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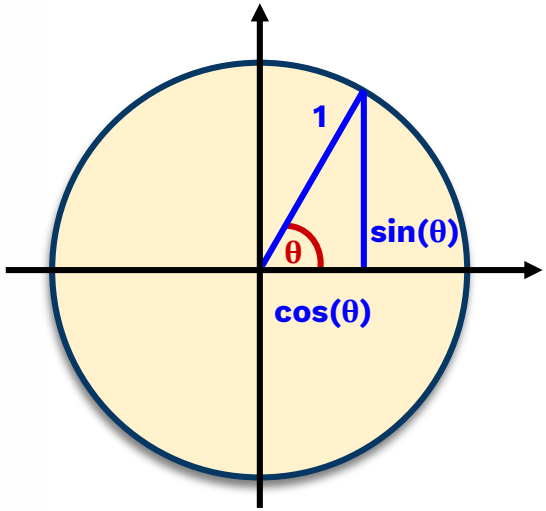
Trigonometric Series & Product of Cosines - 2

Trigonometry 11



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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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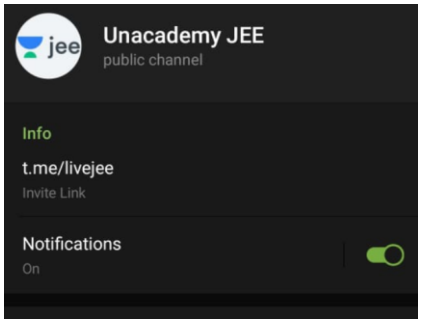

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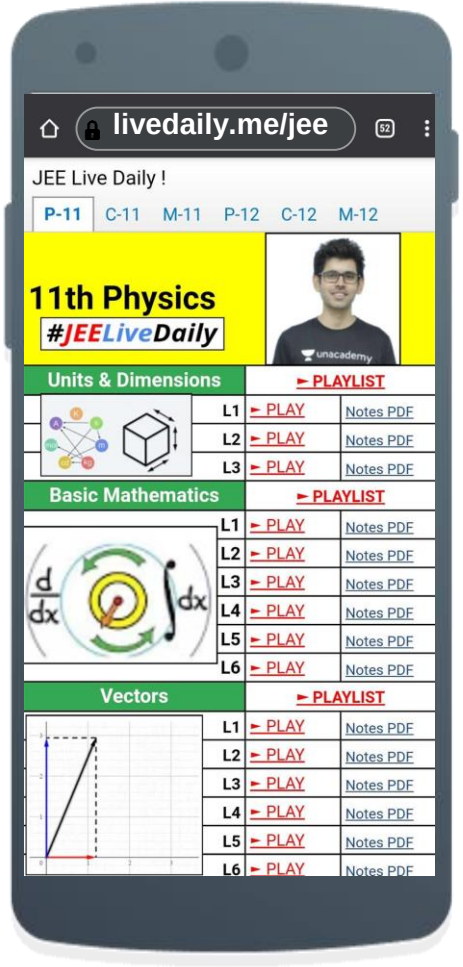

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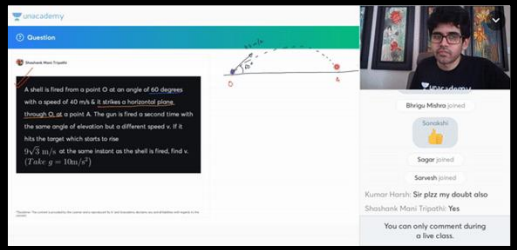

