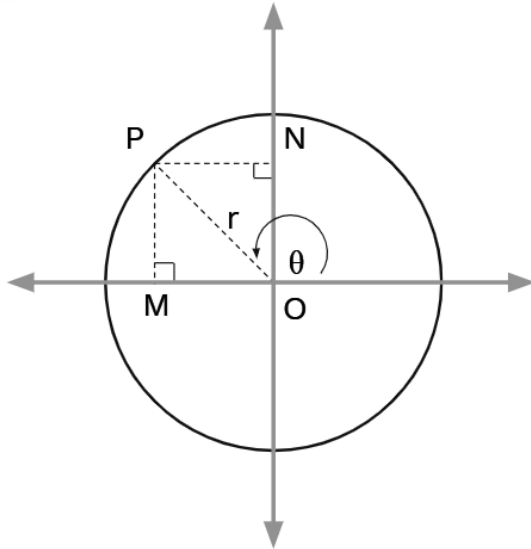


# Allied Angles

## Trigonometry

4



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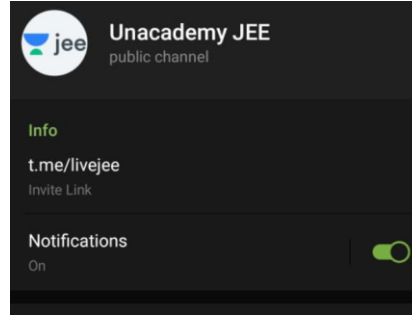
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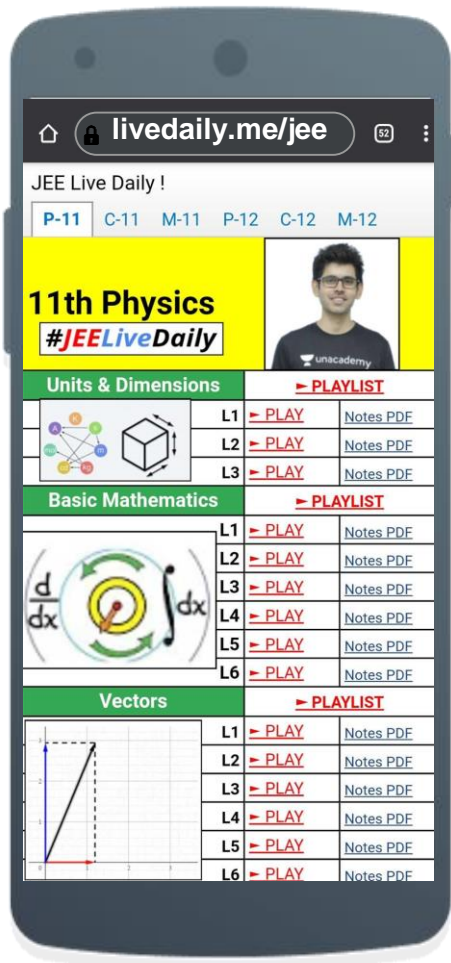
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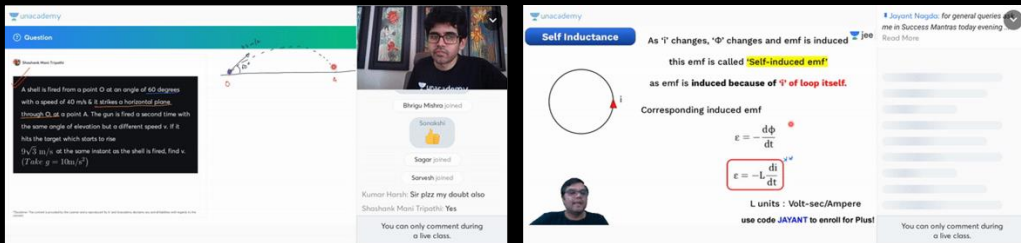
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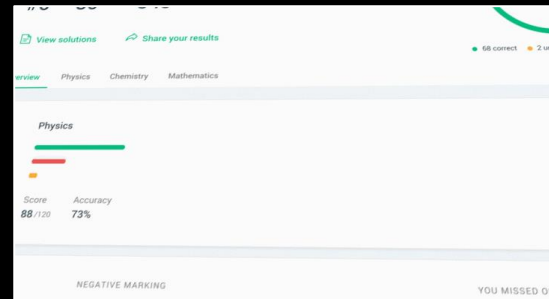
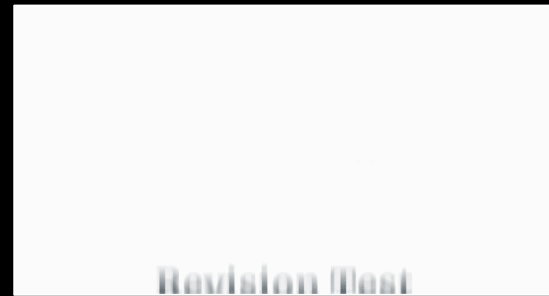


