

Activity 20

Trigonometric graph transformations

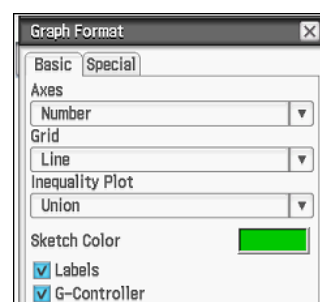
Aim: Modify equations to investigate transformations of the basic trigonometric functions.

We will make use of the Modify function in the Graph&Table application. We will be working with changing parameters a , b , h and v and must initialise these before starting the activity.

Setup

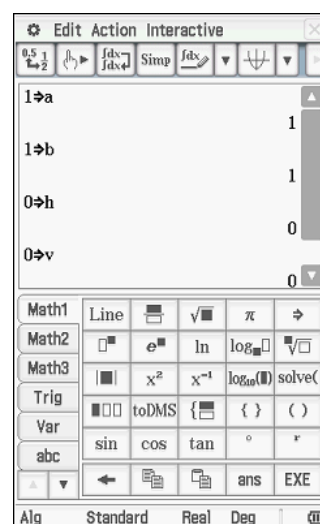
- Open Main
- Select [⚙️ | Graph Format]
- Ensure G-Controller is checked
- Tap Set

Note the angle setting is degrees (DEG)



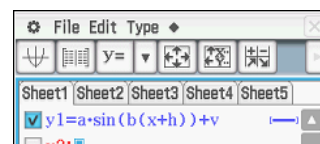
Initialise the parameters

- $1 \Rightarrow a$ [EXE]
- $1 \Rightarrow b$ [EXE]
- $0 \Rightarrow h$ [EXE]
- $0 \Rightarrow v$ [EXE]



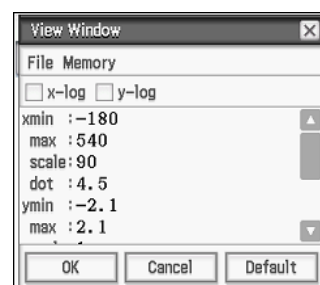
Enter the function $y = a \sin(b(x + h)) + v$

- Open the Graph&Table application
- Type the expression $a \times \sin(b \times (x+h)) + v$ [EXE] into $y1$



Setup the view window

- Tap [⚙️] to open the View Window settings
- Select [Memory | Trigonometric]
- Tap OK
- Adjust to match screen shot and tap OK
- Tap [⏏️] to graph the function
- With the graph window active tap [⏏️] to fill the screen

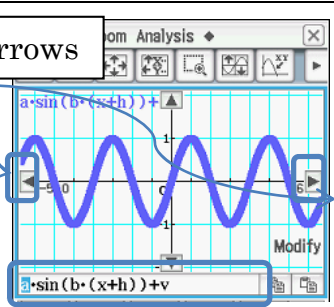


With our initial values for the parameters, $a = 1$, $b = 1$, $h = 0$ and $v = 0$, we have displayed the graph of $y = \sin x$.

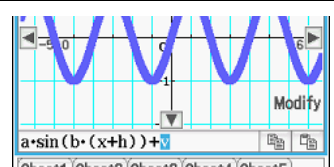
- Describe the main features of the graph of $y = \sin x$ i.e. x - and y - intercepts, period and amplitude.

For the questions that follow use terms such as translation, dilation and reflection when describing changes to the graphs.

- Describe the effect of a on the graph of $y = a \sin x$.

<p>Modify the parameter a</p> <ul style="list-style-type: none"> • Select [Analysis Modify] • With Step set to 1, tap [OK] <i>A bold graph will be overlaid</i> • Highlight the parameter a in the equation and tap the right controller arrow to increase its value. Tap the left controller arrow to decrease its value 	
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- Describe the effect of v on the basic graph of $y = \sin x + v$.