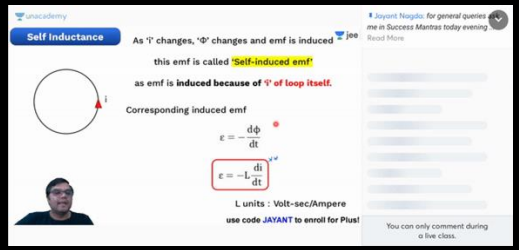

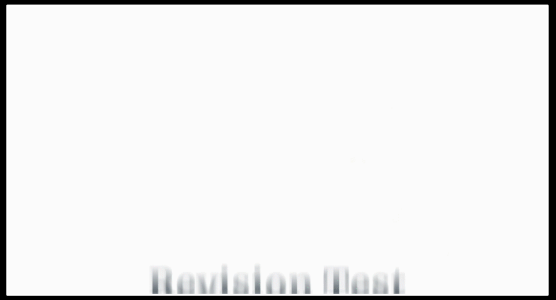

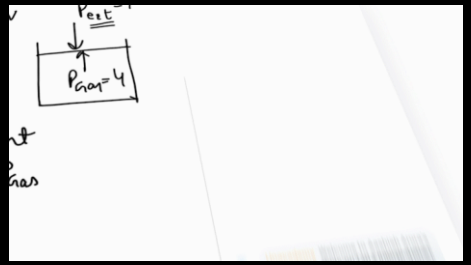

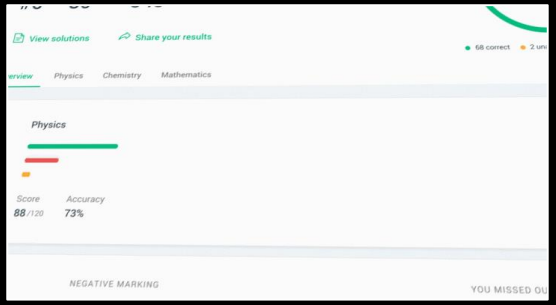

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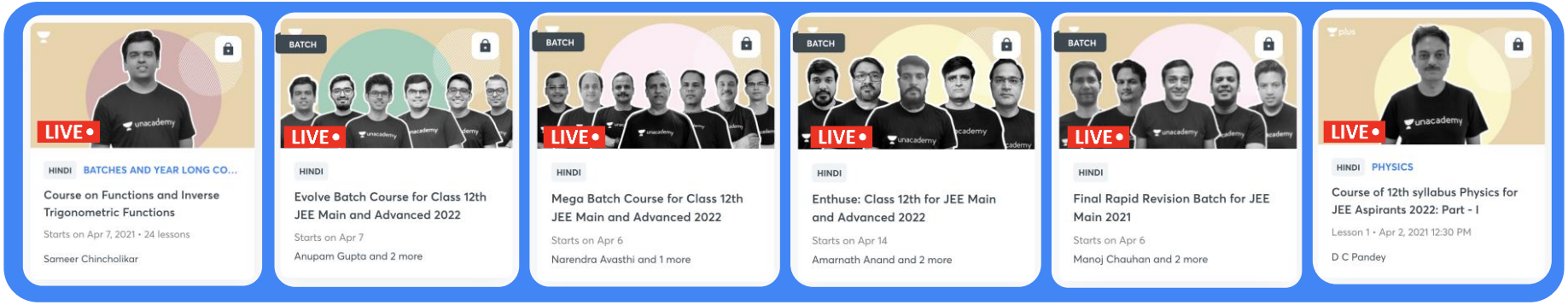

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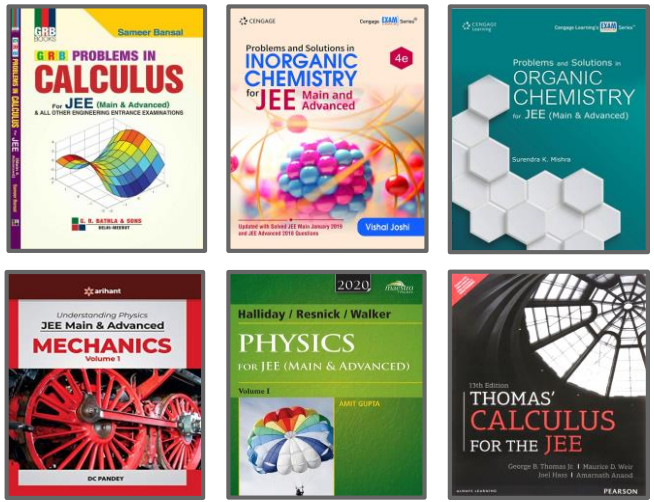

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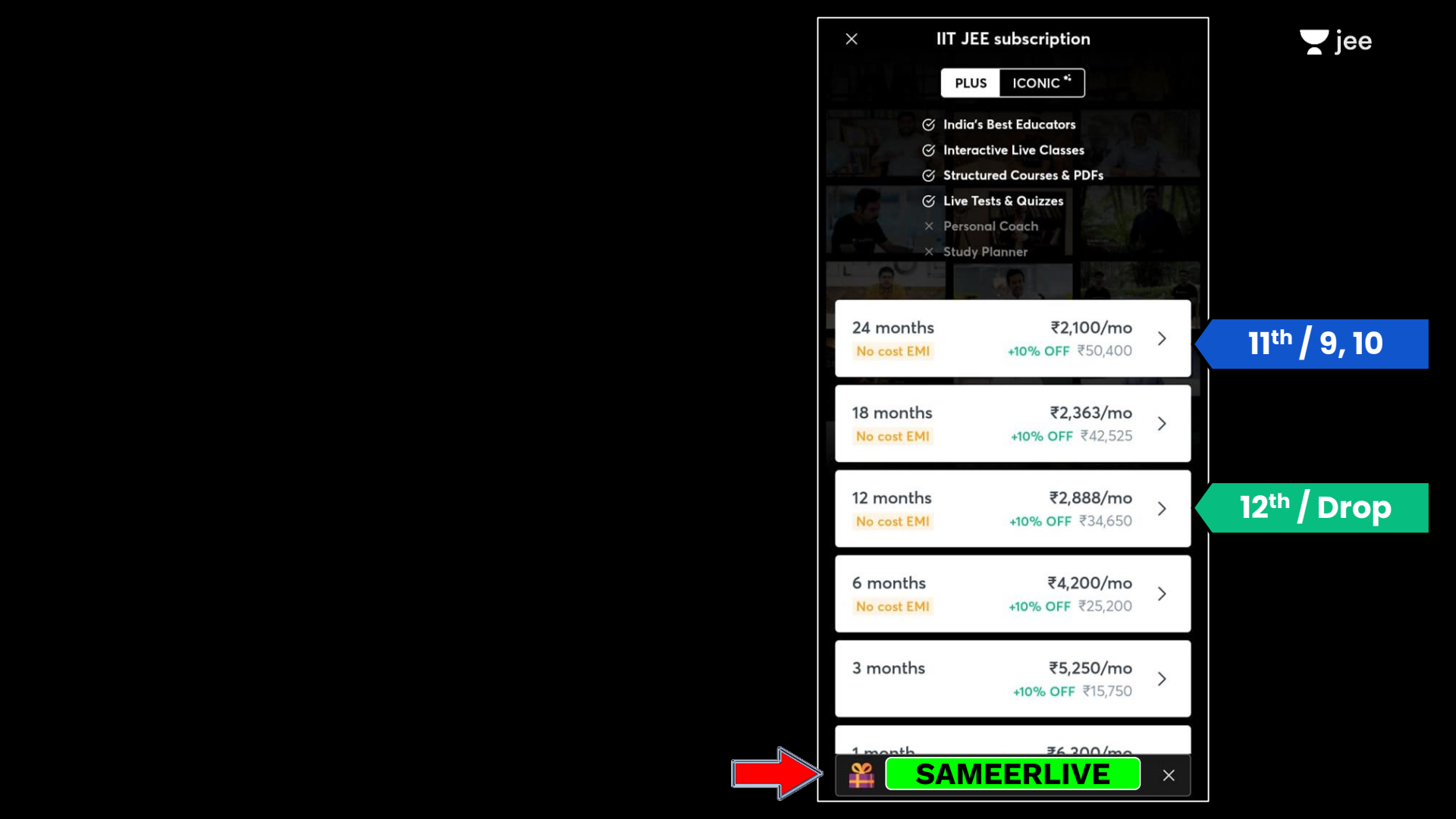
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+10% OFF ₹42,525
12 months
No cost EMI
₹2,888/mo
+10% OFF ₹34,650
6 months
No cost EMI
₹4,200/mo
+10% OFF ₹25,200
3 months
₹5,250/mo
+10% OFF ₹15,750
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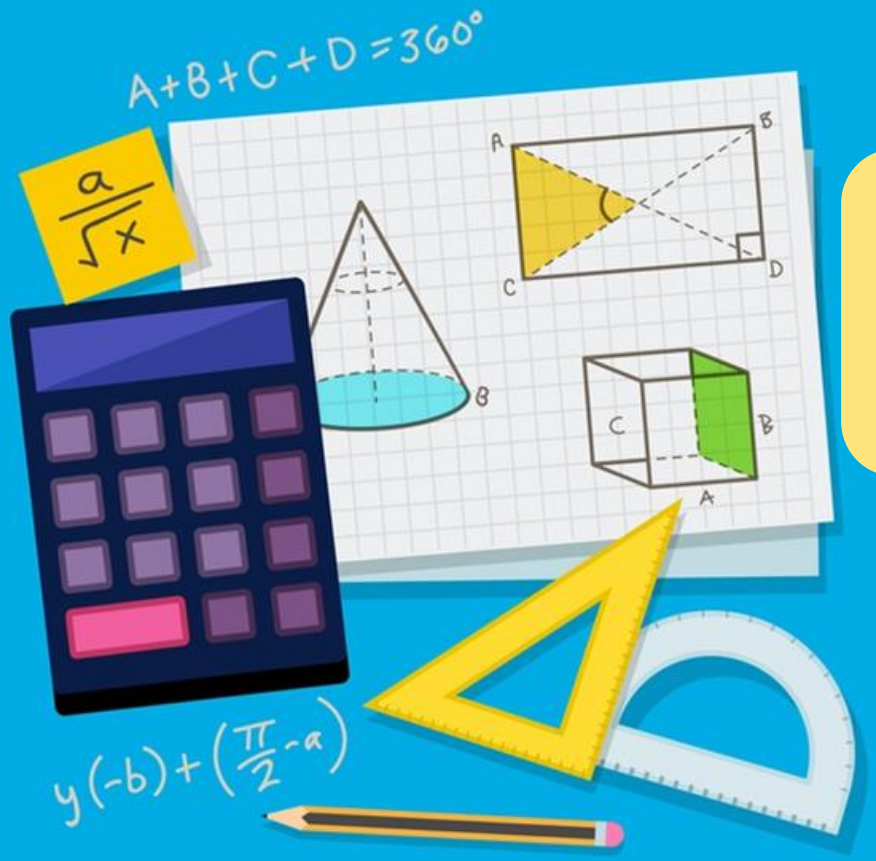
11th / 9, 10
12th / Drop