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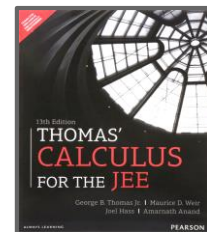
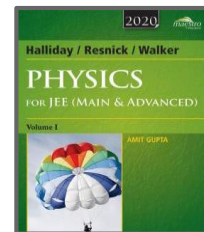
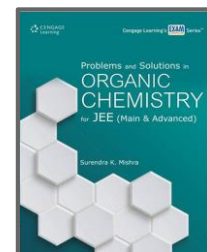
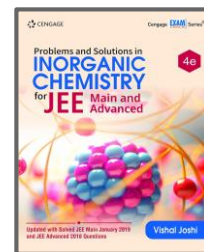
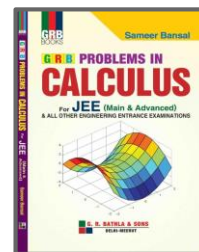
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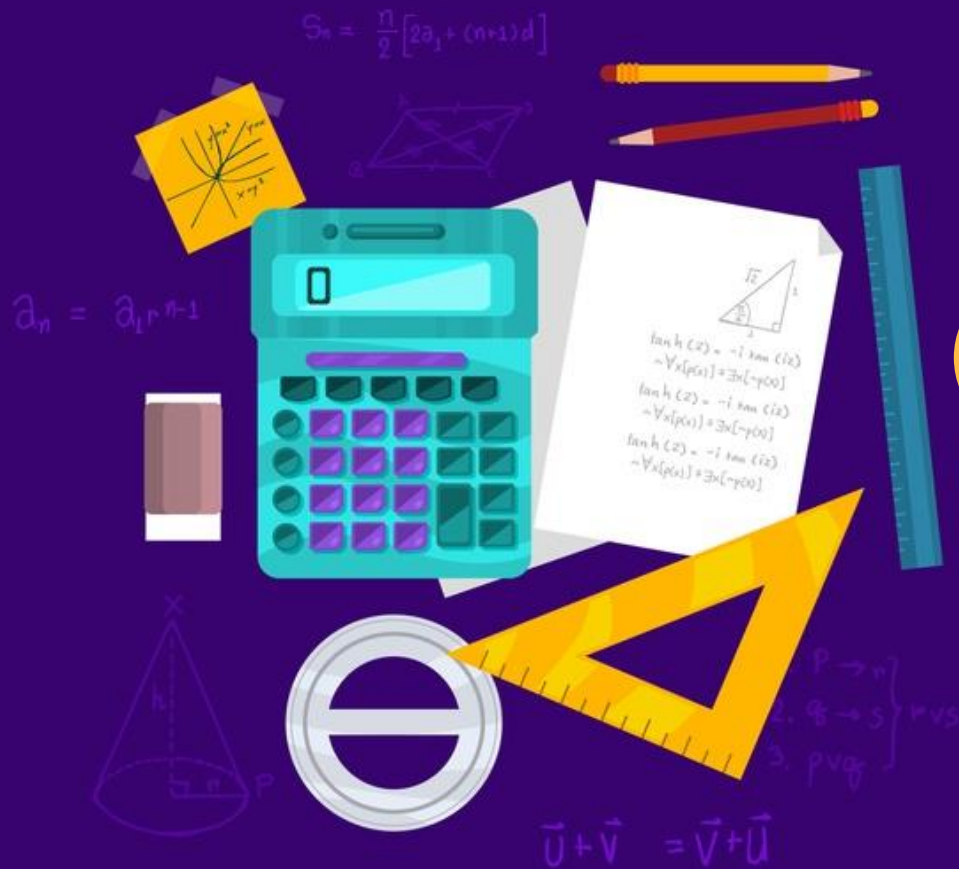
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# LET'S BEGIN!!





# Allied Angles



## What are allied angles?

- If two angles are such that their sum or difference is zero or multiple of  $90^\circ$ , then they are called allied angles.

$$(60^\circ, 30^\circ) \xrightarrow{\text{sum}} 90^\circ$$

$$(120^\circ, 60^\circ) \xrightarrow{\text{sum}} 180^\circ$$

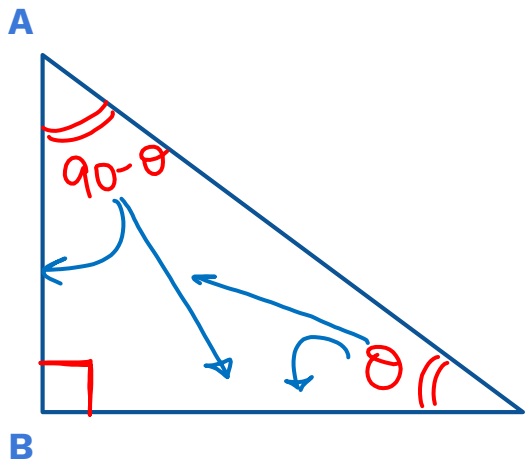
$$(120^\circ, 30^\circ) \xrightarrow{\text{Diff}} 90^\circ$$

$$(\theta, 90 + \theta)$$

$$(\theta, 90 - \theta)$$



## Relation between: $(90^\circ - \theta)$ and $\theta$



$$\textcircled{1} \sin(90 - \theta) = \frac{BC}{AC} = \cos \theta$$

$$\textcircled{2} \cos(90 - \theta) = \frac{AB}{AC} = \sin \theta$$

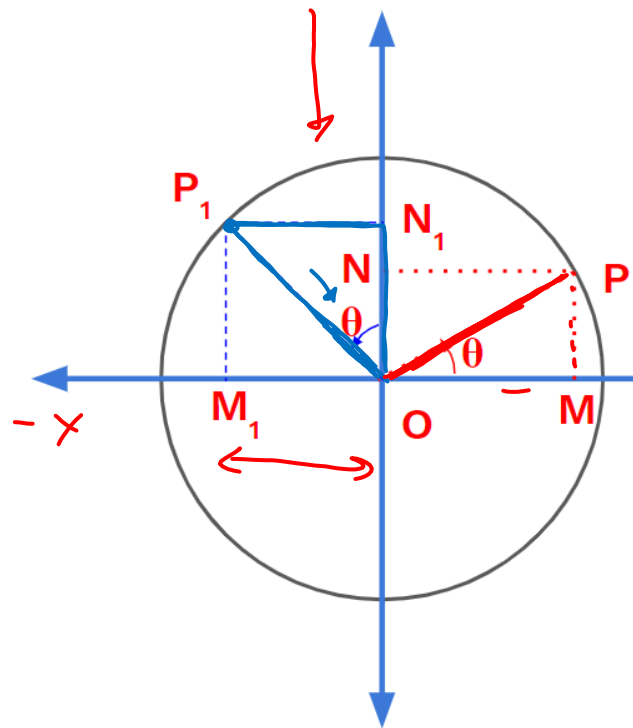
$$\textcircled{3} \tan(90 - \theta) = \cot \theta$$



