BOUNCE BACK 2.0

Unacademy Atoms

JEE MAINS & ADVANCED

ONE SHOT

Hello N.Vians !!

TRIGONOMETRIC EQUATIONS

(8 Marks)

NISHANT VORA

Nishant Vora

B.Tech - IIT Patna

- 7+ years Teaching experience
- Mentored 5 lac+ students
- Teaching Excellence Award

"Easy"

BounceBack

Join with us in Telegram

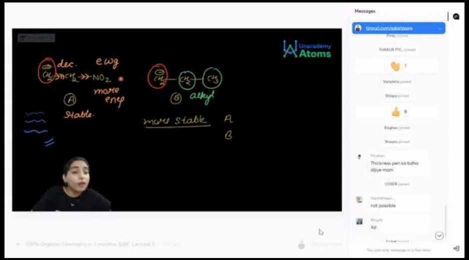
TELEGRAM CHANNEL

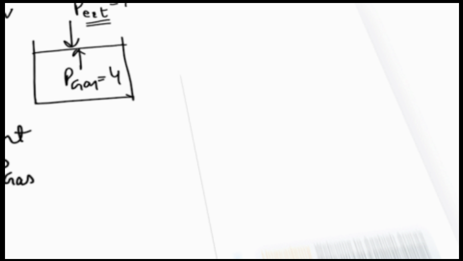
- t.me/unacademyatoms

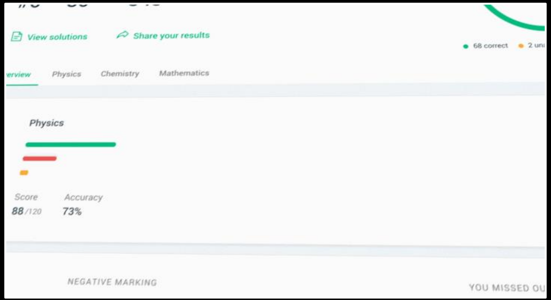
COMPLETE NOTES AND LECTURES

- tinyurl.com/unacademyatoms

Unacademy Subscription







✚ LIVE Class Environment

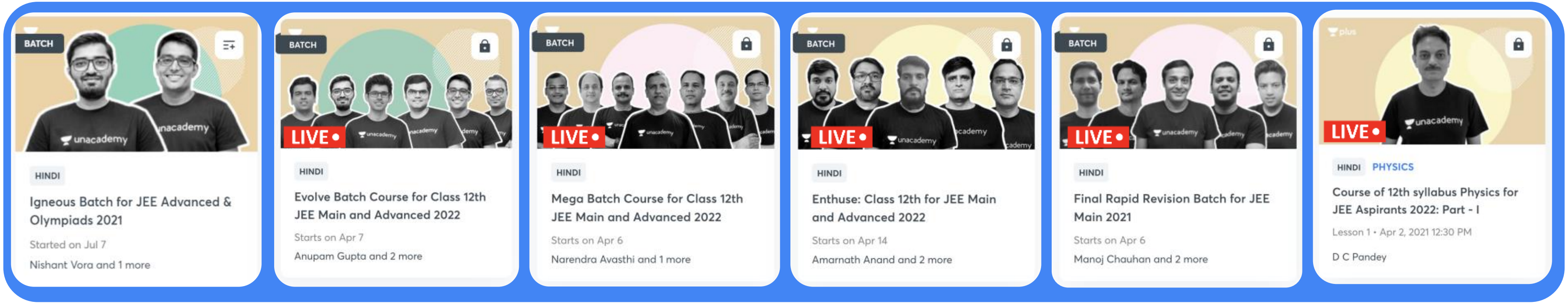
- ✚ **LIVE Polls** & **Leaderboard**
- ✚ **LIVE Doubt** Solving
- ✚ **LIVE** Interaction

✚ **Performance** Analysis

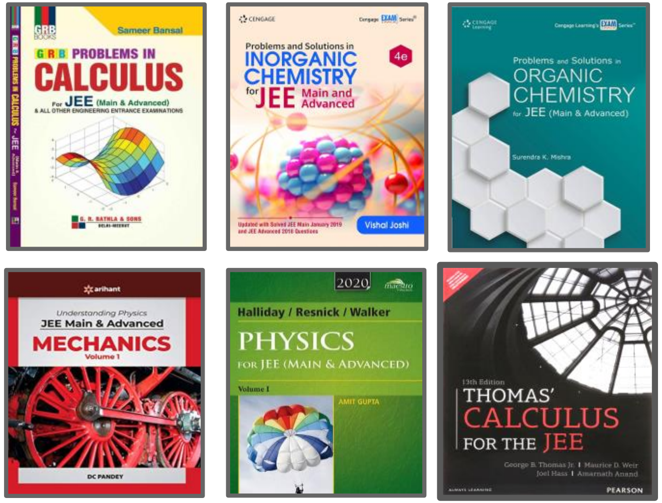
- ✚ **Weekly Test Series**
- ✚ **DPPs** & **Quizzes**

India's **BEST** Educators

Unacademy Subscription



If you want to be the **BEST**
"Learn" from the **BEST**



unacademy

All-Star Crash Course 3.0 Batch

for JEE Main 2023

Starts November 24

Batch highlights:

- 3-month crash course targeting 2023 JEE Main with all IIT JEE Top Educators from Unacademy
- Cover the entire syllabus at a quick pace for JEE Main & Advanced
- Enhance your JEE competitiveness

Enroll Now

unacademy

Early Growth Batch

for Class 11 IIT JEE Main and Advanced 2025

November 10 onwards

Batch highlights:

- Classes by Top Educators who have trained Learners with single-digit ranks
- Comprehensive Class 11 and 12 syllabus completion
- Start early and prepare for JEE effectively
- Learn from Top online and offline Educators
- Top notch study material prepared by Top Educators

Enroll Now

Prashant Jain
Mathematics

Amarnath Anand
Mathematics

Nishant Vora
Mathematics

Piyush Maheshwari
Chemistry

Vijay Tripathi
Chemistry

Sakshi Ganotra
Chemistry

Namo Kaul
Physics

Mohit Bhargav
Physics

Ajit Lulla
Physics

unacademy

(FREE)

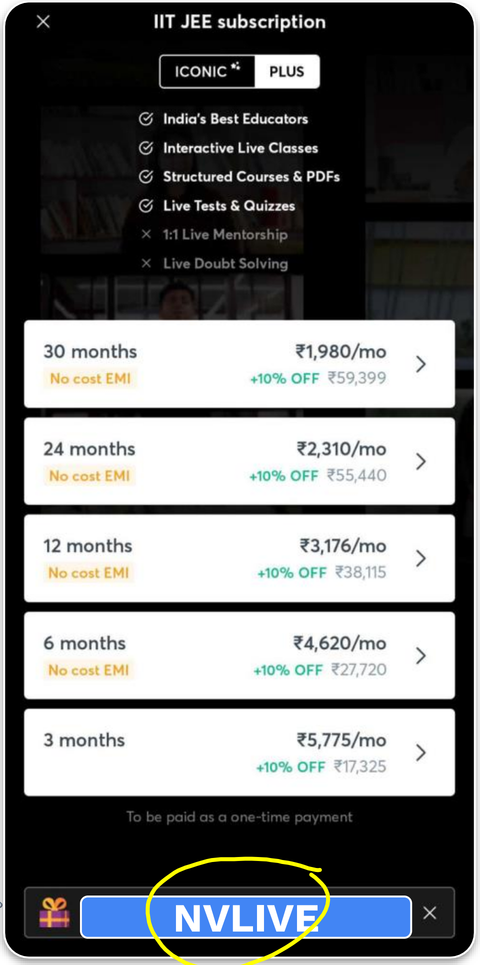
All India Test Series

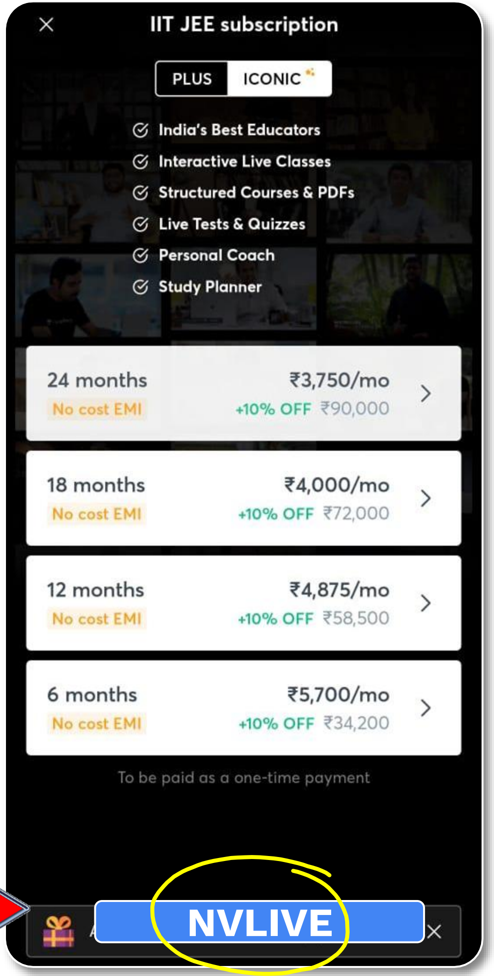
A comprehensive Test Series for your JEE 2023/2024 preparation

November 6, 13, 20 and 27

- Physics, Chemistry and Mathematics Mock Tests
- JEE Main pattern test
- Detailed analysis along with solutions

Enroll Now


IIT JEE subscription
ICONIC
PLUS
India's Best Educators
Interactive Live Classes
Structured Courses & PDFs
Live Tests & Quizzes
1:1 Live Mentorship
Live Doubt Solving
30 months ₹1,980/mo
No cost EMI +10% OFF ₹59,399
24 months ₹2,310/mo
No cost EMI +10% OFF ₹55,440
12 months ₹3,176/mo
No cost EMI +10% OFF ₹38,115
6 months ₹4,620/mo
No cost EMI +10% OFF ₹27,720
3 months ₹5,775/mo
+10% OFF ₹17,325
To be paid as a one-time payment
NVLIVE


IIT JEE subscription
PLUS
ICONIC
India's Best Educators
Interactive Live Classes
Structured Courses & PDFs
Live Tests & Quizzes
Personal Coach
Study Planner
24 months ₹3,750/mo
No cost EMI +10% OFF ₹90,000
18 months ₹4,000/mo
No cost EMI +10% OFF ₹72,000
12 months ₹4,875/mo
No cost EMI +10% OFF ₹58,500
6 months ₹5,700/mo
No cost EMI +10% OFF ₹34,200
To be paid as a one-time payment
NVLIVE

