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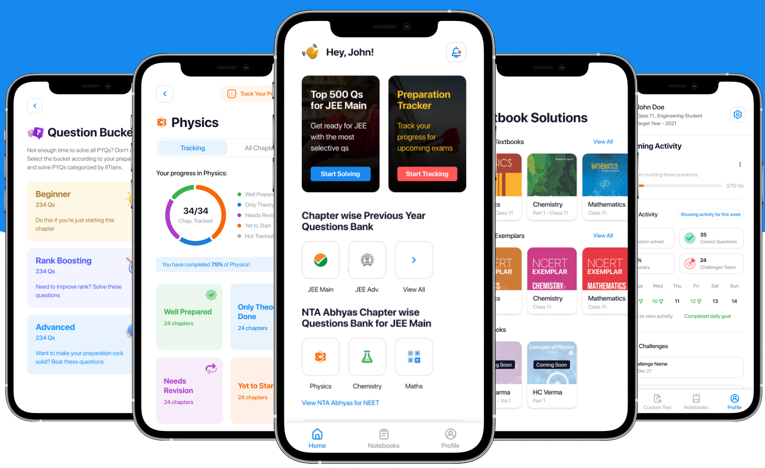

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TRIGONOMETRIC EQUATIONS

DEFINITION

The equations involving trigonometric function of unknown angles are known as Trigonometric equations.

A solution of a trigonometric equation is the value of the unknown angle that satisfies the equation.

PERIODIC FUNCTION

A function f(x) is said to be periodic if there exists T > 0 such that f(x + T) = f(x) for all x in the domain of definitions of f(x). If T is the smallest positive real number such that f(x + T) = f(x) , then it is called the fundamental period (or) period of f(x)

Function	Period
sin (ax + b) , cos (ax +b), sec (ax + b) , cosec (ax +b)	$2\pi/a$
tan (ax + b), cot (ax +b)	π/a
| sin (ax + b), | cos (ax +b) | , | sec (ax +b) | , | cosec (ax +b) |	π/a
| tan (ax + b) | , | cot (ax +b) |	$\pi/2a$

The period of sinx, cosec x, cos x, sec x is 2π and period of tan x, cot x, is π .

TRIGONOMETRICAL EQUATIONS WITH THEIR GENERAL SOLUTION

Trigonometrical equation		General solution
If $\sin\theta = 0$	then	$\theta = n\pi \ : \ n \in I$
If $\cos\theta = 0$	then	$\theta = (n\pi + \pi/2) = (2n+1)\pi/2 \ : \ n \in I$
If $\tan\theta = 0$	then	$\theta = n\pi \ : \ n \in I$
If $\sin\theta = 1$	then	$\theta = 2n\pi + \pi/2 = (4n+1)\pi/2 \ : \ n \in I$
If $\cos\theta = 1$	then	$\theta = 2n\pi \ : \ n \in I$
If $\sin\theta = \sin\alpha$	then	$\theta = n\pi + (-1)^n\alpha$ where $\alpha \in [-\pi/2, \pi/2]$ $: \ n \in I$
If $\cos\theta = \cos\alpha$	then	$\theta = 2n\pi \pm \alpha$ where $\alpha \in (0, \pi] : \ n \in I$
If $\tan\theta = \tan\alpha$	then	$\theta = n\pi + \alpha$ where $\alpha \in (-\pi/2, \pi/2] : \ n \in I$
If $\sin^2\theta = \sin^2\alpha$	then	$\theta = n\pi \pm \alpha \ : \ n \in I$
If $\cos^2\theta = \cos^2\alpha$	then	$\theta = n\pi \pm \alpha \ : \ n \in I$
If $\tan^2\theta = \tan^2\alpha$	then	$\theta = n\pi \pm \alpha \ : \ n \in I$
If $\left.\begin{array}{l}\sin\theta = \sin\alpha \\ \cos\theta = \cos\alpha\end{array}\right\|^{*}$	then	$\theta = 2n\pi + \alpha : \ n \in I$
If $\left.\begin{array}{l}\sin\theta = \sin\alpha \\ \tan\theta = \tan\alpha\end{array}\right\|^{*}$	then	$\theta = 2n\pi + \alpha \ : \ n \in I$
If $\left.\begin{array}{l}\tan\theta = \tan\alpha \\ \cos\theta = \cos\alpha\end{array}\right\|^{*}$	then	$\theta = 2n\pi + \alpha \ : \ n \in I$

* Every where in this chapter "n" is taken as an integer.
* If α be the least positive value of θ which statisfy two given trigonometrical equations , then the general value of θ will be $2n\pi + \alpha$

GENERAL SOLUTION OF TRIGONOMETRICAL EQUATION $a\cos\theta + b\sin\theta = C$

To solve the equation a cos θ + b sin θ = c, subsitute a = r cos ϕ, b = r sin ϕ such that

$$r = \sqrt{a^2 + b^2}\ ,\ \phi = \tan^{-1}\frac{b}{a}$$

Substituting these values in the equation we have r cos ϕ cos θ r sin ϕ sin θ = c

$$\cos(\theta - \phi) = \frac{c}{r} \qquad \Rightarrow \qquad \cos(\theta - \phi) = \frac{c}{\sqrt{a^2 + b^2}}$$

If $|\,c\,| > \sqrt{a^2 + b^2}$, then the equation ;

a cos θ + b sin θ = c has no solution

If $|\,c\,| \le \sqrt{a^2 + b^2}$, then take ;

$$\frac{|\,c\,|}{\sqrt{a^2 + b^2}} = \cos\alpha \text{ , so that}$$

$$\cos\ (\theta - \phi) = \cos\ \alpha$$

$$\Rightarrow \qquad (\theta - \phi) = 2n\pi \pm \alpha$$

$$\Rightarrow \qquad \theta = 2n\pi \pm \alpha + \phi$$

SOLUTIONS IN THE CASE OF TWO EQUATIONS ARE GIVEN

Two equations are given and we have to find the values of variable θ which may satisfy both the given equations, like

cos θ = cos α and sin θ = sin α

so the common solution is $\theta = 2n\pi + \alpha$, $n \in I$

Similarly, sin θ = sin α and tan θ = tan α

so the common solution is , $\theta = 2\,n\pi + \alpha$, $n \in I$

Rule : Find the common values of θ between 0 and 2π and then add $2\pi n$ to this common value

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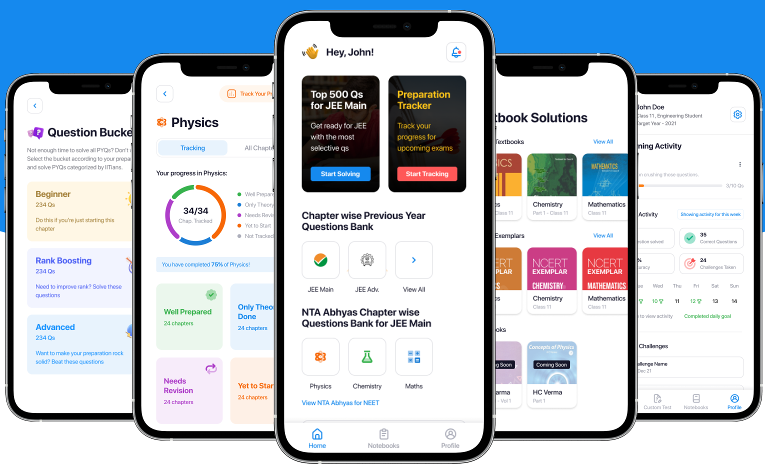

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