vbv



## Relation between: $(90^\circ + \theta)$ and $\theta$



$$\textcircled{1} \sin(90^\circ + \theta) = \frac{ON_1}{OP_1} = \frac{OM}{OP}$$

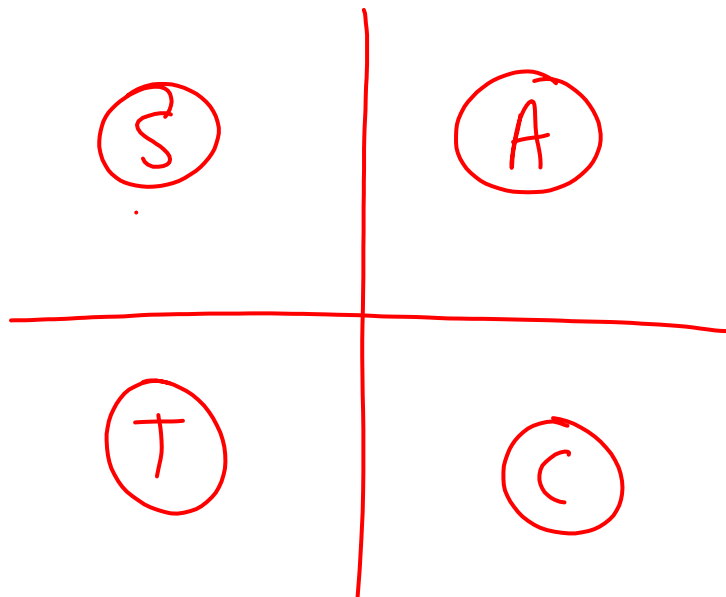
$$= \cos \theta$$

$$\textcircled{2} \cos(90^\circ + \theta) = -\left(\frac{OM_1}{OP_1}\right)$$

$$= -\left(\frac{P_1N_1}{OP_1}\right) = -\left(\frac{PM}{OP}\right) = -\sin \theta$$

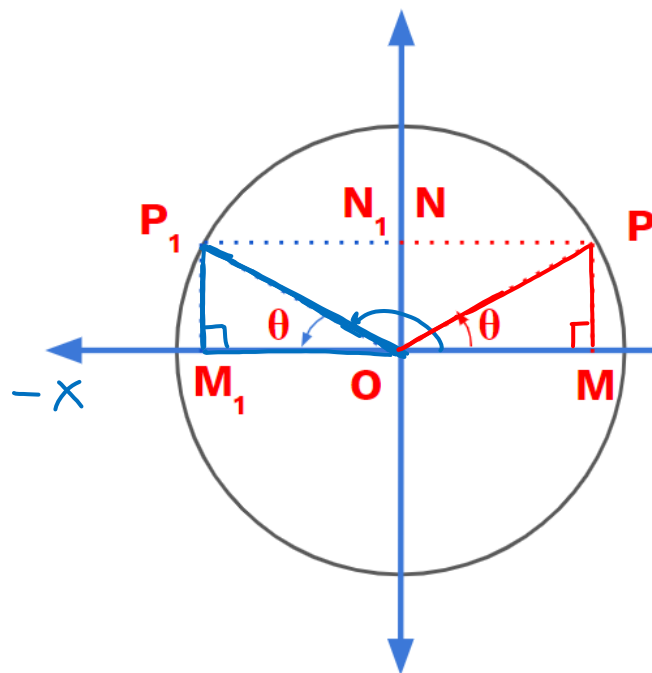
$$\textcircled{3} \tan(90^\circ + \theta) = -\cot \theta$$







## Relation between: $(180^\circ - \theta)$ and $\theta$



① Sin $(180 - \theta) = \frac{ON_1}{OP_1} = \frac{P_1M_1}{OP_1}$

$= \frac{PM}{OP} = \underline{\text{Sin } \theta}$

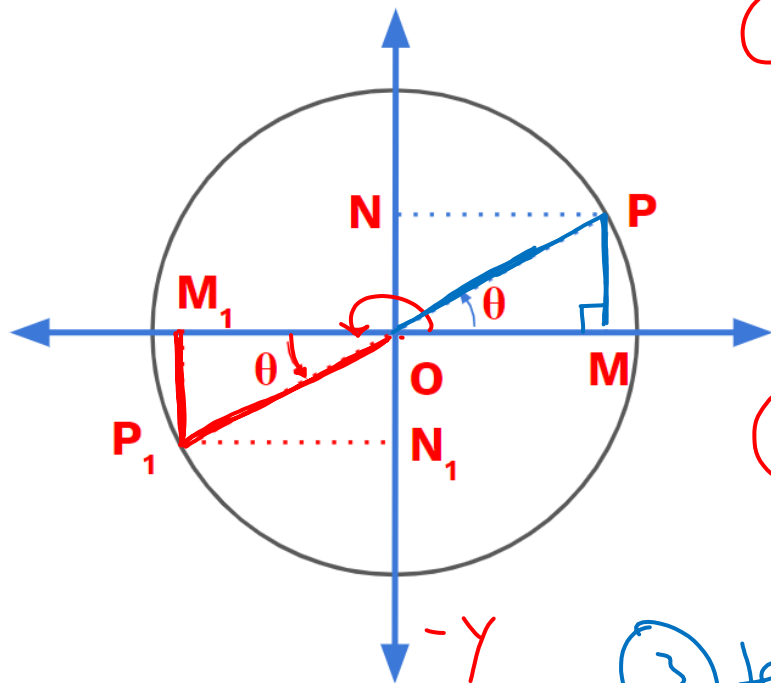
② cos $(180 - \theta) = -\frac{(OM_1)}{OP_1} = -\frac{(OM)}{OP} = -\underline{\text{cos } \theta}$