Trigonometric Equations

Examples of Trigonometric Equations

1 $\sin\theta = \dfrac{1}{2}$

✓ $\boxed{\sin\theta = \frac{1}{2}}$

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

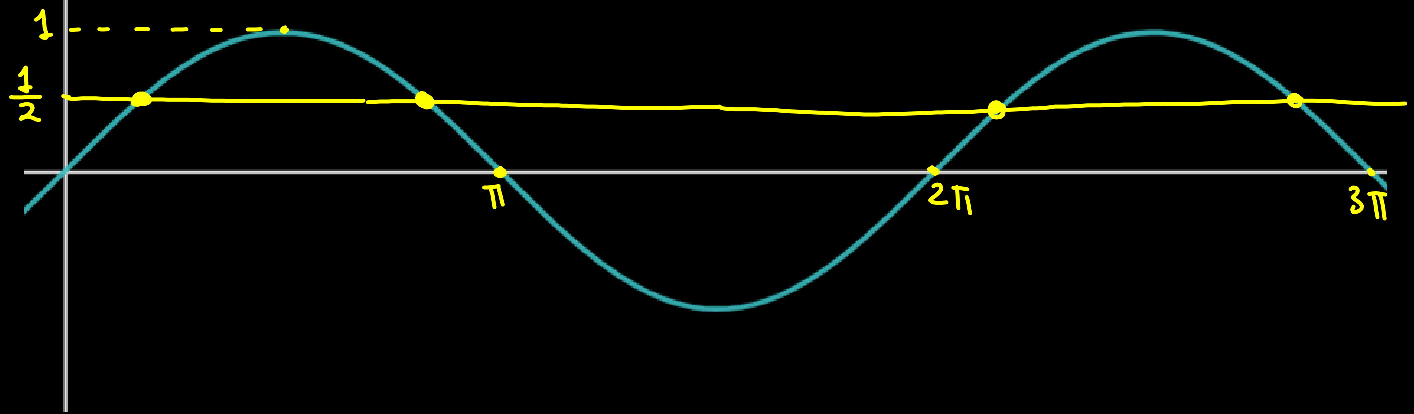
Solution of Trigonometric Equations

1

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

$$\boxed{\sin\theta = \boxed{\tfrac{1}{2}}}$$

$y = \sin\theta$ $\quad$ $y = \frac{1}{2}$



Principal Solution

Principal Solution

$$\boxed{PS \in [0, 2\pi)}$$

$$\boxed{PS \in [0, 2\pi)}$$

Principal Solution - Shortcut Method

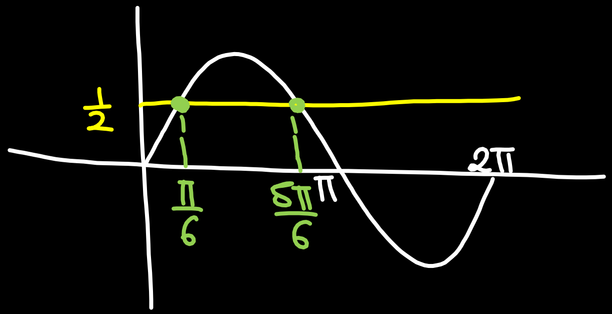
#NVSTYLE

1

$$\boxed{\sin\theta = \frac{1}{2}}$$

#NVStyle

S-1 $\sin\alpha = \frac{1}{2} \Rightarrow \boxed{\alpha = \frac{\pi}{6}}$



S-2

S	A
T	C

1st and 2nd

S-3

$\pi-\alpha$	α
$\pi+\alpha$	$2\pi-\alpha$

$\frac{\pi}{6}, \pi-\frac{\pi}{6} \Rightarrow \boxed{PS \Rightarrow \frac{\pi}{6}, \frac{5\pi}{6}}$

Principal Solution - Shortcut Method

#NVSTYLE

2

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

S-1 $\sin\alpha = \frac{1}{2}$ $\boxed{\alpha \Rightarrow \frac{\pi}{6}}$

S-2

S	A
T	C

III and IV

S-3

$\pi-\alpha$	α
$\pi+\alpha$	$2\pi-\alpha$

$PS = \pi + \frac{\pi}{6}, 2\pi - \frac{\pi}{6}$

$$\boxed{PS = \frac{7\pi}{6}, \frac{11\pi}{6}}$$

Ans Verify

$\sin\left(\frac{7\pi}{6}\right)$

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

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

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

Principal Solution - Shortcut Method

#NVSTYLE

3

$$\boxed{\tan x = -\frac{1}{\sqrt{3}}}$$

S-1 $\tan\alpha = \frac{1}{\sqrt{3}}$ $\boxed{\alpha = \frac{\pi}{6}}$

S-2

S	A
T	C

II and IV

S-3

$\pi-\alpha$	α
$\pi+\alpha$	$2\pi-\alpha$

$\pi - \frac{\pi}{6}$, $2\pi - \frac{\pi}{6}$

$\frac{5\pi}{6}$, $\frac{11\pi}{6}$

Principal Solution - Shortcut Method

#NVSTYLE

4

$$\operatorname{cosec} x = -2$$

$$\boxed{\sin x = \frac{-1}{2}}$$

S-1 $\quad \sin\alpha = \frac{1}{2} \qquad \alpha = \frac{\pi}{6}$

S-2

S-3 $\quad PS \Rightarrow \pi + \frac{\pi}{6},\ 2\pi - \frac{\pi}{6}$

General Solution

General Solution

$\sin\theta = \sin\alpha \qquad \theta = n\pi + (-1)^n\alpha \qquad n \in Z$

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

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

General Solution

$$\left.\begin{aligned} \sin^2\theta &= \sin^2\alpha \\ \cos^2\theta &= \cos^2\alpha \\ \tan^2\theta &= \tan^2\alpha \end{aligned}\right\} \quad \boxed{\theta = n\pi \pm \alpha}$$

$n \in \mathbb{Z}$

General solutions

$\sin\theta = \sin\alpha$	$\Rightarrow$	$\theta = n\pi + (-1)^n\alpha$
$\cos\theta = \cos\alpha$	$\Rightarrow$	$\theta = 2n\pi \pm \alpha$
$\tan\theta = \tan\alpha$	$\Rightarrow$	$\theta = n\pi + \alpha$
$\sin^2\theta = \sin^2\alpha$	$\Rightarrow$	$\theta = n\pi \pm \alpha$
$\tan^2\theta = \tan^2\alpha$	$\Rightarrow$	$\theta = n\pi \pm \alpha$
$\cos^2\theta = \cos^2\alpha$	$\Rightarrow$	$\theta = n\pi \pm \alpha$

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

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

$\boxed{\theta = n\pi \pm \frac{\pi}{6}}$ $n \in \mathbb{Z}$

General Solutions - Examples

1

$$\sin x = -\frac{\sqrt{3}}{2}$$

Method (G S)

S-1 P.S i)
ii)
iii)

S-2 Use respective formula of G.S

S-1 i) $\sin\alpha = \frac{\sqrt{3}}{2}$ $\boxed{\alpha = \frac{\pi}{3}}$

ii)

S	A
T	C

iii) PS $\pi + \frac{\pi}{3}$, $2\pi - \frac{\pi}{3}$

PS $\frac{4\pi}{3}$, $\frac{5\pi}{3}$

S-2 $\sin x = \sin \frac{4\pi}{3}$

$\boxed{x = n\pi + (-1)^n \frac{4\pi}{3}}$ $n \in \mathbb{Z}$

General Solutions - Examples

2

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

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

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

S-2 $\quad \boxed{x = n\pi \pm \frac{\pi}{6}}$

General Solutions - Examples

3

$\cancel{\cot x = -1}$

cotx / secx / cosecx

☆ $\tan x = -1$

S-1 i) $\tan\alpha = 1 \quad \alpha = \frac{\pi}{4}$

ii)

S	A
T	C

II and IV

iii) PS $\pi - \frac{\pi}{4}$, $2\pi - \frac{\pi}{4}$

$\frac{3\pi}{4}$, $\frac{7\pi}{4}$

S-2 $\tan x = \tan\left(\frac{3\pi}{4}\right)$

GS $\boxed{x = n\pi + \frac{3\pi}{4}}$ $n \in Z$

* PS ✓
* GS ✓
* No of sol^n

Number of Solution

Find Number of Solutions :

1

$$\sin 4x = -\frac{1}{2} \; in \; x \in [0, 2\pi]$$

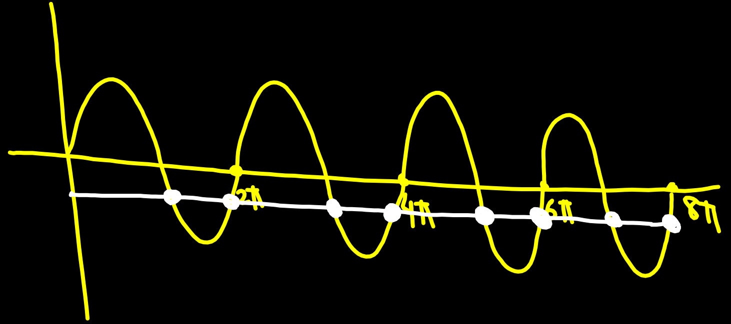
$\sin(\underline{4x}) = -\frac{1}{2}$ $\quad x \in [0, 2\pi]$

$\boxed{\text{No of sol}^n = 8}$

$4x = \theta$

$\sin(4x) = -\frac{1}{2}$ $\quad 4x \in [0, 8\pi]$

$\sin(\theta) = -\frac{1}{2}$ $\quad \theta \in [0, 8\pi]$



Find Number of Solutions :