LET'S BEGIN!!



Homework Question

Find the value of: $\sin\frac{2\pi}{7}+\sin\frac{4\pi}{7}+\sin\frac{8\pi}{7}$

$$x=\sin\frac{2\pi}{7}+\sin\frac{4\pi}{7}+\sin\frac{8\pi}{7}$$

$$x^2=\left(\sin\frac{2\pi}{7}+\sin\frac{4\pi}{7}+\sin\frac{8\pi}{7}\right)^2$$

$$x^2=\underbrace{\left(\sin^2\frac{2\pi}{7}+\sin^2\frac{4\pi}{7}+\sin^2\frac{8\pi}{7}\right)}_{A}+\underbrace{2\left(\sin\frac{2\pi}{7}\sin\frac{4\pi}{7}+\sin\frac{4\pi}{7}\sin\frac{8\pi}{7}+\sin\frac{8\pi}{7}\sin\frac{2\pi}{7}\right)}_{B}$$

Now:

$$B = 2\sin\frac{2\pi}{7}\sin\frac{4\pi}{7} + 2\sin\frac{4\pi}{7}\sin\frac{8\pi}{7} + 2\sin\frac{8\pi}{7}\sin\frac{2\pi}{7}$$

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

$$B = \left[\cos\left(-\frac{2\pi}{7}\right) - \cos\left(\frac{6\pi}{7}\right)\right] + \left[\cos\left(-\frac{4\pi}{7}\right) - \cos\left(\frac{12\pi}{7}\right)\right]$$

$$+ \left[\cos\left(\frac{6\pi}{7}\right) - \cos\left(\frac{10\pi}{7}\right)\right]$$

$$B = \cos\left(\frac{2\pi}{7}\right) + \cos\left(\frac{4\pi}{7}\right) - \cos\left(2\pi - \frac{2\pi}{7}\right) - \cos\left(2\pi - \frac{4\pi}{7}\right)$$

$$B = \cos\left(\frac{2\pi}{7}\right) + \cos\left(\frac{4\pi}{7}\right) - \cos\left(\frac{2\pi}{7}\right) - \cos\left(\frac{4\pi}{7}\right)$$

$$\boxed{B = 0}$$

Now.

