

Lab 6

Solutions of trigonometric equations

Aim :

- To use graphs of trigonometric functions to find solutions of trigonometric equations.

Concepts:

- Principal and general solutions of trigonometric functions



Discussion :


The point at which the graph of the function $f(x)$ meets the x axis gives the solutions of the equation $f(x) = 0$.

The solutions of $f(x) = a$ are given by the x coordinates of the points of intersection of the curves $y = f(x)$ and $y = a$ or the x coordinates of the points of intersection of the curve $y = f(x) - a$ with the x axis. For the convenience of finding the x coordinate, we use the second method.

Activity 6.1 Solution of $\sin x = a$

Procedure:


- Initial settings - to change the distance marking on the x axis
Create an integer slider **n**, with min=1 and max=6. Right click anywhere on the graphics view-**Graphics**→**x axis**→**distance**→ Type pi/n in the box
- Create a slider **a** with increment 0.01
- Draw the graph of $f(x) = \sin x - a$
- The points at which this graph cuts or touches the x axis gives the solution of the equation $\sin x = a$
-  Set **a**=0 and find the solutions of the equation $\sin x = 0$
-  Gradually increase the value of **a**, and observe how the above points deviate from multiples of π
- Create an input box for f

-  Find the principal and general solutions of the equations given in the following table. If needed, you can change the distance on the x axis using the slider **n**. (Use input box of f to change the function.)

Sl. No	Trig. Equation	Principal Solutions	General Solution
1	$\sin x = \frac{1}{2}$		
2	$\sin x = \frac{\sqrt{3}}{2}$		
3	$\sin x = -\frac{1}{2}$		
4	$\sin 2x = \frac{1}{2}$		
5	$\sin 3x = -\frac{\sqrt{3}}{2}$		
6	$\sin x = \frac{1}{\sqrt{2}}$		
7	$\sin\left(\frac{x}{3}\right) = \frac{\sqrt{3}}{2}$		

Activity 6.2 Solution of $\cos x = a$

Procedure:

- In the above applet, change the function to $\cos x - a$
-  By observing the points at which the graph cuts or touches the x axis, find the principal and general solutions of the equations given in the following table.

Sl. No	Trig. Equation	Principal Solutions	General Solution
1	$\cos x = \frac{1}{2}$		
2	$\cos x = \frac{\sqrt{3}}{2}$		
3	$\cos x = -\frac{1}{2}$		
4	$\cos 2x = \frac{1}{2}$		
5	$\cos 3x = -\frac{\sqrt{3}}{2}$		
6	$\cos\left(\frac{x}{2}\right) = \frac{1}{\sqrt{2}}$		
7	$\cos\left(\frac{x}{3}\right) = \frac{1}{2}$		



Activity 6.3 Solution of $\tan x = a$

Procedure:



Using the above applet, find the principal and general solutions of the following equations.

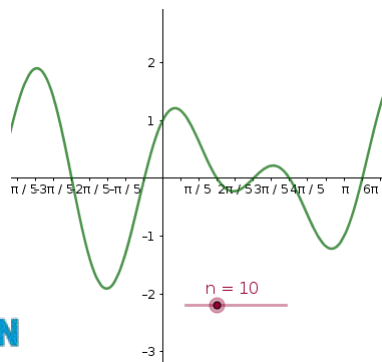
Sl. No	Trig. Equation	Principal Solutions	General Solution
1	$\tan x = 1$		
2	$\tan x = \sqrt{3}$		
3	$\tan 2x = \frac{1}{\sqrt{3}}$		
4	$\tan 3x = -1$		
5	$\tan x = -\sqrt{3}$		
6	$\tan(\frac{x}{2}) = -\sqrt{3}$		
7	$\tan(\frac{x}{4}) = \sqrt{3}$		

Save the applet as [Activity 6.3](#)

Activity 6.4 Solution of trigonometric equations in general

Procedure:

- Create an integer slider n
- Change the distance mark on the x-axis as $\frac{\pi}{n}$
- Input $f(x) = \sin x$ and $g(x) = \cos x$
- Create input boxes for f and g .
- Using input command $f - g$, draw the graph of $f(x) - g(x)$.
- Hide the graphs of f and g



Observe the points of intersection of the graph of $f(x) - g(x)$ with the x axis, which gives the solution of the equation $f(x) = g(x)$. Hence find the principal and general solutions of the following equations (To confirm your answer, you may change the distance on the x axis using slider n)

Sl. No	Trig. Equation	Principal Solutions	General Solution
1	$\sin x = \cos x$		
2	$\sin 2x = \cos x$		
3	$\cos 2x = \sin x$		
4	$\cos 2x = \cos x$		
5	$\sin 2x + \cos x = 0$		
6	$\sin 2x + \sin 3x = 0$		