2

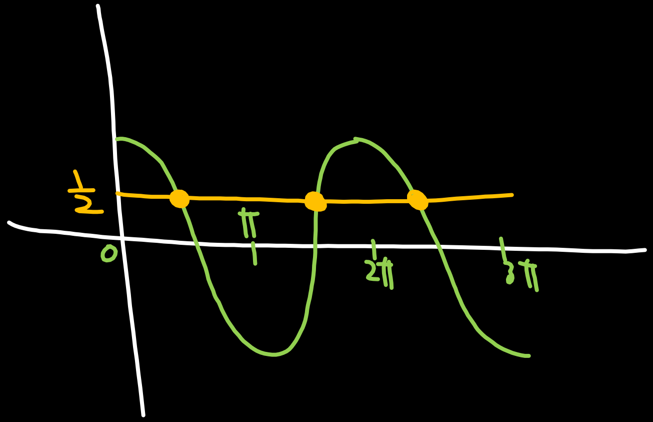
$$\sec 3x = 2 \; in \; x \in [0, \pi]$$

$\cos(3x) = \frac{1}{2} \qquad x \in [0, \pi]$

$\cos(3x) = \frac{1}{2} \qquad 3x \in [0, 3\pi]$

$\cos\theta = \frac{1}{2} \qquad \theta \in [0, 3\pi]$

$\boxed{\text{No of sol}^n = 3}$



Unacademy Atoms

Q

The number of distinct solutions of the equation

$$\frac{5}{4}\cos^2 2x + \boxed{\cos^4 x + \sin^4 x} + \cos^6 x + \sin^6 x = 2$$

in the interval $[0, 2\pi]$ is

[JEE Adv. 2015]

$$\frac{5}{4}\cos^2 2x + \cancel{1} - 2\sin^2 x\cos^2 x + \cancel{1} - 3\sin^2 x\cos^2 x = \cancel{2}$$

$$\frac{5}{4}\cos^2 2x - \frac{5}{4}\left(4\sin^2 x\cos^2 x\right) = 0$$

$$\frac{5}{4}\left\{\cos^2 2x - \sin^2 2x\right\} = 0$$

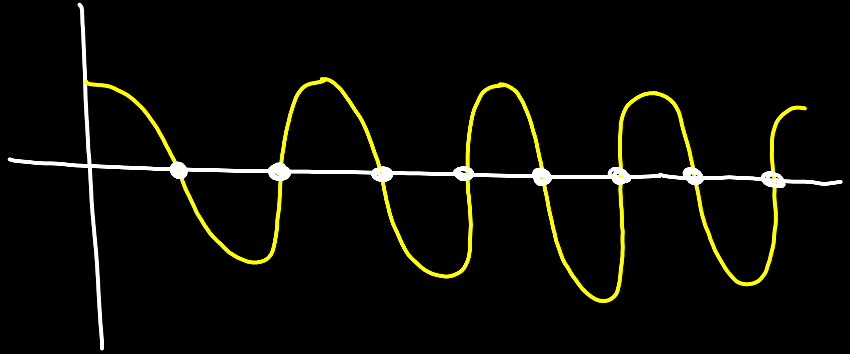
$\frac{5}{4}\cos 4x = 0$

$\Rightarrow \cos 4x = 0 \quad x \in [0, 2\pi]$

$\cos 4x = 0 \quad 4x \in [0, 8\pi]$

$\cos\theta = 0 \quad \theta \in [0, 8\pi]$

$\boxed{\text{No of Sol}^n = 8}$



PS ✓
GS ✓
No of Sol^n ✓

Type – 1

* Factorisation

Type 1: Factorization/ Quadratic Form

$\sin x / \cos x \longrightarrow \boxed{Q.E}$

↓

factorize

↓

Roots ___ ___

↓

No. of Sol^n | Sum of sol^n

Q

Solve $\boxed{(2 \sin x - \cos x)(1 + \cos x) = \sin^2 x}$ in $[0, 2\pi]$.

$$(2\sin x - \cos x)\cancel{(1+\cos x)} = (1-\cos x)\cancel{(1+\cos x)}$$

$$2\sin x - \cancel{\cos x} - 1 + \cancel{\cos x} = 0$$

$$1 + \cos x = 0$$

$$\boxed{\cos x = -1}$$

$$\boxed{x = \pi}$$

$$2\sin x = 1$$

$$\boxed{\sin x = \frac{1}{2}} \rightarrow [0, 2\pi]$$

$$\frac{\pi}{6}, \pi - \frac{\pi}{6}$$

★ $\boxed{\text{CUTE}}$

$\longrightarrow$ 3 Sol^n . $\boxed{\pi, \frac{\pi}{6}, \frac{5\pi}{6}}$

$\boxed{\text{Sum of Sol}^n = 2\pi}$

Q

If $\sqrt{3}\cos^2 x = (\sqrt{3} - 1)\cos x + 1$, the number of solutions of the given equation when $x \in \left[0, \frac{\pi}{2}\right]$ is

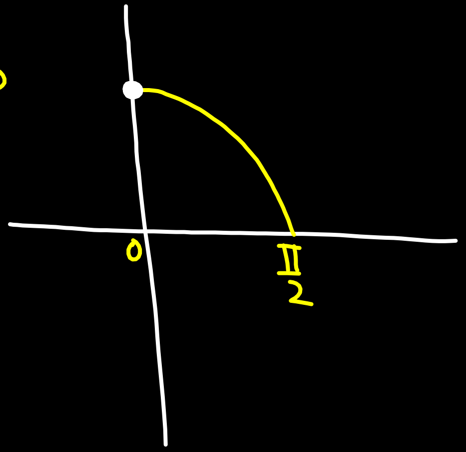
[JEE M 2021]

$$\sqrt{3}\cos^2 x - \sqrt{3}\cos x + \cos x - 1 = 0$$

$$\sqrt{3}\cos x(\cos x - 1) + 1(\cos x - 1) = 0$$

$$\cos x = 1 \quad \text{OR} \quad \cos x = \frac{-1}{\sqrt{3}}$$

$$\boxed{1 + 0} = 1$$



Let $4+(-8)=-4$

$S = \{\theta \in [0, 2\pi] : 8^{2\sin^2\theta} + 8^{2\cos^2\theta} = 16\}$. Then

$\underset{4}{n(S)} + \boxed{\sum_{\theta \in S}\left(\sec\left(\frac{\pi}{4}+2\theta\right)\operatorname{cosec}\left(\frac{\pi}{4}+2\theta\right)\right)}$ is

equal to :

$\boxed{8^{2\sin^2\theta}} + 8^{2-2\sin^2\theta} = 16$

$\boxed{8^{2\sin^2\theta} = t}$

[JEE M 2022]

A. 0

B. -2

C. -4

D. 12

$\Rightarrow t + \frac{64}{t} = 16$

$\Rightarrow t^2 - 16t + 64 = 0$

$\Rightarrow (t-8)^2 = 0$

$8^{2\sin^2\theta} = 8^1$

$\therefore \boxed{\sin^2\theta = \frac{1}{2}}$

$1^{st}/2^{nd}$ $\quad$ $3^{rd}/4^{th}$

$\underbrace{\sin\theta = \frac{+1}{\sqrt{2}}}$ $\quad$ $\sin\theta = \frac{-1}{\sqrt{2}}$

$$\frac{2}{\cos\pi} + \frac{2}{\cos 3\pi} + \frac{2}{\cos 5\pi} + \frac{2}{\cos 7\pi}$$

$$S = \left\{ \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4} \right\} \qquad \underline{n(S) = 4}$$

$$-2 \times 4 = -8$$

$$\sum_{\theta \in S} \frac{1 \times 2}{2\cos\left(\frac{\pi}{4}+2\theta\right)\sin\left(\frac{\pi}{4}+2\theta\right)} \Rightarrow \sum_{\theta \in S} \frac{2}{\sin\left(\frac{\pi}{2}+4\theta\right)}$$

$$\Rightarrow \sum_{\theta \in S} \left(\frac{2}{\cos 4\theta}\right)$$

Q

If the sum of solutions of the system of equations $2\sin^2\theta - \cos 2\theta = 0$ and $2\cos^2\theta + 3\sin\theta = 0$ in the interval $[0, 2\pi]$, then k is equal to__.

[JEE M 2022]

$$2\sin^2\theta = \cos 2\theta$$

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

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

$$\sin\theta = \frac{1}{2} \text{ OR } \frac{-1}{2}$$

$$2\cos^2\theta + 3\sin\theta = 0$$

$$2(1-\sin^2\theta) + 3\sin\theta = 0$$

$$2\sin^2\theta - 3\sin\theta - 2 = 0$$

$$2\sin^2\theta - 4\sin\theta + \sin\theta - 2 = 0$$

$$(2\sin\theta + 1)(\sin\theta - 2) = 0$$

$$\sin\theta = \frac{-1}{2} \text{ OR } \cancel{2}$$

$\sin\theta = \frac{-1}{2}$ $[0, 2\pi]$

S-1 $\sin\alpha = \frac{1}{2}$ $\alpha = \frac{\pi}{6}$

S	A
T	C

S-2 3^{rd} and 4^{th}

S-3 PS. $\pi + \frac{\pi}{6}$ and $2\pi - \frac{\pi}{6}$

$$\boxed{\frac{7\pi}{6}, \frac{11\pi}{6}}$$

$$\text{sum} = 3\pi$$

Q

If $S = \{\theta \in (0, 2\pi) : 7\cos^2\theta - 3\sin^2\theta - 2\cos^2 2\theta = 2\}$. Then, the sum of roots of all the equations $x^2 - 2(\tan^2\theta + \cot^2\theta)x + 6\sin^2\theta = 0$ $\theta \in S$, is_

[JEE M 2022]

$$\Rightarrow 7\left(\frac{1+\cos 2\theta}{2}\right) - 3\left(\frac{1-\cos 2\theta}{2}\right) - 2\cos^2 2\theta = 2$$

$$\Rightarrow \cancel{2} + 5\cos 2\theta - 2\cos^2 2\theta = \cancel{2}$$

$$\Rightarrow \cos 2\theta\,(5 - 2\cos 2\theta) = 0$$

$$\Rightarrow \boxed{\cos 2\theta = 0} \text{ OR } \cancel{\cos 2\theta = \frac{5}{2}}$$

$\cos 2\theta = 0$ $\quad \theta \in (0, 2\pi)$

$\cos(2\theta) = 0$ $\quad 2\theta \in (0, 4\pi)$

$2\theta = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}$

$\therefore \theta = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

$S = \left\{\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\right\}$

Sum of Root $= \boxed{2(\tan^2\theta + \cot^2\theta)}$

$\Rightarrow \quad 4 + 4 + 4 + 4$

$\Rightarrow 16$

Unacademy Atoms

Q

Let

$$S = \left\{\theta \in [-\pi, \pi] - \left\{\pm\frac{\pi}{2}\right\} : \sin\theta\tan\theta + \tan\theta = \sin 2\theta\right\}.$$

If $\boxed{T = \sum_{\theta \in S} \cos 2\theta}$, then $T + n(S)$ is equal

$\boxed{4 + 5}$

[JEE M 2022]

A. $7 + \sqrt{3}$

B. 9

C. $8 + \sqrt{3}$

D. 10

$\cancel{\tan}\theta(\sin\theta + 1) = \dfrac{2\cancel{\tan\theta}}{\boxed{1 + \tan^2\theta}}$

$\tan\theta = 0$

$\sin\theta + 1 = 2\cos^2\theta$

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

$2\sin^2\theta + \sin\theta - 1 = 0$

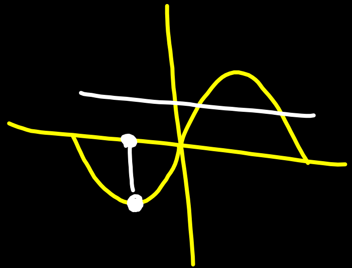
$2\sin^2\theta + 2\sin\theta - \sin\theta - 1 = 0$

$(2\sin\theta - 1)(\sin\theta + 1) = 0$

$$[-\pi,\pi]-\left\{\pm\frac{\pi}{2}\right\}$$

$\tan\theta=0$	$\sin\theta=\frac{1}{2}$	$\sin\theta=-1$
$-\pi, 0, \pi$	$\frac{\pi}{6}, \frac{5\pi}{6}$	No Sol^n

$$S=\left\{-\pi, 0, \pi, \frac{\pi}{6}, \frac{5\pi}{6}\right\}$$



$$T=\sum_{\theta\in S}\cos 2\theta$$

$$=\cos(-2\pi)+\cos 0+\cos 2\pi+\cos\frac{\pi}{3}+\cos\frac{5\pi}{3}$$

$$=1+1+1+\frac{1}{2}+\frac{1}{2}$$

$$=4$$

Q

The number of elements in the set $S = \{\theta \epsilon [-4\pi, 4\pi] : 3\cos^2 2\theta + 6\cos 2\theta - 10\cos^2\theta + 5 = 0\}$ is 32 ______.