$$A = \sin^2\frac{2\pi}{7} + \sin^2\frac{4\pi}{7} + \sin^2\frac{8\pi}{7}$$

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

$$A = \frac{1}{2}\left(1-\cos\frac{4\pi}{7}\right) + \frac{1}{2}\left(1-\cos\frac{8\pi}{7}\right) + \frac{1}{2}\left(1-\cos\frac{16\pi}{7}\right)$$

$$A = \frac{3}{2} - \frac{1}{2}\left(\cos\frac{4\pi}{7} + \cos\frac{8\pi}{7} + \cos\frac{16\pi}{7}\right)$$

$$A = \frac{3}{2} - \frac{1}{2}\left(\cos\frac{2\pi}{7} + \cos\frac{4\pi}{7} + \cos\frac{8\pi}{7}\right)$$

$= \left(-\frac{1}{2}\right)$ { as discussed in previous lecture

$$\cos\left(\frac{14\pi}{7} + \frac{2\pi}{7}\right)$$

$$\cos\left(2\pi + \frac{2\pi}{7}\right)$$

$$\cos\left(\frac{2\pi}{7}\right)$$

$$A = \frac{3}{2} - \frac{1}{2}\left(-\frac{1}{2}\right) = \frac{7}{4}$$

Now: $x^2 = A + B = \frac{7}{4} + 0 \Rightarrow x = \frac{\sqrt{7}}{2}$

Find the value of $\sin\frac{\pi}{14}\sin\frac{3\pi}{14}\sin\frac{5\pi}{14}\sin\frac{7\pi}{14}\sin\frac{9\pi}{14}\sin\frac{11\pi}{14}\sin\frac{13\pi}{14}$

$\frac{13\pi}{14} = \pi - \frac{\pi}{14}$

$\sin\frac{13\pi}{14} = \sin\left(\pi - \frac{\pi}{14}\right)$

$= \sin\frac{\pi}{14}$

$\sin^2\frac{\pi}{14}\ \sin^2\frac{3\pi}{14}\cdot\sin^2\frac{5\pi}{14}$

$= \left(\cos\left(\frac{\pi}{2} - \frac{\pi}{14}\right)\cos\left(\frac{\pi}{2} - \frac{3\pi}{14}\right)\cdot\cos\left(\frac{\pi}{2} - \frac{5\pi}{14}\right)\right)^2$

$= \left(\cos\frac{6\pi}{14}\cdot\cos\left(\frac{4\pi}{14}\right)\cdot\cos\left(\frac{2\pi}{14}\right)\right)^2$

$$= \left(\cos\frac{\pi}{7}\ \cos\frac{2\pi}{7}\ \cos\frac{3\pi}{7}\right)^2$$

$$\cos\left(\pi - \frac{4\pi}{7}\right)$$

$$\left(-\cos\frac{4\pi}{7}\right)$$

$$= \left(\cos\frac{\pi}{7}\ \cos\frac{2\pi}{7}\ \cos\frac{4\pi}{7}\right)^2$$

$$= \left(\frac{\sin\left(2^3\frac{\pi}{7}\right)}{2^3\sin\frac{\pi}{7}}\right)^2$$

$$= \left(\frac{\sin\left(\frac{8\pi}{7}\right)}{8\sin\left(\frac{\pi}{7}\right)}\right)^2$$

$$= \left(\frac{-\sin\frac{\pi}{7}}{8\sin\frac{\pi}{7}}\right)^2 = \frac{1}{64}$$

$\sin\frac{\pi}{18}\sin\frac{5\pi}{18}\sin\frac{7\pi}{18}$ is equal to

A. 1/8 **B.** 1/2 **C.** 1/4 **D.** 1/16

M-1

$\cos\left(\frac{\pi}{2}-\frac{\pi}{18}\right)\cos\left(\frac{\pi}{2}-\frac{5\pi}{18}\right)\cos\left(\frac{\pi}{2}-\frac{2\pi}{18}\right)$

$= \cos\left(\frac{8\pi}{18}\right)\cdot\cos\left(\frac{4\pi}{18}\right)\cdot\cos\left(\frac{2\pi}{18}\right)$

$= \cos\left(\frac{\pi}{9}\right)\cos\left(\frac{2\pi}{9}\right)\cos\left(\frac{4\pi}{9}\right)$