③ tan $(180 - \theta) = -\underline{\text{tan } \theta}$





## Relation between: $(180^\circ + \theta)$ and $\theta$



$$\begin{aligned}\textcircled{1} \quad \underline{\underline{\sin(180+\theta)}} &= \frac{-ON_1}{OP_1} \\ &= -\left(\frac{P_1M_1}{OP_1}\right) = -\left(\frac{PM}{OP}\right) \\ &= -\underline{\underline{\sin\theta}}\end{aligned}$$

$$\begin{aligned}\textcircled{2} \quad \underline{\underline{\cos(180+\theta)}} &= \frac{-OM_1}{OP_1} = \frac{-OM}{OP} \\ &= -\underline{\underline{\cos\theta}}\end{aligned}$$

$$\textcircled{3} \quad \underline{\underline{\tan(180+\theta)}} = \underline{\underline{\tan\theta}}$$





## How to use in Questions?

1.

Check how allied angle is created?

For **[(odd multiples of 90)  $\pm \theta$ ]** change the ratio

**$\sin \leftrightarrow \cos$  ;  $\tan \leftrightarrow \cot$  ;  $\sec \leftrightarrow \csc$**

& for **[(even multiples of 90  $\pm \theta$ )]** keep ratio as it is.

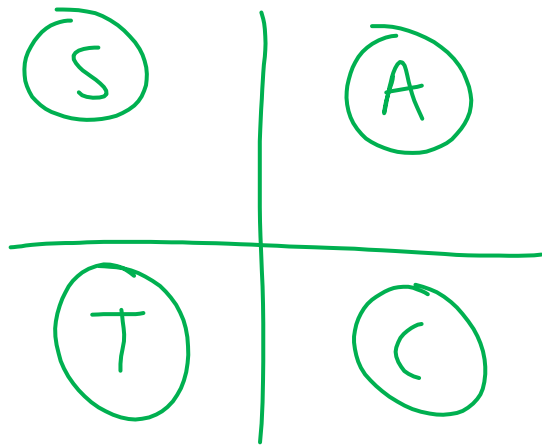




## How to use in Questions?

2.

Check in which quadrant the angle lies & what sign the T-ratio has in that quadrant?