[JEE M 2022]

$3\cos^2 2\theta + 6\cos 2\theta - 5(2\cos^2\theta) + 5 = 0$

$3\cos^2 2\theta + 6\cos 2\theta - 5(1 + \cos 2\theta) + \cancel{5} = 0$

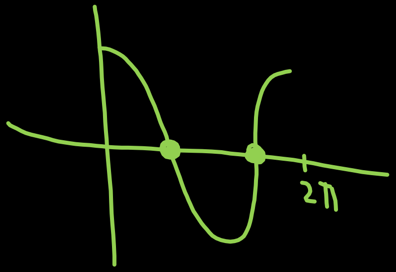
$3\cos^2 2\theta + \cos 2\theta = 0$

$\cos 2\theta(3\cos 2\theta + 1) = 0$

$\cos 2\theta = 0 \qquad \cos 2\theta = \frac{-1}{3}$

$\cos 2\theta = 0 \qquad \theta \in [-4\pi, 4\pi]$

$\cos x = 0 \qquad x \in [-8\pi, 8\pi]$



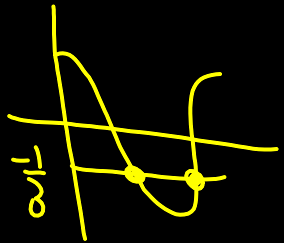
2×8

$= 16$

$\cos 2\theta = \frac{-1}{3} \qquad \theta \in [-4\pi, 4\pi]$

$\cos 2\theta = \frac{-1}{3} \qquad 2\theta \in [-8\pi, 8\pi]$

$\cos x = \frac{-1}{3} \qquad x \in [-8\pi, 8\pi]$



$2 \times 8 = 16$

$\boxed{a \sin x + b \cos x = c}$

??

Type – 2

$$\boxed{a \sin x + b \cos x = c}$$

Type 2

$$a \sin x + b \cos x = c$$

Method

$\Rightarrow$ divide by $\sqrt{a^2+b^2}$ both sides.

Find general solution of sin x + cos x = √2.

$$\sqrt{(1)^2+(1)^2} = \sqrt{2}$$

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

$$\sin\frac{\pi}{4}\sin x + \cos\frac{\pi}{4}\cos x = 1$$

$$2n\pi \pm \alpha$$

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

$$\# \quad \cos\left(x - \frac{\pi}{4}\right) = \cos 0$$

$$x - \frac{\pi}{4} = 2n\pi \pm 0$$

$$\boxed{x = 2n\pi + \frac{\pi}{4}} \quad n \in I$$

Q

Find general solution of √3 cos x + sin x = 2.

$$\sqrt{(\sqrt{3})^2 + 1^2} = 2$$

$$\boxed{\frac{\sqrt{3}}{2}} \cos x + \frac{1}{2} \sin x = \frac{2}{2}$$

$$\cos\frac{\pi}{6} \cos x + \sin\frac{\pi}{6} \sin x = 1$$

$$\cos\left(x - \frac{\pi}{6}\right) = \cos 0$$

$$x - \frac{\pi}{6} = 2n\pi$$

$$\boxed{x = 2n\pi + \frac{\pi}{6}}$$

Q

Find the general solutions of equation sin x + cos x = 3/2

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

$$\Rightarrow \underbrace{\cos\left(x - \frac{\pi}{4}\right) = \frac{3}{2\sqrt{2}}}_{\text{No sol}^n}$$

$$\frac{\sqrt{9}}{\sqrt{8}} = \sqrt{\frac{9}{8}}$$

$$\boxed{1.\mathrm{Sm}}$$

$$\cos\left(x - \frac{\pi}{4}\right) = 1.\mathrm{Sm}$$

Q

The number of integral values of 'k' for which the equation $\boxed{\underbrace{3\sin x + 4\cos x}_{} = k + 1}$ has a solution, $k \epsilon R$ is

[JEE M 2021]

$$\left[-\sqrt{a^2+b^2}, \sqrt{a^2+b^2}\right]$$

$$[-5, 5] \quad k+1$$

$$-5 \le k+1 \le 5$$

$$\boxed{-6 \le k \le 4}$$

$$\underbrace{-6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4}_{\boxed{11 \text{ Values}}}$$

Concept - "sol^n Exist Karta hai"

$\sin x = 4$

$[-1, 1]$

No sol^n

$\sin x = \frac{1}{2}$

$[-1, 1]$

$\sqrt{3}/2$

$1/3$

$2/3$

$\sin x = k$

$\boxed{-1 \le k \le 1}$

Consider the following lists:

[JEE Adv. 2022]

List-I	List-II
(I) $\left\{x \in \left[-\frac{2\pi}{3}, \frac{2\pi}{3}\right] : \cos x + \sin x = 1\right\}$	(P) has two elements
(II) $\left\{x \in \left[-\frac{5\pi}{18}, \frac{5\pi}{18}\right] : \sqrt{3}\tan 3x = 1\right\}$	(Q) has three elements
(III) $\left\{x \in \left[-\frac{6\pi}{5}, \frac{6\pi}{5}\right] : 2\cos(2x) = \sqrt{3}\right\}$	(R) has four elements
(IV) $\left\{x \in \left[-\frac{7\pi}{4}, \frac{7\pi}{4}\right] : \sin x - \cos x = 1\right\}$	(S) has five elements
	(T) has six elements

The correct option is:

(A) (I) → (P); (II) → (S); (III) → (P); (IV) → (S)

(B) (I) → (P); (II) → (P); (III) → (T); (IV) → (R)

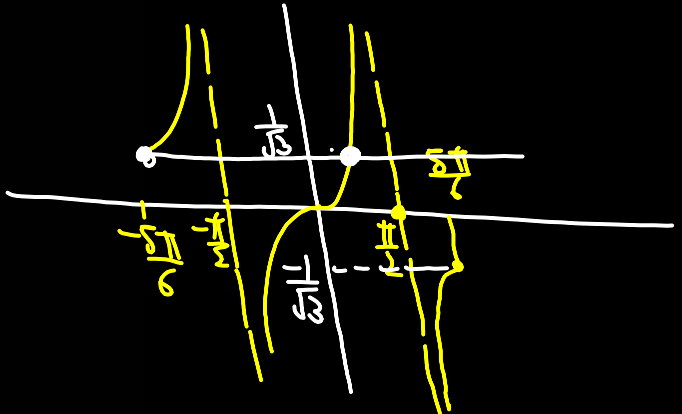
(C) (I) → (Q); (II) → (P); (III) → (T); (IV) → (S)

(D) (I) → (Q); (II) → (S); (III) → (P); (IV) → (R)

$\tan\left(-\frac{5\pi}{6}\right)$
$= -\tan\frac{5\pi}{6}$
$= -\tan\left(\pi - \frac{\pi}{6}\right)$
$= \frac{1}{\sqrt{3}}$

$\tan 3x = \frac{1}{\sqrt{3}} \qquad x \in \left[-\frac{5\pi}{18}, \frac{5\pi}{18}\right]$

$\tan(\theta) = \frac{1}{\sqrt{3}} \qquad \theta \in \left[-\frac{5\pi}{6}, \frac{5\pi}{6}\right]$

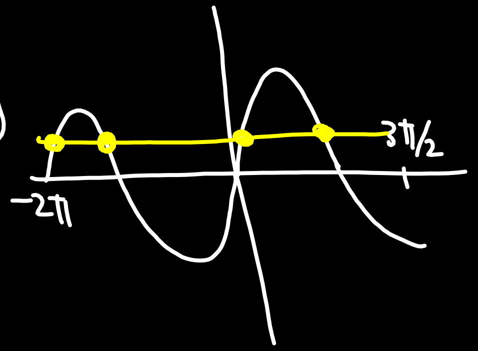


$-\frac{7\pi}{4}-\frac{\pi}{4}, \frac{7\pi}{4}-\frac{\pi}{4}$

$\frac{1}{\sqrt{2}}\sin x - \frac{1}{\sqrt{2}}\cos x = \frac{1}{\sqrt{2}}$ $\quad x \in \left[-\frac{7\pi}{4}, \frac{7\pi}{4}\right]$

$\sin\left(x-\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$ $\quad \left(x-\frac{\pi}{4}\right) \in \left[-2\pi, \frac{3\pi}{2}\right]$

$\sin(\theta) = \frac{1}{\sqrt{2}}$ $\quad \theta \in \left[-2\pi, \frac{3\pi}{2}\right]$



1. QE – factorise
2. $a \sin x + b \cos x = c$

Type – 3
(Convert Sum to Product)

Type 3

Convert Sum to Product

If $0 \leq x < \frac{\pi}{2}$, then the number of values of x for which

$\boxed{\sin x - \sin 2x + \sin 3x = 0}$ is $x \in \left[0, \frac{\pi}{2}\right)$

A. 3
B. 1
C. 4
D. 2

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

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

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

$\sin 2x = 0$ OR $\cos x = 1/2$

[JEE M 2019]

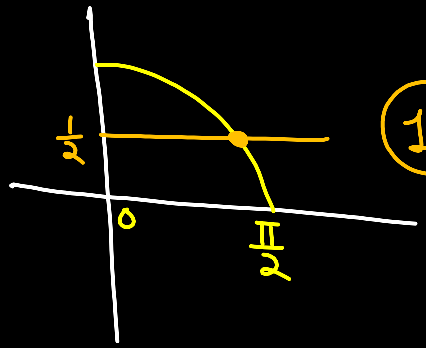
$\sin 2x = 0 \quad x \in [0, \tfrac{\pi}{2})$

$\sin 2x = 0 \quad 2x \in [0, \pi)$

$\sin\theta = 0 \quad \theta \in [0, \pi)$

$\boxed{\theta = 0}$

$\cos x = \tfrac{1}{2} \quad x \in [0, \tfrac{\pi}{2})$



1

$1 + 1 = \boxed{2}$

If the sum of values of x in $[0, 2\pi]$, for which

$\sin x + \sin 2x + \sin 3x + \sin 4x = 0$, is equal to

A. 8π

B. 11π

C. 12π

D. 9π

[JEE M 2021]