<p>Modify the parameter v</p> <ul style="list-style-type: none"> • Set a to 1 • Highlight the parameter v adjust its value using the controller arrows 	
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- Describe the effect of b on the basic graph of $y = \sin bx$.

<p>Modify the parameter b</p> <ul style="list-style-type: none"> • Set v to 0 • Highlight the parameter b 	
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6. Describe the effect of h on the basic graph of $y = \sin(x + h)$. Return the value of h to 0 when finished.

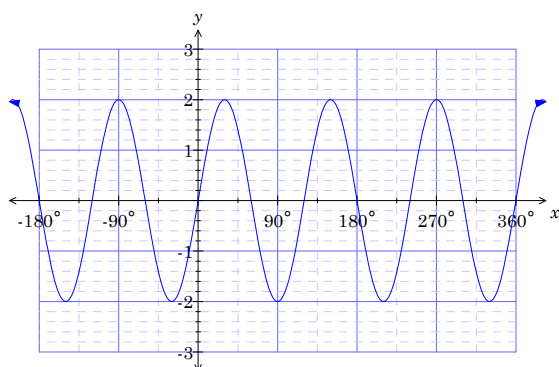
Modify the parameter h

- Set b to 1
- Press Esc .
- Select [Analysis | Modify], change the step to 15 then tap OK.
- Highlight the parameter h

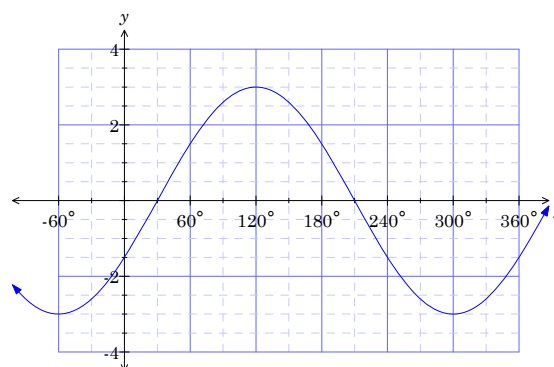
$a \cdot \sin(b \cdot (x+h)) + v$

7. Determine equations for the following sine graphs.

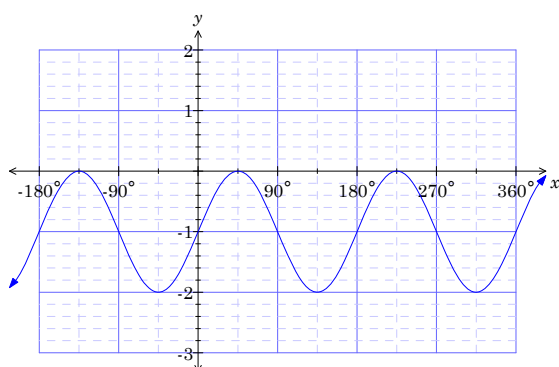
a)



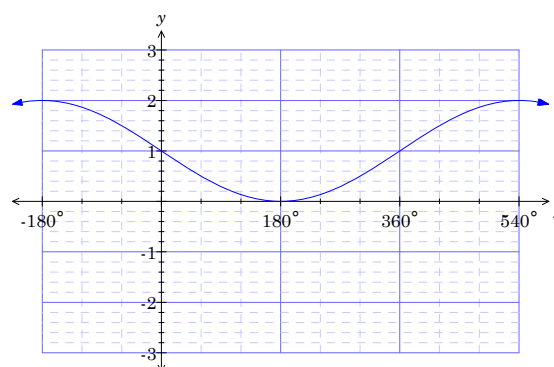
b)



c)



d)