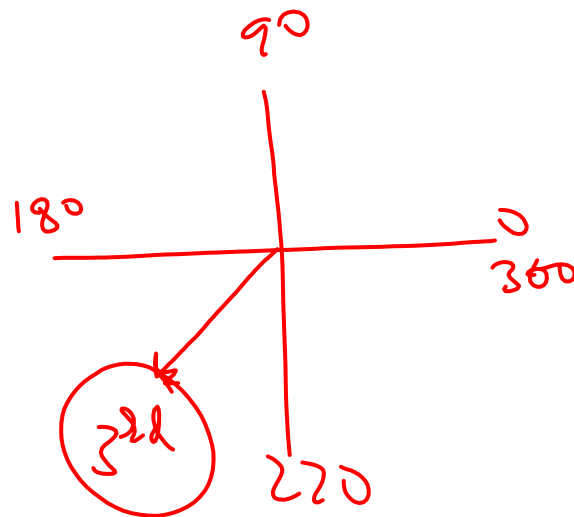


## Relation between $(270^\circ - \theta)$ & $\theta$

1  $\sin (270^\circ - \theta) = -\cos \theta$

2  $\cos (270^\circ - \theta) = -\sin \theta$

3  $\tan (270^\circ - \theta) = +\cot \theta$



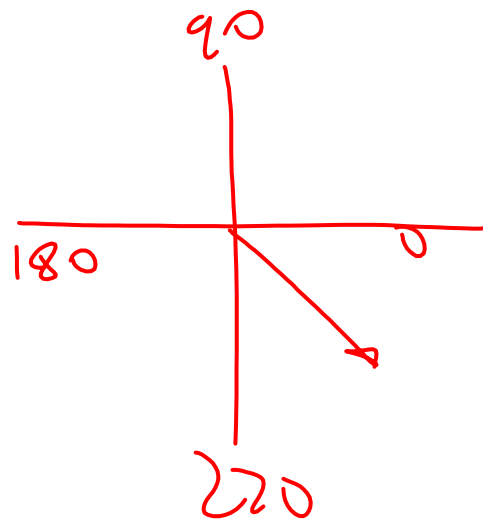


## Relation between $(270^\circ + \theta)$ & $\theta$

1  $\sin (270^\circ + \theta) = -\cos \theta$

2  $\cos (270^\circ + \theta) = +\sin \theta$

3  $\tan (270^\circ + \theta) = -\cot \theta$



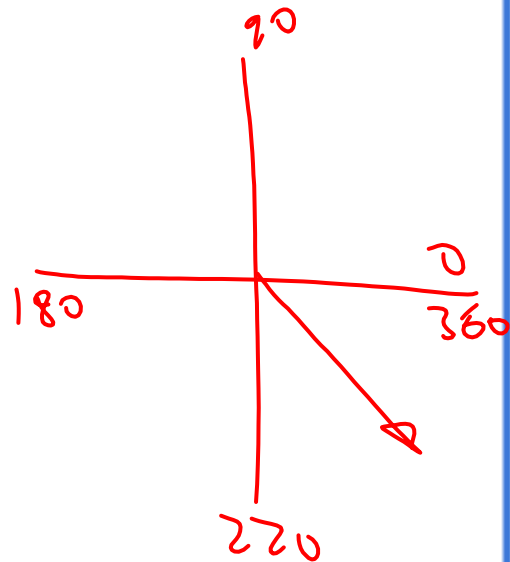


## Relation between $(360 - \theta)$ & $\theta$

1  $\sin (360^\circ - \theta) = -\sin \theta$

2  $\cos (360^\circ - \theta) = +\cos \theta$

3  $\tan (360^\circ - \theta) = -\tan \theta$





## Important Results

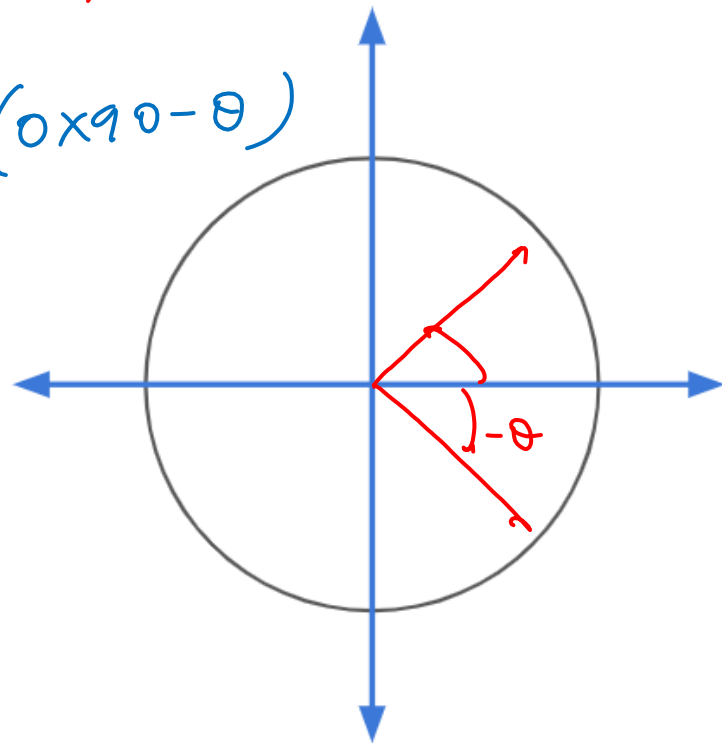
1  $\sin(-\theta) = -\sin \theta$

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

3  $\tan(-\theta) = -\tan \theta$

$(-\theta, \theta)$

$\sin(0 \times 90 - \theta)$



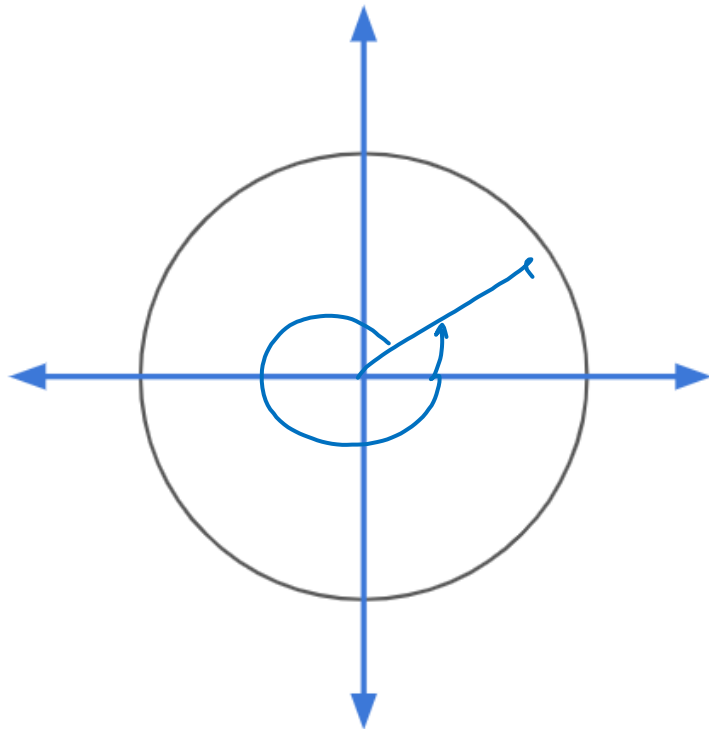


## Important Results

4  $\sin (360 + \theta) = \sin \theta$

5  $\cos (360 + \theta) = \cos \theta$

6  $\tan (360 + \theta) = \tan \theta$



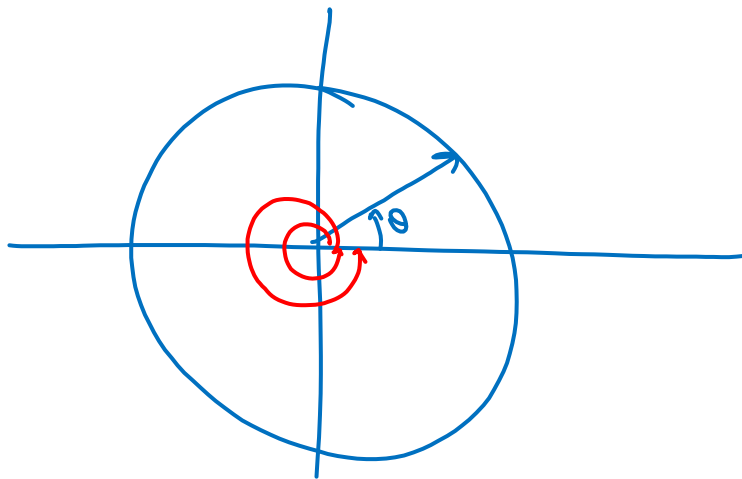






## Important Results

- Adding or subtracting multiples of  $360^\circ$  (or  $2\pi^\circ$ ) does not change the value of trigonometric ratio.