$$= \frac{\sin 2^3 \frac{\pi}{9}}{2^3 \sin \frac{\pi}{9}}$$

$$= \frac{\sin \frac{8\pi}{9}}{8 \sin \frac{\pi}{9}}$$

$$= \frac{1}{8}$$

M-2

$$\sin \frac{\pi}{18} \sin \frac{5\pi}{18} \cdot \sin \frac{7\pi}{18}$$

$$\sin 10^\circ \sin 50^\circ \sin 70^\circ$$

$$\sin\theta \sin(60-\theta) \sin(60+\theta) = \frac{1}{4}\sin 3\theta$$

$$= \frac{1}{4}\sin(3(10^\circ)) = \frac{1}{8}$$

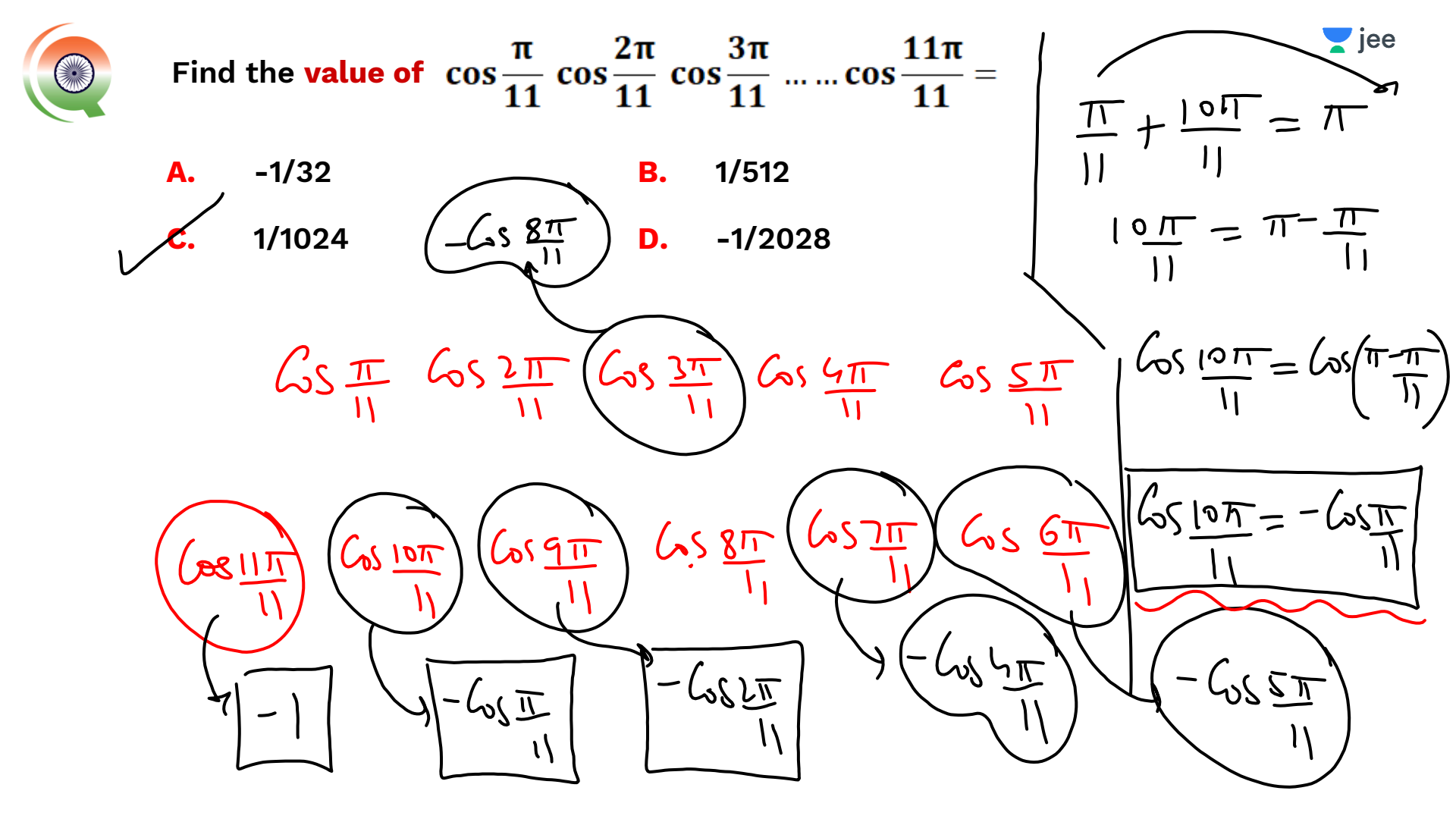
Find the value of $\cos\frac{\pi}{11}\cos\frac{2\pi}{11}\cos\frac{3\pi}{11}\ldots\ldots\cos\frac{11\pi}{11}=$

A. -1/32

B. 1/512

C. 1/1024

D. -1/2028



$$= \left(-\cos^2\frac{\pi}{11}\right)\left(-\cos^2\frac{2\pi}{11}\right)\left(-\cos^2\frac{4\pi}{11}\right)\left(-\cos^2\frac{8\pi}{11}\right)$$

$$\left(-\cos^2\frac{5\pi}{11}\right)(-1)$$

$$= \left(\cos\frac{\pi}{11}\cdot\cos\frac{2\pi}{11}\cdot\cos\frac{4\pi}{11}\cdot\cos\frac{8\pi}{11}\cdot\cos\frac{5\pi}{11}\right)^2$$

$$= \left(\frac{\sin 16\frac{\pi}{11}}{16\sin\frac{\pi}{11}}\cdot\cos\frac{5\pi}{11}\right)^2$$

$$= \left(\frac{\sin\left(\pi + \frac{5\pi}{11}\right)}{16 \sin\frac{\pi}{11}} \cos\frac{5\pi}{11} \right)^2$$

$$= \left(\frac{-2\sin\frac{5\pi}{11} \cdot \cos\frac{5\pi}{11}}{(2)16\sin\frac{\pi}{11}} \right)^2$$

$$= \left(-\frac{1}{32} \frac{\sin\frac{10\pi}{11}}{\sin\frac{\pi}{11}} \right)^2 = \frac{1}{2^{10}}$$

Prove that: $(1 + \sec 2\theta)(1 + \sec 2^2\theta).....(1 + \sec 2^n\theta) = \tan 2^n\theta.\cot\theta.$

$$LHS = \left(1+\frac{1}{\cos 2\theta}\right)\left(1+\frac{1}{\cos 2^2\theta}\right)\text{----}\left(1+\frac{1}{\cos 2^n\theta}\right)$$

$$= \frac{(\cos 2\theta+1)(\cos 2^2\theta+1)\text{------}(\cos 2^n\theta+1)}{(\cos 2\theta\cdot\cos 2^2\theta\cdot\text{----}\cos 2^n\theta)}$$

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

$$= \frac{(2\cos^2\theta)(2\cos^2 2\theta)\text{----}(2\cos^2 2^{n-1}\theta)}{(\cos 2\theta\cdot\cos 2^2\theta\text{----}\cos 2^n\theta)}$$

$$= \frac{2^n \left(\cos\theta \cdot \cos 2\theta \cdots \cos 2^{n-1}\theta\right)^2}{\left[\cos\theta \cos 2\theta \cos 2^2\theta \cdots \cos 2^{n-1}\theta\right] \cos 2^n\theta} (\cos\theta)$$

$$= \frac{\left(2^n \cos\theta\right)\left(\cos\theta \cdot \cos 2\theta \cdots \cos 2^{n-1}\theta\right)}{\cos 2^n\theta}$$

$$= \frac{\left(2^n \boxed{\cos\theta}\right)\left(\frac{\sin 2^n\theta}{2^n \boxed{\sin\theta}}\right)}{\cos 2^n\theta} \longrightarrow \boxed{\cot\theta \tan 2^n\theta}$$

