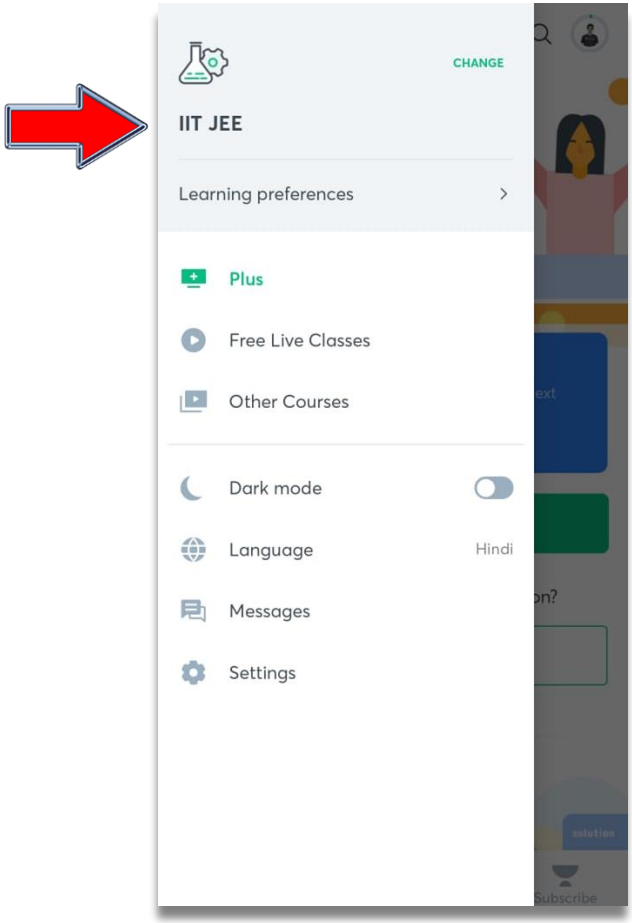
Step 1



Step 2

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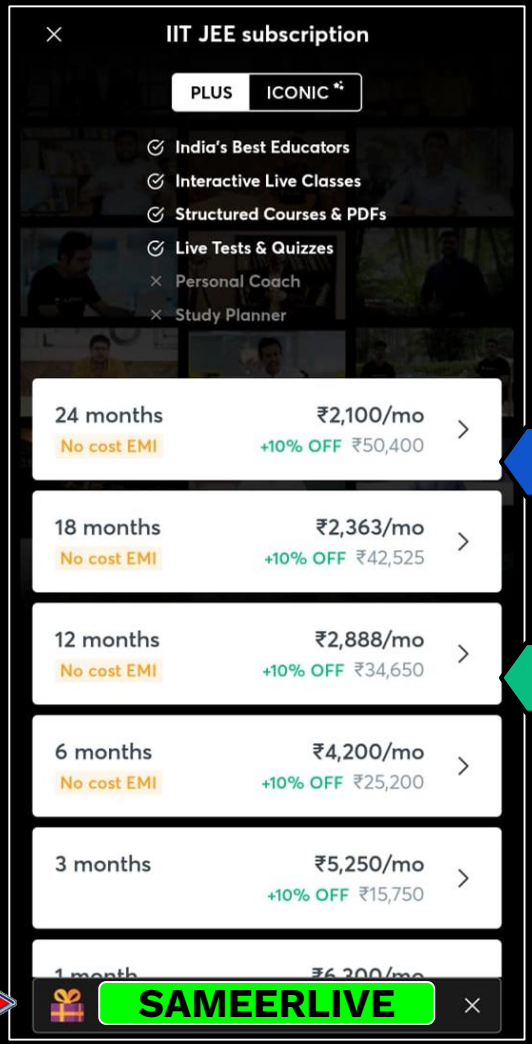

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