D

$$2\sin\left(\frac{5x}{2}\right)\cos\left(\frac{3x}{2}\right) + 2\sin\left(\frac{5x}{2}\right)\cos\left(\frac{x}{2}\right) = 0$$

$$2\sin\left(\frac{5x}{2}\right)\left\{\cos\frac{3x}{2} + \cos\frac{x}{2}\right\} = 0$$

$$2\sin\left(\frac{5x}{2}\right)\left\{2\cos x \cos\frac{x}{2}\right\} = 0$$

$$\frac{C-D}{2} = \frac{x-4x}{2} = \frac{-3x}{2}$$

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

$\sin\frac{5x}{2} = 0$

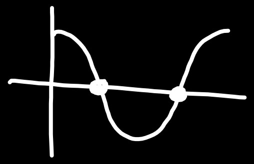
$\sin\left(\frac{5x}{2}\right) = 0$ $\quad$ $\frac{5}{2}x \in [0, 5\pi]$

$\frac{5x}{2} = 0, \pi, 2\pi, 3\pi, 4\pi, 5\pi$

$\boxed{x = 0, \frac{2\pi}{5}, \frac{4\pi}{5}, \frac{6\pi}{5}, \frac{8\pi}{5}, 2\pi}$

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

$\cos x = 0$



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

$\cos\frac{x}{2} = 0$ $\quad$ $x \in [0, 2\pi]$

$\cos\left(\frac{x}{2}\right) = 0$ $\quad$ $\frac{x}{2} \in [0, \pi]$

$\frac{x}{\cancel{2}} = \frac{\pi}{\cancel{2}}$

$\boxed{x = \pi}$

$\boxed{\text{Sum of Sol}^{n} \Rightarrow 9\pi}$

Q

The positive integer value of $n > 3$ satisfying the equation

$$\frac{1}{\sin\left(\frac{\pi}{n}\right)} = \frac{1}{\sin\left(\frac{2\pi}{n}\right)} + \frac{1}{\sin\left(\frac{3\pi}{n}\right)}$$ is

$\boxed{\text{Sum} \Rightarrow \text{Product}}$

[JEE Adv. 2011]

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

$$\frac{\boxed{\sin\left(\frac{3\pi}{n}\right) - \sin\left(\frac{\pi}{n}\right)}}{\sin\left(\frac{\pi}{n}\right)\sin\left(\frac{3\pi}{n}\right)} = \frac{1}{\sin\left(\frac{2\pi}{n}\right)}$$

$$\frac{2\cos\left(\frac{2\pi}{n}\right)\cancel{\sin\left(\frac{\pi}{n}\right)}}{\cancel{\sin\left(\frac{\pi}{n}\right)}\sin\left(\frac{3\pi}{n}\right)} = \frac{1}{\sin\left(\frac{2\pi}{n}\right)}$$

$$\underbrace{2\cos\left(\frac{2\pi}{n}\right)\sin\left(\frac{2\pi}{n}\right)} = \sin\left(\frac{3\pi}{n}\right)$$

$$\underbrace{\sin\left(\frac{4\pi}{n}\right) = \sin\left(\frac{3\pi}{n}\right)}$$

Ans.-

$$\boxed{n = 7}$$

$$\sin\left(\frac{4\pi}{7}\right) = \sin\left(\frac{3\pi}{7}\right)$$

$$** \boxed{\sin\theta = \sin(\pi - \theta)}$$

Type – 4

(Convert Product to Sum)

Type 4

Convert Product into Sum

Q

Number of solutions of the trigonometric equation in [0, π],

$\boxed{\sin 3\theta = 4 \sin\theta \cdot \sin 2\theta . \sin 4\theta}$

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

A. 4

B. 6

C. 8 ✓

D. 10

$\Rightarrow \sin 3\theta = 4 \sin\theta \, \underline{\sin(3\theta-\theta)\sin(3\theta+\theta)}$

$\Rightarrow \underline{\sin 3\theta} = 4\sin\theta\left(\sin^2 3\theta - \sin^2\theta\right)$

$\Rightarrow 3\sin\theta - \cancel{4\sin^3\theta} = 4\sin\theta\sin^2 3\theta - \cancel{4\sin^3\theta}$

$\Rightarrow 3\cancel{\sin\theta} = 4\cancel{\sin\theta}\sin^2 3\theta$

$\sin\theta = 0$ $\qquad$ $3 = 4\sin^2 3\theta$ $\qquad$ $\theta \in [0, \pi]$

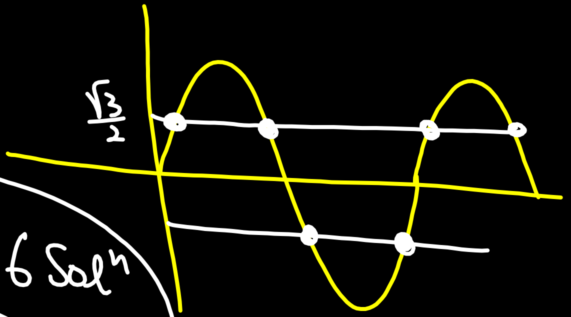
$\sin\theta = 0$

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

$\boxed{\theta = 0, \pi}$

$\sin 3\theta = \pm\frac{\sqrt{3}}{2}$ $\qquad$ $3\theta \in [0, 3\pi]$

$\sin x = \pm\frac{\sqrt{3}}{2}$ $\qquad$ $x \in [0, 3\pi]$



2 Sol^n

\+ 6 Sol^n

* $\sin x \pm \cos x$ ✓
* $\sin x \cos x$ ✓

Type-5

$\boxed{\sin x + \cos x = \sin x \cos x + 2}$

Method

Type – 5

$$f(\sin x \pm \cos x\,, \sin x\, cosx)$$

Type 5

(i) Equations of the form $P(\sin x \pm \cos x, \sin x . \cos x) = 0$, can be solved by the substituting $\boxed{\cos x \pm \sin x = t}$

(ii) Many equations can be solved by introducing a new variable

e.g. consider the equation $\sin^4 2x + \cos^4 2x = \sin 2x . \cos 2x$

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

Method $\sin x + \cos x = t$

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

$$\Rightarrow 1 + 2\boxed{\sin x \cos x} = t^2$$

$$\Rightarrow \boxed{\sin x \cos x = \frac{t^2 - 1}{2}}$$

Q.E

$$\boxed{t = \frac{t^2 - 1}{2} + 2}$$

Find general value of x satisfying the equation

$\sin^4 2x + \cos^4 2x = \sin 2x \cos 2x$.

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

$$\Rightarrow 2 - \sin^2 4x = \sin 4x$$

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

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

$$\cancel{\sin 4x = -2} \qquad \sin 4x = 1$$

$$\sin 4x = \sin \frac{\pi}{2}$$

$$\boxed{x = \frac{n\pi}{4} + (-1)^n \frac{\pi}{8}}$$

$\underbrace{LHS}_{} = \underbrace{RHS}_{}$

$[-2, 2] \quad [2, 8]$

$\boxed{LHS = 2 \quad RHS = 2}$

*

Type - 6

Using Range of Functions

Type 6

Solving equations with the use of boundedness of the function.

Remember :-

$-1 \leq \sin x \leq 1$, $-1 \leq \cos x \leq 1$, $\tan x \in R$, $\cot x \in R$.

$\underbrace{|\operatorname{cosec} x|} \geq 1$, $\underbrace{|\sec x|} \geq 1$.

$\left.\begin{matrix} \sec x \\ \operatorname{cosec} x \end{matrix}\right\} (-\infty, -1] \cup [1, \infty)$

Most GS

Q ~~Solve~~ for x : $\cos x + \cos 2x + \cos 3x = 3$

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

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

$n \in \mathbb{Z}$

$\cancel{\boxed{x = 2n\pi}}$ $\cancel{2}x = \cancel{2}n\pi$ $3x = 2n\pi$

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

$\{0, 2\pi, 4\pi, 6\pi, \}$

$\{0, \pi, 2\pi, 3\pi, 4\pi, \ldots\}$ $\{0, \frac{2\pi}{3}, \frac{4\pi}{3}, 2\pi, \frac{8\pi}{3}, \ldots\}$

$$\boxed{GS \in \{n\pi\} \cup \{\frac{2n\pi}{3}\}}$$

Q

All the pairs (x, y) that satisfy the inequality

$$\boxed{2^{\sqrt{\sin^2 x - 2\sin x + 5}} \cdot \frac{1}{4^{\sin^2 y}} \leq 1}$$ also satisfy the equation:

(1) $2|\sin x| = 3\sin y$ (2) $2\sin x = \sin y$

(3) $\sin x = 2\sin y$ (4) $\sin x = |\sin y|$

[JEE M 2019]

D

$$\sqrt{\sin^2 x - 2\sin x + 5} \leq 2\sin^2 y$$

$\sin x = -1$

$$\underbrace{\sqrt{(\sin x - 1)^2 + 4}}_{[2,\, 2\sqrt{2}]} \leq \underbrace{\boxed{2\sin^2 y}}_{[0,\, 2]}$$

$\boxed{\sin x = 1}$ $\sin^2 y = 1$

$\boxed{\sin y = \pm 1}$

$\sin x = |\sin y|$

The number of solutions of $\boxed{\sin^7 x + \cos^7 x = 1}$, $x \in [0, 4\pi]$ is equal to

A. 11
B. 7
C. 5
D. 9

[JEE M 2021]

$\sin^7 x + \cos^7 x = 1$

$\sin x$	$\cos x$
1	0
0	1

$\boxed{x = \frac{\pi}{2}, \cancel{\frac{3\pi}{2}}, \frac{5\pi}{2}, \cancel{\frac{7\pi}{2}}}$

$x = 0, \cancel{\pi}, 2\pi, \cancel{3\pi}, 4\pi$

5 Sol^n

For $x \in (0, \pi)$, the equation $\sin x + 2\sin 2x - \sin 3x = 3$ has

(a) infinitely many solutions
(b) three solutions
(c) one solution
(d) no solution

[JEE Adv. 2014]

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

D

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

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

$$-2(2\cos^2 x - 1) + 4\cos x = \frac{3}{\sin x}$$

$$\underbrace{-1-4\cos^2 x+4\cos x}+3 = 3\operatorname{cosec} x$$

$$\boxed{\underbrace{3-(2\cos x-1)^2}_{[-6,\,3]}} = \boxed{\underbrace{3\operatorname{cosec} x}_{[3,\,\infty)}}$$

$\cos x = -1$

$\cos x = 1/2$

No Sol^n

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

$\operatorname{cosec} x = 1$

$\boxed{\sin x = 1}$

(Root wale sawal)