Property of Summation (Σ)

1. $\sum_{n=1}^{100}(n) = 1 + 2 + 3 + \cdots + 100$

2. $\sum_{n=1}^{100}(n)^2 = 1^2 + 2^2 + 3^2 + \cdots + (100)^2$

3. $\sum_{n=1}^{100}(n^2 + n) = (1^2+1) + (2^2+2) + \cdots (100^2+100)$

$$\sum_{n=1}^{100}(n^2+n) = \sum n^2 + \sum n$$

(4) $\sum_{n=1}^{100}(2n) = 2+4+6+\cdots+200$

$= 2(1+2+3+\cdots+100)$

$= 2\left(\sum_{n=1}^{100} n\right)$

Find the value of : $\sum_{r=0}^{10} \cos^3 \frac{\pi r}{3}$,

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

$$\cos^3\theta = \left(\frac{\cos 3\theta + 3\cos\theta}{4}\right)$$

$$\sum_{r=0}^{10} \cos^3\left(\frac{\pi r}{3}\right) = \sum_{r=0}^{10} \left(\frac{\cos\left(3 \cdot \frac{\pi r}{3}\right) + 3\cos\left(\frac{\pi r}{3}\right)}{4}\right)$$

$$= \sum_{r=0}^{10} \left(\frac{\cos \pi r}{4}\right) + \sum_{r=0}^{10} \left(\frac{3\cos \frac{\pi r}{3}}{4}\right)$$

$$= \frac{1}{4}\left(\sum_{r=0}^{10} \cos \pi r\right) + \frac{3}{4}\left(\sum_{r=0}^{10} \cos \frac{\pi r}{3}\right)$$

S_1

S_2

$$S_1 = \sum_{r=0}^{10} \cos \pi r$$

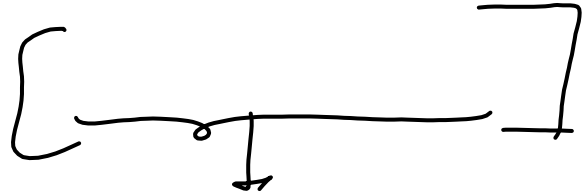
$$= \cos 0 + \cos \pi + \cos 2\pi + \cdots\cdots + \cos 10\pi$$

$$= 1 - 1 + 1 - 1 + \cdots - 1$$

$$\boxed{S_1 = 1}$$

$$S_2 = \sum_{r=0}^{10} \cos \frac{\pi r}{3}$$

$$= \cos 0 + \left[\cos \frac{\pi}{3} + \cos \frac{2\pi}{3} + \cos \frac{3\pi}{3} + \cdots + \cos \frac{10\pi}{3} \right]$$

$S_2 = 1 + [$  $]$

$\alpha = \frac{\pi}{3}, \quad \beta = \frac{\pi}{3}$

$\frac{\beta}{2} = \frac{\pi}{6} ; \quad n = 10$

$$S_2 = 1 + \frac{\sin\left(\frac{5}{10}\cdot\frac{\pi}{6}\right)}{\sin\left(\frac{\pi}{6}\right)} \cdot \cos\left(\frac{\pi}{3} + \frac{9}{20}\cdot\frac{\pi}{6}\right)$$

$$S_2 = 1 + \frac{\left(-\frac{\sqrt{3}}{2}\right)}{\left(\frac{1}{2}\right)}\left(\frac{\sqrt{3}}{2}\right) = 1 - \frac{3}{2} = \boxed{-\frac{1}{2}}$$

$\therefore$ Ans.

$= \frac{1}{4}S_1 + \frac{3}{4}S_2$

$= \frac{1}{4}(1) + \frac{3}{4}\left(-\frac{1}{2}\right)$

$= \frac{1}{4} - \frac{3}{8}$

$= \frac{2-3}{8}$

$= \boxed{-\frac{1}{8}}$

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Namo Sir | Physics

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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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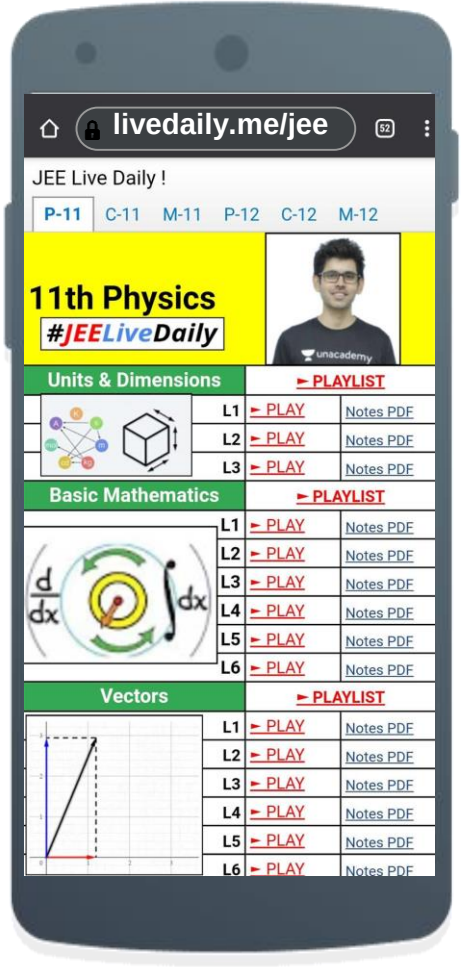