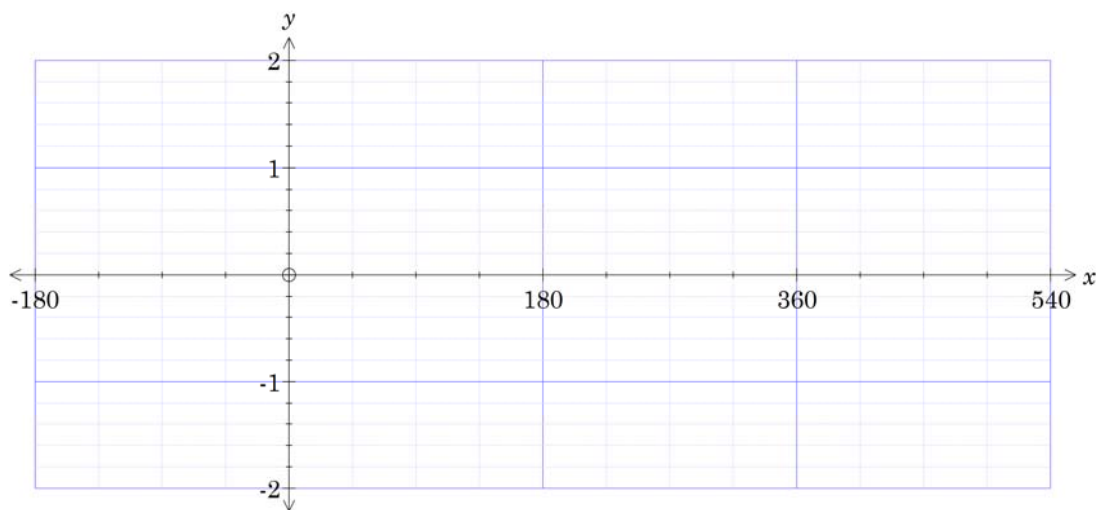


Investigate cos graph

- Tap Esc to exit Modify
- Tap $\sqrt{y1:}$ to bring up the function entry window
- Change the equation in $y1:$ to $a \cdot \cos(b \cdot (x+h)) + v$
- Draw the graph

File Edit Type
 $y =$
 Sheet1 | Sheet2 | Sheet3 | Sheet4 | Sheet5
 $y1 = a \cdot \cos(b \cdot (x+h)) + v$
 $y2 =$

8. Sketch the graph of $y = \cos x$ on the axes below showing key features.

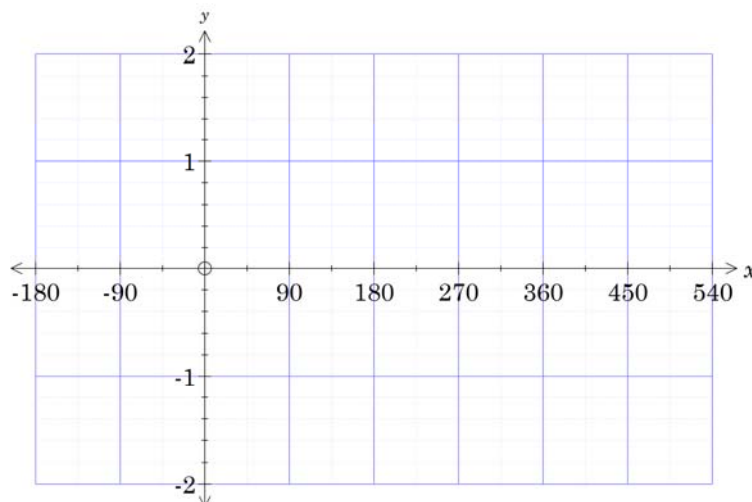


9. Use the Modify function to change the values of a , b , h and v . Note that a Step of 1 should be used for all except h . How do the transformations compare to those of the sine function?