* Type – 7

$$\boxed{f(x) = \sqrt{\varphi(x)}}$$

Type 7

Solution of trigonometric equation of the form $f(x) = \sqrt{\varphi(x)}$

(i) $f(x) \geq 0, \varphi(x) \geq 0$

(ii) $f^2(x) = \varphi(x)$

* Jab bhi sq both sides

$\Downarrow$

faltu Sol^n

$\Downarrow$

Reject

Solve for x, $\boxed{\sin x = \sqrt{1 - \cos x}}$ in x ∈ [0, 2π]

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

$$(1 - \cancel{\cos x})(1 + \cos x) = (1 - \cancel{\cos x})$$

$$\boxed{\cos x = 1}$$

$$\boxed{x = 0, 2\pi}$$

$$1 + \cos x = 1$$

$$\boxed{\cos x = 0}$$

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

$$\sin x = \sqrt{1-\cos x}$$

$$\begin{cases} x = 0 & 0 = \sqrt{1-1} \checkmark \\ x = 2\pi & 0 = \sqrt{1-1} \checkmark \\ x = \frac{\pi}{2} & 1 = \sqrt{1-0} \checkmark \end{cases}$$

$\cancel{\boxed{x = \frac{3\pi}{2}}}$ $\quad -1 = \sqrt{1-0}$ X

Type – 8
Log wale Questions

Q

The number of distinct solutions of the equation,

$\log_{\frac{1}{2}}|\sin x| = 2 - \log_{\frac{1}{2}}|\cos x|$ in the interval $[0, 2\pi]$, is ____

[JEE M 2020]

$\log_{\frac{1}{2}}|\sin x| + \log_{\frac{1}{2}}|\cos x| = 2$

$\log_{\frac{1}{2}}|\sin x||\cos x| = 2$

$|a||b| = |ab|$

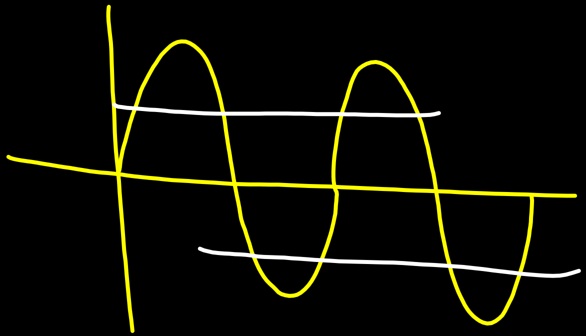
$|2\sin x \cos x| = \frac{1}{4} \times 2$

$|\sin 2x| = \frac{1}{2}$

$\sin 2x = \pm \frac{1}{2} \qquad x \in [0, 2\pi]$

$\sin(2x) = \pm \frac{1}{2} \qquad 2x \in [0, 4\pi]$

$\star$ $\sin(\theta) = \pm \frac{1}{2} \qquad \theta \in [0, 4\pi]$



8

Q

If for $x \in \left(0, \frac{\pi}{2}\right)$, $\boxed{\log_{10}\sin x + \log_{10}\cos x = -1}$ and $\boxed{\log_{10}(\sin x + \cos x) = \frac{1}{2}(\log_{10} n - 1)}$, n > 0 then the value of n is

A. 20
B. 12
C. 9
D. 16

[JEE M 2021]

$$\log_{10}(\sin x \cos x) = -1$$

$$\sin x \cos x = 10^{-1} = \frac{1}{10} \quad \text{——— } (1)$$

$$\log_{10}(\sin x + \cos x)^2 = \log_{10} n - \log_{10} 10$$

$$\cancel{\log_{10}}\left(1 + 2\sin x \cos x\right) = \cancel{\log_{10}}\left(\frac{n}{10}\right)$$

$$1 + 2 \times \frac{1}{10} = \frac{n}{10}$$

$$\boxed{n = 12}$$

Type – 9

Graph wale Questions

Trig + algebra

$\tan x = x - 10$

$y = \tan x \qquad y = x - 10$

POI

no. of Soln

#

Q The number of solutions of equation $x + 2\tan x = \frac{\pi}{2}$ in the interval $[0, 2\pi]$ is :

[JEE M 2021]

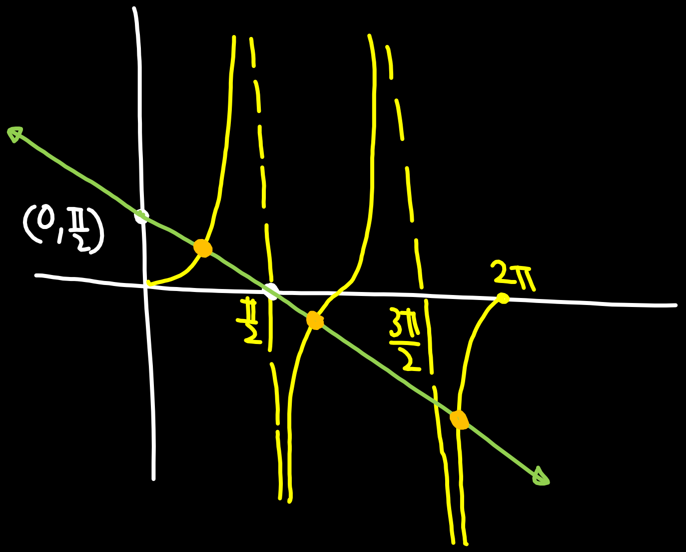
A. 3 ✓
B. 4
C. 2
D. 5

$\underbrace{2\tan x}_{} = \underbrace{\frac{\pi}{2} - x}_{}$

$y = 2\tan x$

$\underbrace{y = \frac{\pi}{2} - x}_{}$

x	y
0	$\pi/2$
$\frac{\pi}{2}$	0



The number of solutions of $|\cos x| = \sin x$, such that $-4\pi \le x \le 4\pi$ is

[JEE M 2022]

A. 4

B. 6

C. 8

D. 12

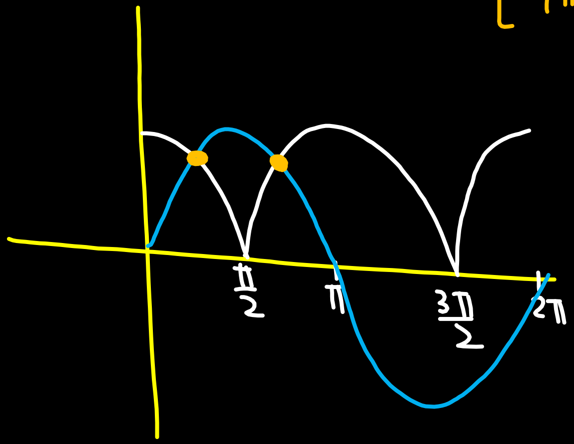
$[0, 2\pi] \rightarrow 2$ sol^n

$[-4\pi, 4\pi] \rightarrow 2 \times 4$

$= 8$ sol^n

$y = |\cos x|$

$y = \sin x$



Q The number of solutions of the equation $2\theta - \cos^2\theta + \sqrt{2} = 0$ ~~is~~ in R is equal to_. 1

[JEE M 2022]

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

$(0, \sqrt{2})$ $y = 2x + \sqrt{2}$

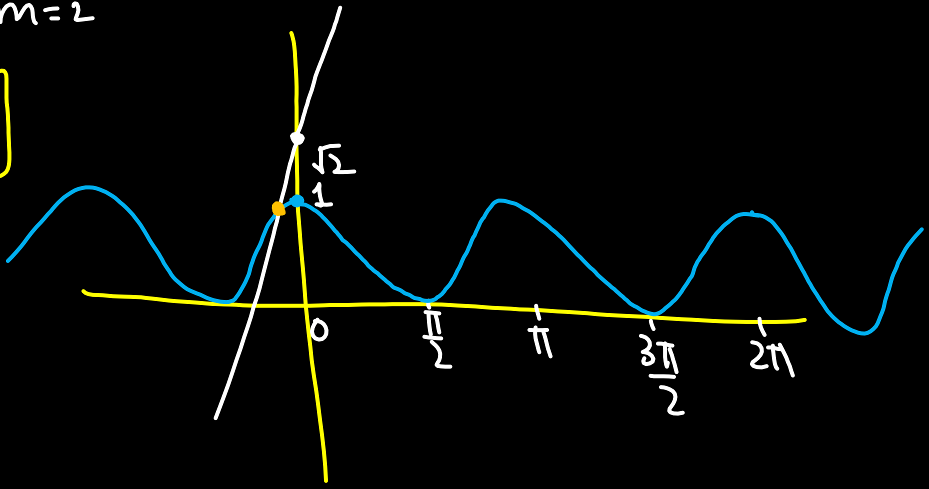
$m = 2$

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

$\theta \in (-\infty, \infty)$

$\boxed{y = \cos^2\theta}$

θ	y
0	1
$\frac{\pi}{2}$	0
π	1
$\frac{3\pi}{2}$	0
2π	1



Q

The number of solutions of the equation sin x = cos² x in the interval (0,10) is_.

[JEE M 2022]

$\boxed{\sqrt{5} \approx 2.2}$

$\boxed{\sqrt{3} \approx 1.7}$

M-1

(4)