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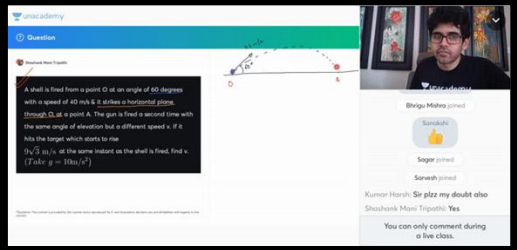

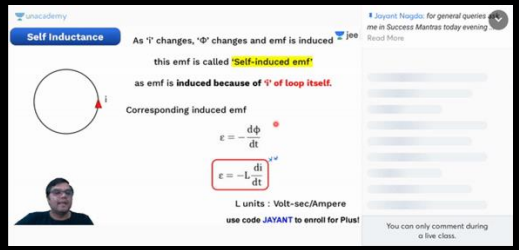

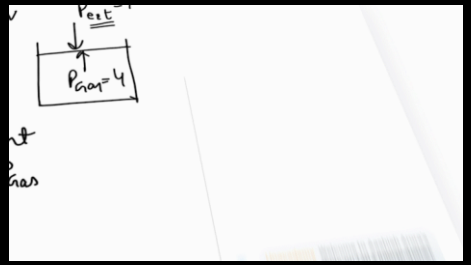

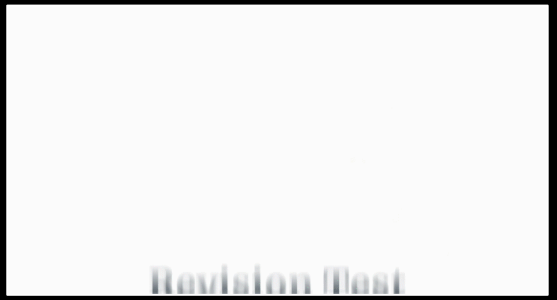

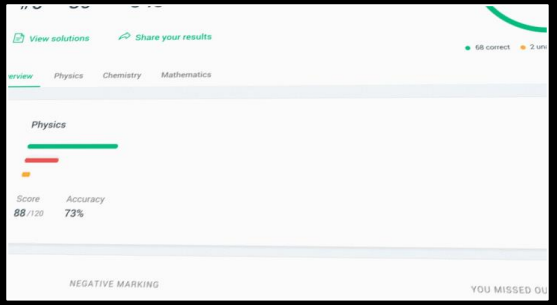

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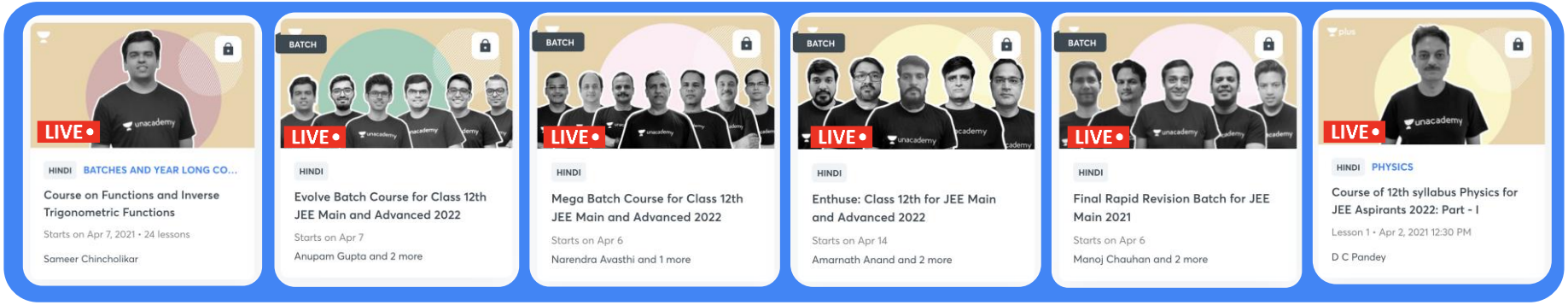

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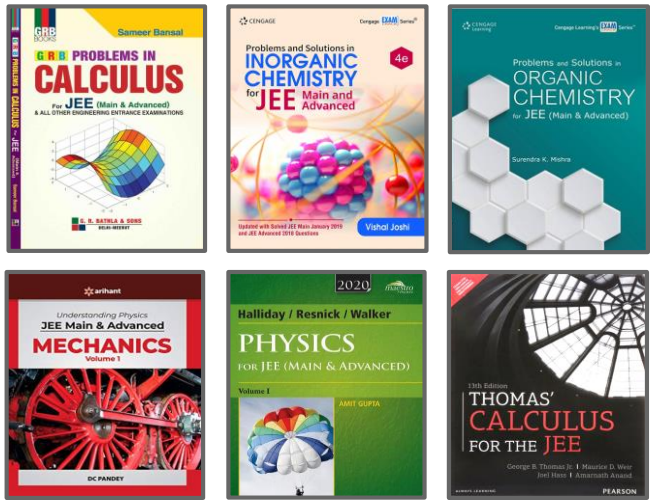

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MIHIR PRAJAPATI
98.16

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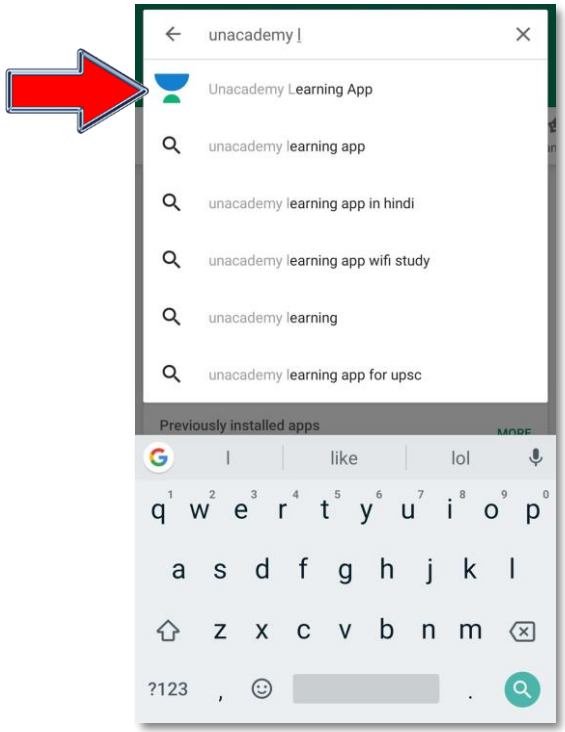
Step 1