$$\sin(\cancel{720} + \theta)$$

↓

$$\cancel{360 \times 2} + \theta$$



**Find the value of :**

1

$$\sin(225^\circ) = \sin(180 + 45^\circ) = -\sin 45^\circ = \left(-\frac{1}{\sqrt{2}}\right)$$

2

$$\cos(330^\circ) = \cos(360 - 30^\circ) = +\cos 30^\circ = \left(\frac{\sqrt{3}}{2}\right)$$

3

$$\tan(150^\circ) = \tan(180 - 30^\circ) = -\tan 30^\circ = \left(-\frac{1}{\sqrt{3}}\right)$$



**Find the value of :**

4

$\sin (765^\circ)$

$$= \sin(\cancel{720} + 45^\circ) = \sin 45^\circ = \frac{1}{\sqrt{2}}$$

5

$\operatorname{cosec} (-1410^\circ)$

$$= \operatorname{cosec} (-1410 + 4 \times 360^\circ) = \operatorname{cosec} 30^\circ = 2$$

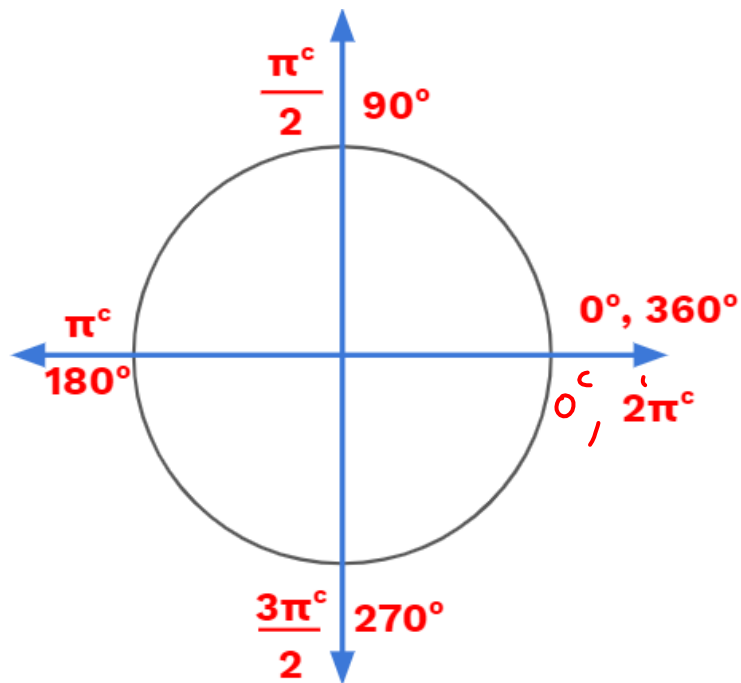
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$\cos (-1710^\circ)$

$$= \cos (-1710 + 5 \times 360^\circ) \\ = \cos 90^\circ = 0$$



## Learn to read angles in Radians:









Find the value of:

$$\sec(270^\circ - A) \sec(90^\circ - A) - \tan(270^\circ - A) \tan(90^\circ + A)$$

A. 1

☒ B. -1

C. 0

D. None

$$(-\csc A)(\sec A) - (\cot A)(-\cot A)$$

$$-\csc^2 A + \cot^2 A$$

$$= -(\csc^2 A - \cot^2 A) = -1$$





Find the value of:  $\tan \underline{225^\circ} \cot \underline{405^\circ} + \tan \underline{765^\circ} \cot \underline{675^\circ}$

A. 1

B. -1

☒ C. 0

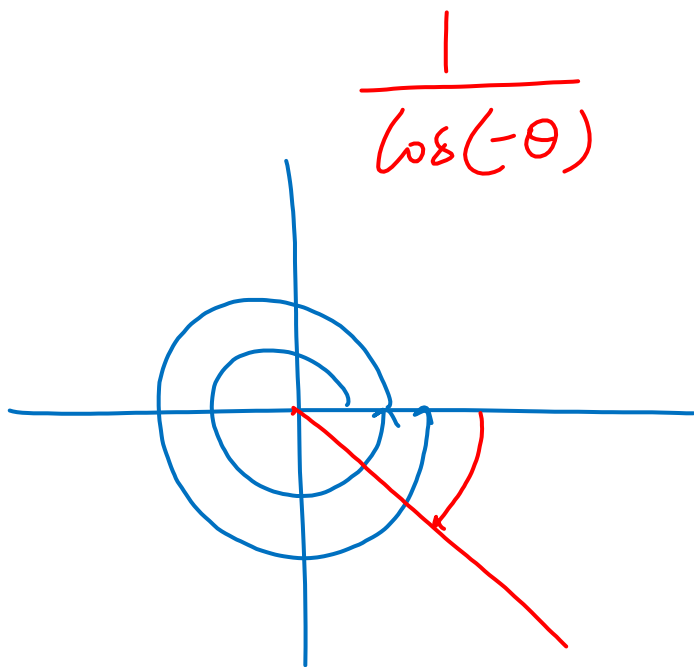
D. None

$$\tan(\underline{180} + \underline{45^\circ}) \cot(\underline{360} + \underline{45^\circ})$$

$$+ \tan(\underline{720} + \underline{45^\circ}) \cdot \cot(\underline{720} - \underline{45^\circ})$$