$\sin x = \cos^2 x$

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

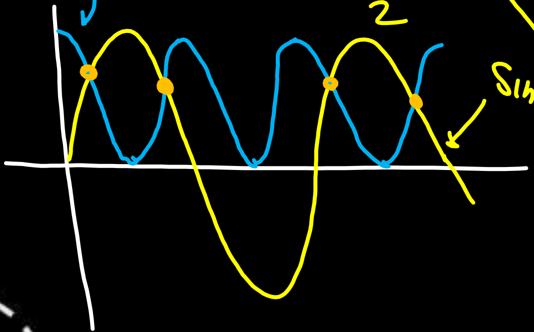
$\sin^2 x + \sin x - 1 = 0$

$\sin x = \dfrac{-1 \pm \sqrt{5}}{2}$ <

$\dfrac{-1+\sqrt{5}}{2} \approx 0.6$

$\cancel{\dfrac{-1-\sqrt{5}}{2} \approx -1.6}$

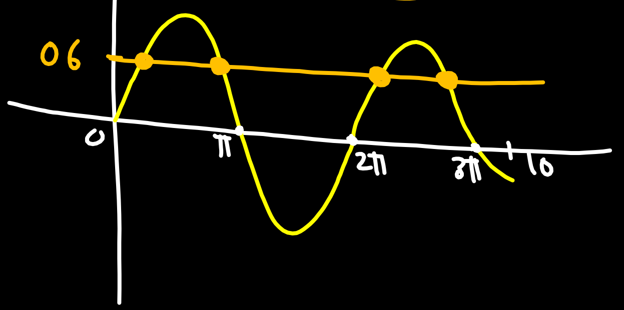
cos²x



sin x

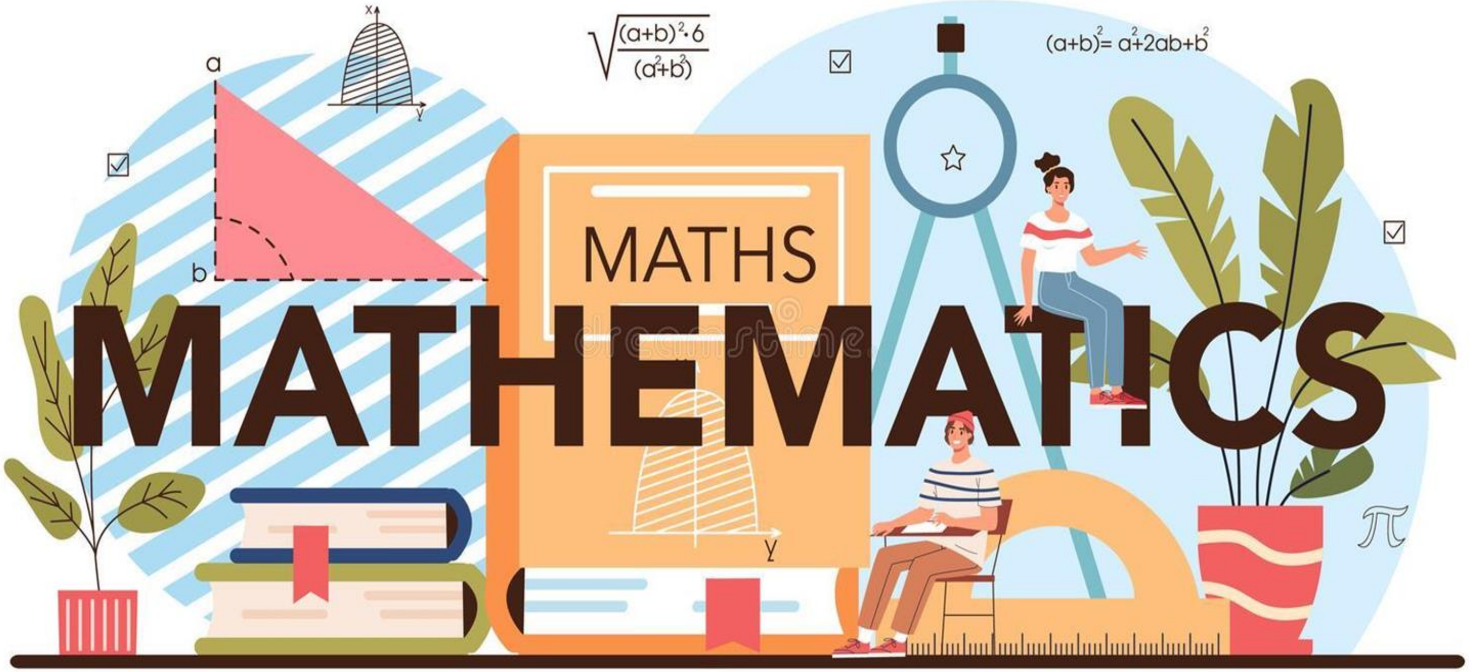
$\sin x = 0.6 \quad x \in (0,10)$

$\boxed{4 \text{ Sol}^n}$



PYQs

Unacademy Atoms



Q

The number of values of θ in the interval, $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ such that $\theta \neq \frac{n\pi}{5}$ for $n = 0, \pm1, \pm2$ and $\tan\theta = \cot 5\theta$ as well as $\sin 2\theta = \cos 4\theta$ is 3

[JEE Adv. 2010]

① $\tan\theta = \cot 5\theta$

$\tan\theta = \tan\left(\frac{\pi}{2} - 5\theta\right)$

$\theta = n\pi + \frac{\pi}{2} - 5\theta$

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

$\therefore \boxed{\theta = \frac{(2n+1)\pi}{12}}$

$\theta = \frac{(2n+1)\pi}{12}$

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

$\theta \in \left(-\frac{6\pi}{12}, \frac{6\pi}{12}\right)$

$n = 0$: $\frac{\pi}{12}$ ✓

$n = 1$: $\frac{3\pi}{12}$ ✓

$n = 2$: $\frac{5\pi}{12}$ ✓

$n = -1$: $-\frac{\pi}{12}$ ✓

$n = -2$: $-\frac{3\pi}{12}$ ✓

$n = -3$: $-\frac{5\pi}{12}$ ✓

$\theta \in (\quad) \quad \left\{ \frac{\pi}{12}, \frac{5\pi}{12}, \frac{-3\pi}{12} \right\}$

$\sin 2\theta = \cos 4\theta$

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

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

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

$\frac{\pi}{2} - 2n\pi = 6\theta$

$\boxed{\frac{(1-4n)\pi}{12} = \theta}$

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

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

$\boxed{\theta = \frac{(4n-1)\pi}{4}}$

$n=0 \quad \frac{\pi}{12}$ ✓

$n=1 \quad \frac{-3\pi}{12}$ ✓

$n=2 \quad -\frac{7\pi}{12}$ ✗

$n=-1 \quad \frac{5\pi}{12}$ ✓

$n=-2 \quad \frac{9\pi}{12}$ ✗

$\theta \in \left(\frac{-2\pi}{4}, \frac{2\pi}{4}\right)$

$n=0 \quad -\frac{\pi}{4}$ ✓

$n=1 \quad \frac{3\pi}{4}$ ✗

$\vdots$

$n=-1 \quad -\frac{5\pi}{4}$ ✗

Let $S = \left\{x \in (-\pi, \pi) : x \neq 0, \pm\frac{\pi}{2}\right\}$. The sum of all distinct solutions of the equation $\sqrt{3}\sec x + \operatorname{cosec} x + 2(\tan x - \cot x) = 0$ in the set S is equal to

[JEE Adv. 2016]

(a) $-\frac{7\pi}{9}$ (b) $-\frac{2\pi}{9}$

(c) 0 c (d) $\frac{5\pi}{9}$

$$\sqrt{3}\sec x + \operatorname{cosec} x + 2(\tan x - \cot x) = 0$$

$$\frac{\sqrt{3}}{\cos x} + \frac{1}{\sin x} + 2\left(\frac{\boxed{\sin^2 x - \cos^2 x}}{\sin x \cos x}\right) = 0$$

$$\frac{\sqrt{3}\sin x + \cos x}{\sin x \cos x} + \frac{2(-\cos 2x)}{\sin x \cos x} = 0$$

$x \in (-\pi, \pi) \equiv \left(-\frac{9\pi}{9}, \frac{9\pi}{9}\right)$

$\sin\frac{\pi}{3}$ $\quad$ $\cos\frac{\pi}{3}$

$\frac{\sqrt{3}}{2}\sin x + \frac{\cos x}{2} = \cos 2x$

$\sin\frac{\pi}{3}\sin x + \cos\frac{\pi}{3}\cos x = \cos 2x$

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

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

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

$\boxed{-\frac{(6n+1)\pi}{3} = x}$

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

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

$\boxed{x = \frac{(6n+1)\pi}{9}}$

$\boxed{n = 0 \quad -\frac{\pi}{3}}$ ✓

$n = 1 \quad -\frac{7\pi}{3}$ ✗

$n = -1 \quad \frac{5\pi}{3}$ ✗

$n = 0 \quad \frac{\pi}{9}$ ✓

$n = 1 \quad \frac{7\pi}{9}$ ✓

$n = 2 \quad \frac{13\pi}{9}$ ✗

$n = -1 \quad -\frac{5\pi}{9}$ ✓

$n = -2 \quad -\frac{11\pi}{9}$ ✗

$-\frac{\pi}{3} + \frac{\pi}{9} + \frac{7\pi}{9} - \frac{5\pi}{9}$

$= \boxed{0}$

Join with us in Telegram

TELEGRAM CHANNEL

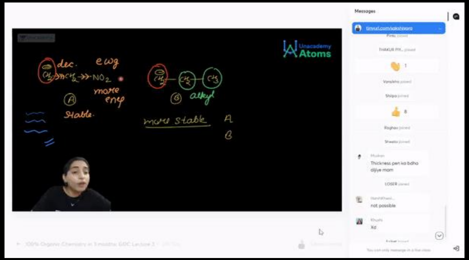
- t.me/unacademyatoms

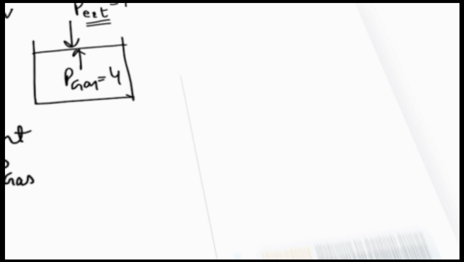
COMPLETE NOTES AND LECTURES

- tinyurl.com/unacademyatoms

$\boxed{4+4}$

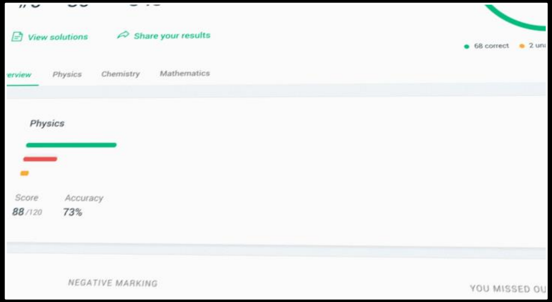
Unacademy Subscription





Crash Course

All Star



+ LIVE Class Environment

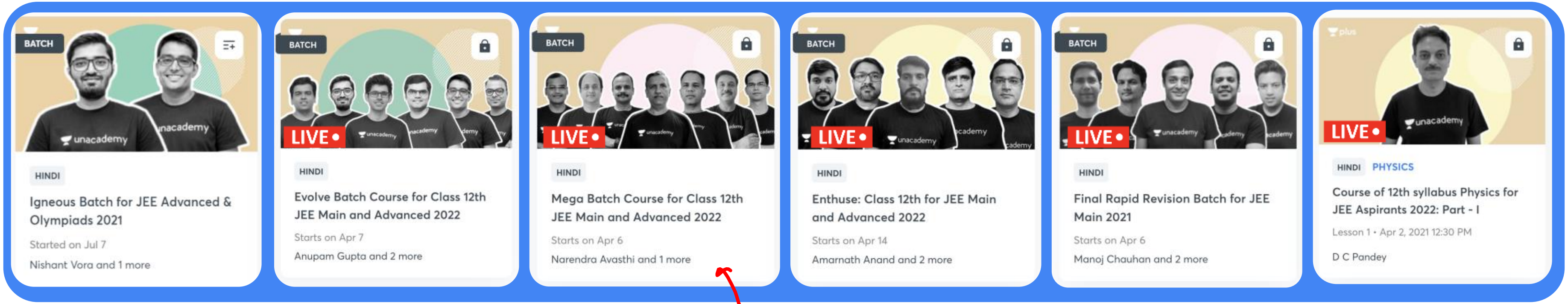
- + **LIVE Polls** & **Leaderboard**
- + **LIVE Doubt** Solving
- + **LIVE** Interaction