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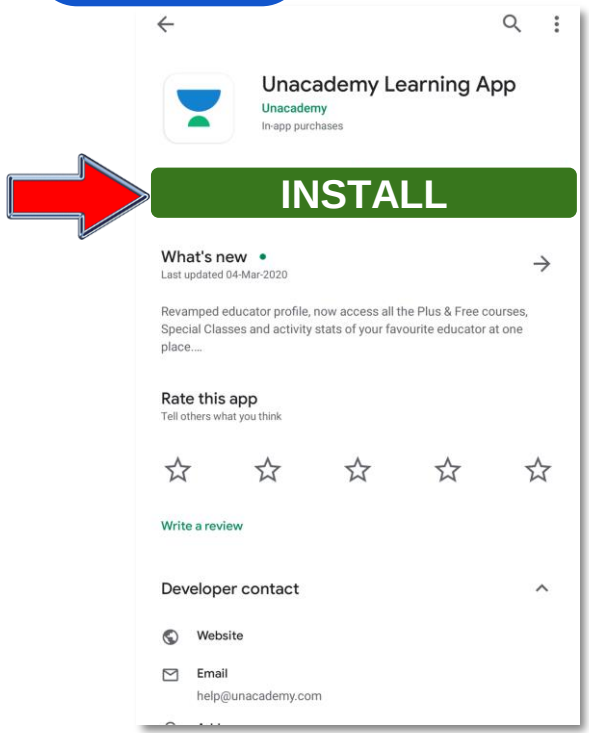

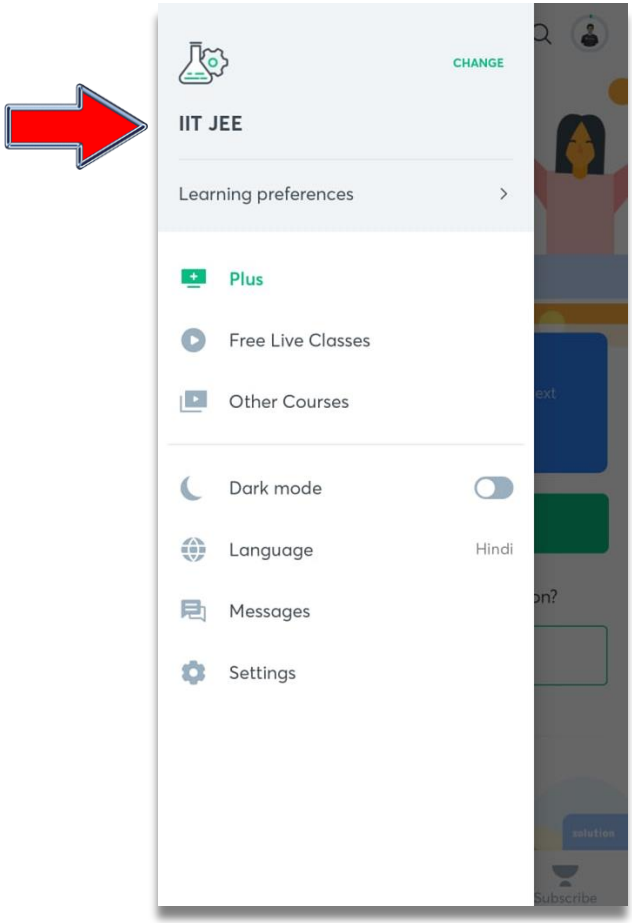
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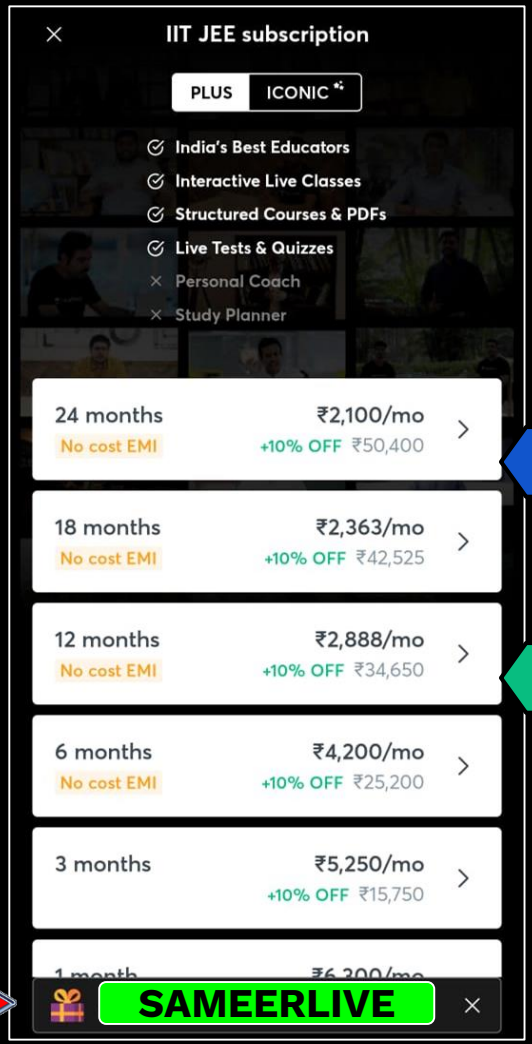

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