$$(\tan 45^\circ) \cdot (\cot 45^\circ) + (\tan 45^\circ)(-\cot 45^\circ)$$

$$(1)(1) + (1)(-1) = 0$$



$$\sec(-\theta) = -\sec\theta$$

$$\sec(-\theta) = \sec\theta$$

$$\cot(-\theta) = -\cot\theta$$



Find the **value of:**  $\sin \frac{3\pi}{5} + \sin \frac{4\pi}{5} + \sin \frac{6\pi}{5} + \sin \frac{7\pi}{5}$

$$\left\{ \begin{array}{l} \frac{3\pi}{5} + \boxed{\frac{7\pi}{5}} = \frac{10\pi}{5} = 2\pi \rightarrow 4\left(\frac{\pi}{2}\right) \\ \frac{4\pi}{5} + \boxed{\frac{6\pi}{5}} = \frac{10\pi}{5} = 2\pi \end{array} \right.$$

$$\sin\left(\frac{3\pi}{5}\right) + \sin\left(\frac{4\pi}{5}\right) + \sin\left(2\pi - \frac{4\pi}{5}\right) + \sin\left(2\pi - \frac{3\pi}{5}\right)$$



$$\cancel{\sin\left(\frac{3\pi}{5}\right)} + \cancel{\sin\left(\frac{4\pi}{5}\right)} + \left(-\cancel{\sin\frac{4\pi}{5}}\right) + \left(-\cancel{\sin\frac{3\pi}{5}}\right)$$

$$= 0$$



If  $\tan \theta = \frac{3}{4}$  and  $\theta$  is not in the 1<sup>st</sup> Quadrant, then find the value of

$$\frac{\sin(90^\circ + \theta) - \cot(180^\circ - \theta)}{\tan(270^\circ - \theta) - \cos(270^\circ + \theta)}$$

HW







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11<sup>th</sup>



Namo Sir | Physics

6:00 - 7:30 PM



Ashwani Sir | Chemistry

7:30 - 9:00 PM



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12<sup>th</sup>



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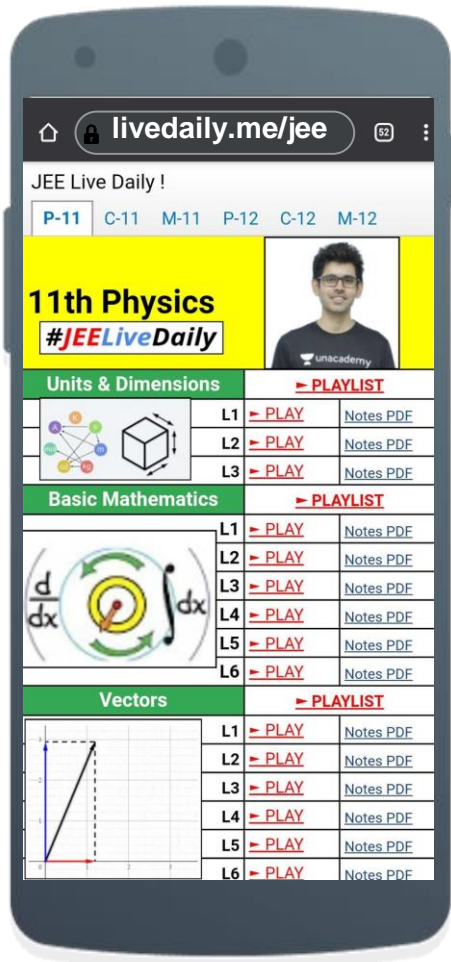
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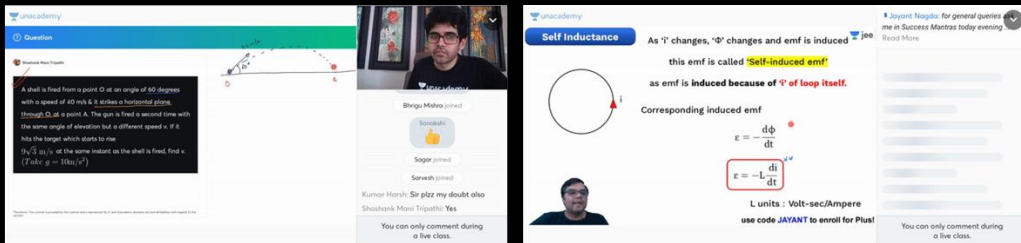
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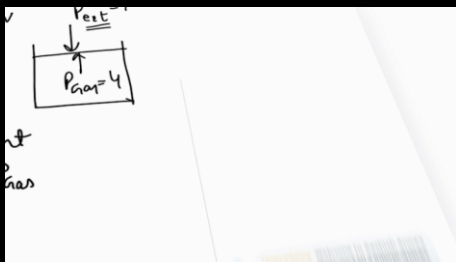
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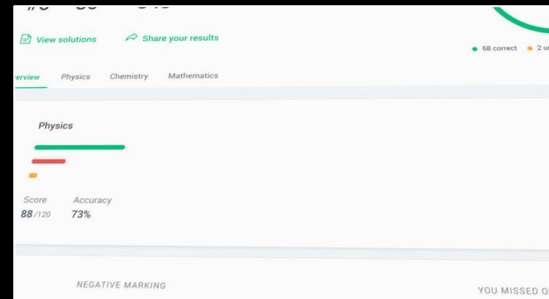
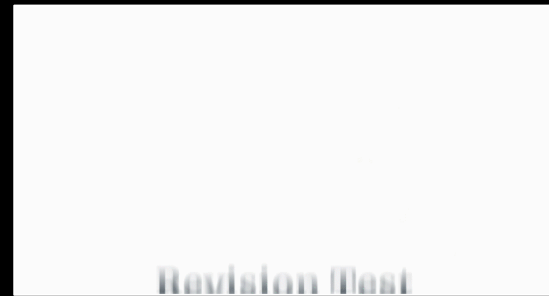