+ Performance Analysis

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

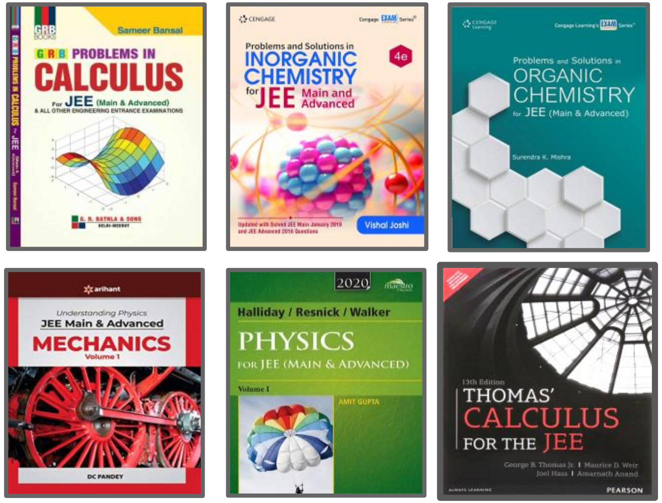
India's **BEST** Educators

Unacademy Subscription



If you want to be the **BEST**
"Learn" from the **BEST**

6 month



unacademy

All-Star Crash Course 3.0 Batch

for JEE Main 2023

NVLIVE

Starts November 24

Batch highlights:

- 3-month crash course targeting 2023 JEE Main with all IIT JEE Top Educators from Unacademy
- Cover the entire syllabus at a quick pace for JEE Main & Advanced
- Enhance your JEE competitiveness

Enroll Now

unacademy

Early Growth Batch

for Class 11 IIT JEE Main and Advanced 2025

November 10 onwards

Batch highlights:

- Classes by Top Educators who have trained Learners with single-digit ranks
- Comprehensive Class 11 and 12 syllabus completion
- Start early and prepare for JEE effectively
- Learn from Top online and offline Educators
- Top notch study material prepared by Top Educators

Enroll Now

Prashant Jain
Mathematics

Amarnath Anand
Mathematics

Nishant Vora
Mathematics

Piyush Maheshwari
Chemistry

Vijay Tripathi
Chemistry

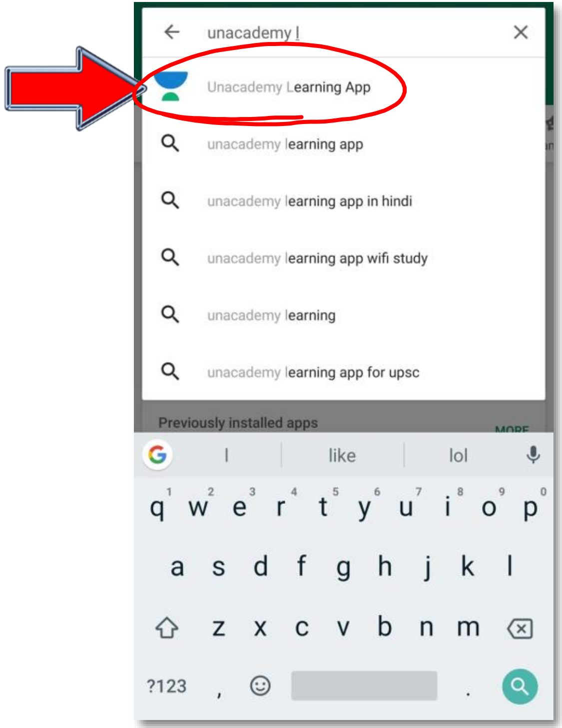
Sakshi Ganotra
Chemistry

Namo Kaul
Physics

Mohit Bhargav
Physics

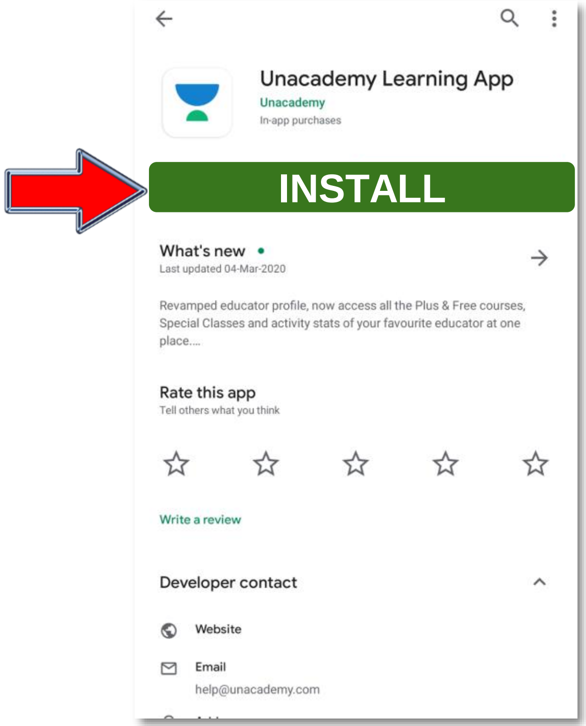
Ajit Lulla
Physics

Step 1

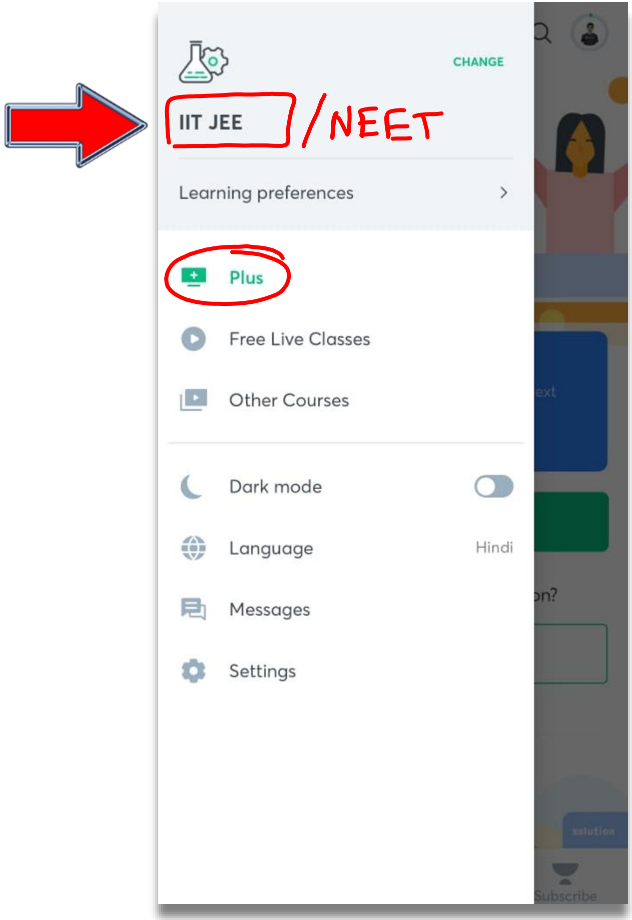


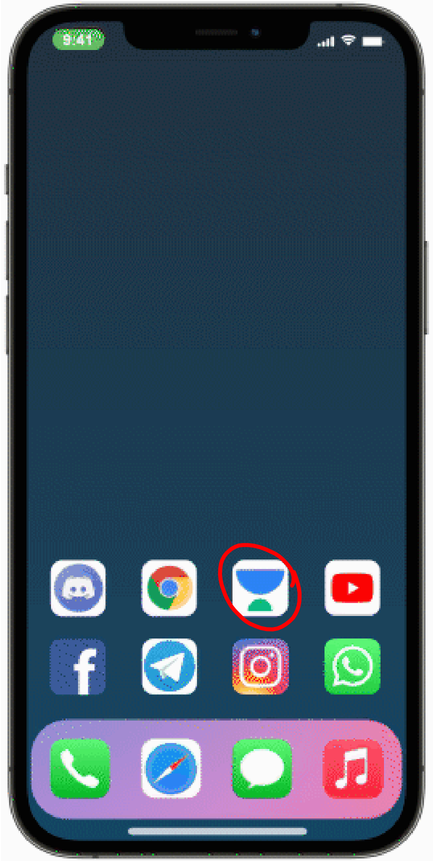
unacademy l
Unacademy Learning App
unacademy learning app
unacademy learning app in hindi
unacademy learning app wifi study
unacademy learning
unacademy learning app for upsc
Previously installed apps

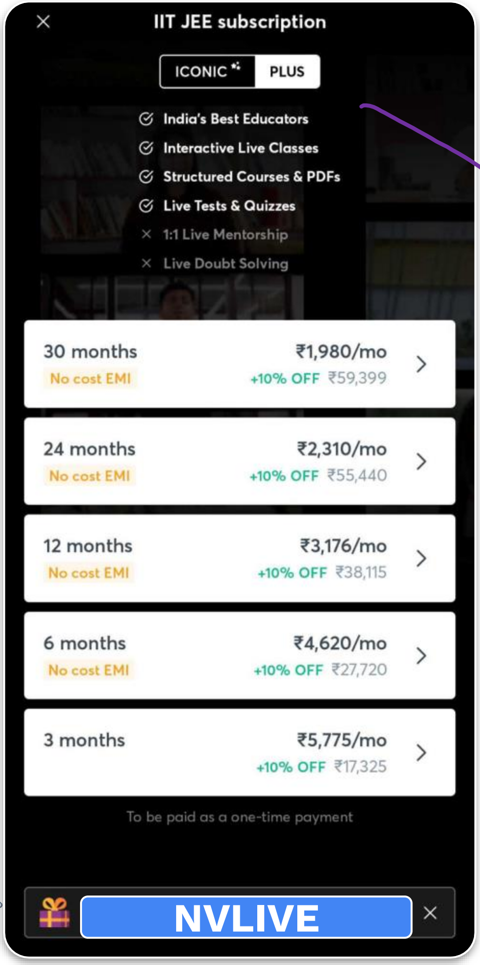
Step 2



Unacademy Learning App
Unacademy
In-app purchases
INSTALL
What's new
Last updated 04-Mar-2020
Revamped educator profile, now access all the Plus & Free courses, Special Classes and activity stats of your favourite educator at one place....
Rate this app
Tell others what you think
Write a review
Developer contact
Website
Email
help@unacademy.com


CHANGE
IIT JEE
/NEET
Learning preferences
Plus
Free Live Classes
Other Courses
Dark mode
Language
Hindi
Messages
Settings
Subscribe


9:41



OFFLINE

(online)

NVLIVE