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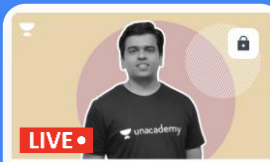


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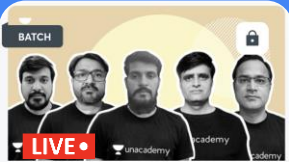
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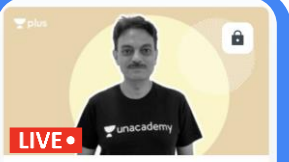
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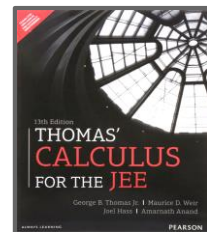
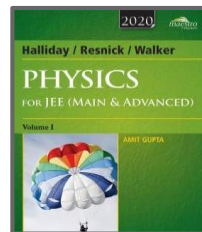
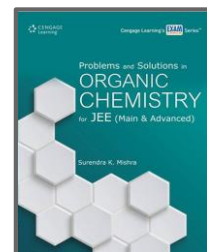
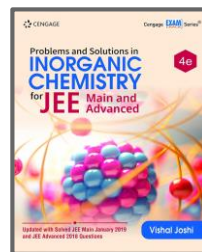
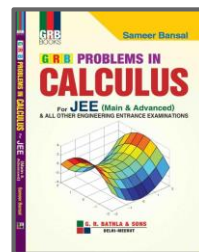
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Adnan  
99.95



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  
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Megh Gupta  
98.59

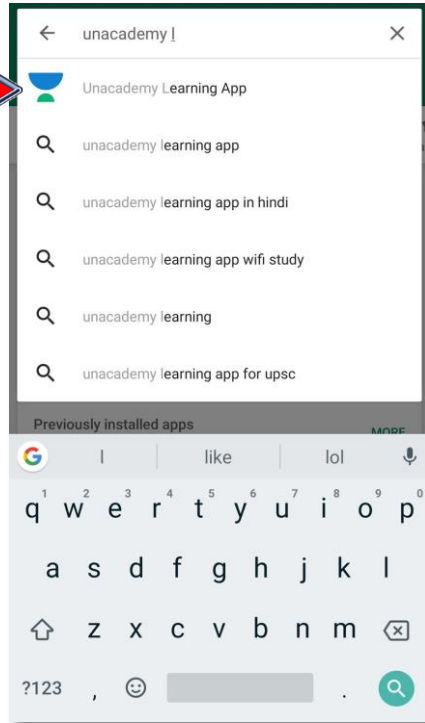


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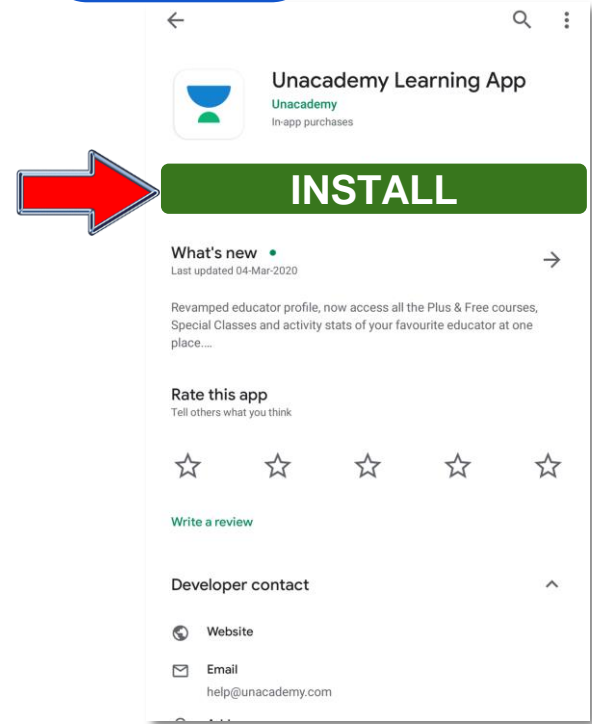


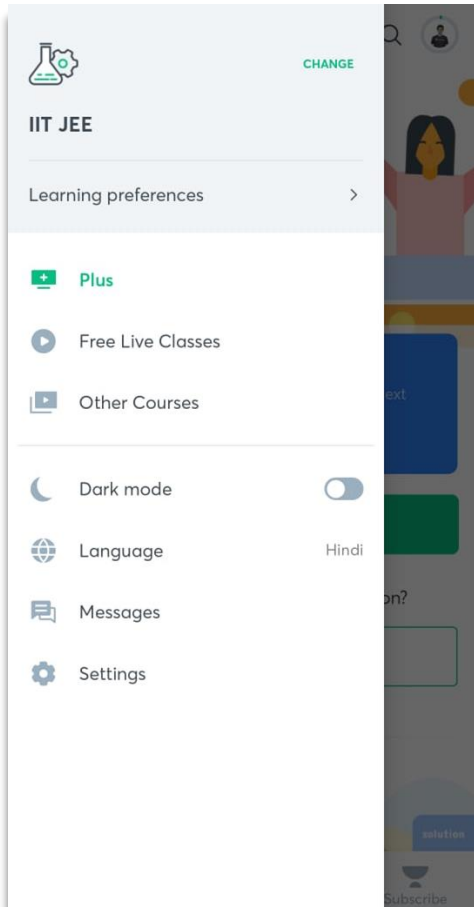
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