Investigate tan graph

- Tap Esc to exit Modify
- Tap $\begin{matrix} \text{Y1:} \\ \text{Y2:} \end{matrix}$ to bring up the function entry window
- Change the equation in $y1$: to $a \tan(b \cdot (x+h)) + v$
- Tap $\begin{matrix} \text{V} \\ \text{W} \end{matrix}$ to graph the function
- With the graph window active, tap $\begin{matrix} \text{Resize} \\ \text{Screen} \end{matrix}$ to fill the screen

10. Sketch the graph of $y = \tan x$ on the axes below showing key features.

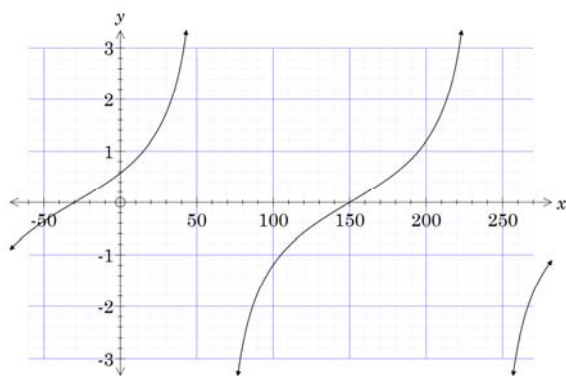


11. Use the Modify function to change the values of a , b , h and v . Describe the effect on the basic tangent graph of changing each of the parameters.

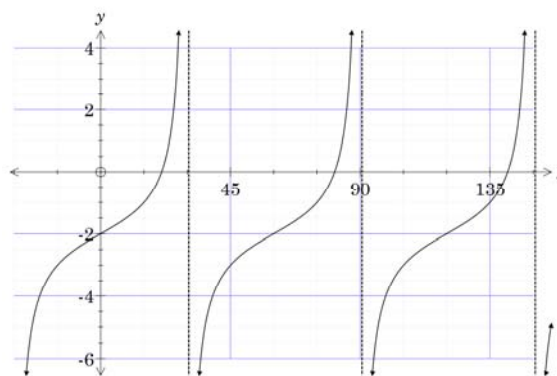
- Note the following suggestions for the Step size:
 - For b and v use 1.
 - For h use 15.
 - For a use 0.5.

12. Determine equations for the following tangent graphs.

a)



b)

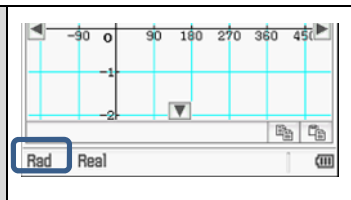


13. Discuss the effects on the sine graph $y = a \cdot \sin(b \cdot (x + h)) + v$ when changing a , b , h and v in radian mode. Try a step size of $\frac{\pi}{6}$ for h .

Set Radian mode

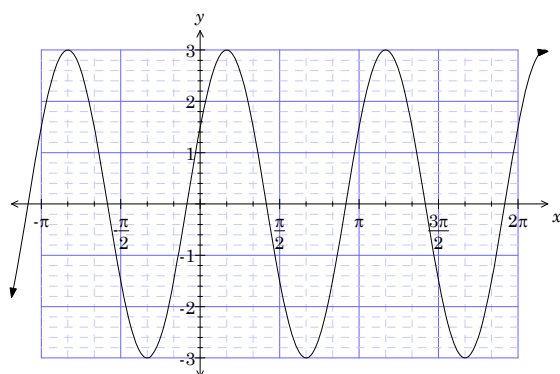
- Tap on Angle unit until Rad is displayed
- Change the equation in $y1$: to $a \cdot \sin(b \cdot (x + h)) + v$

(see Learning notes for step by step instructions)



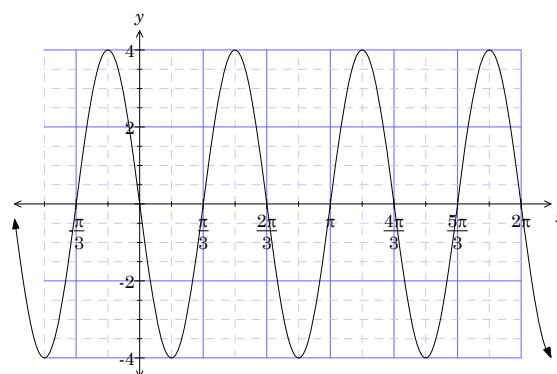
14. Discuss the effects on the cosine graph $y = a \cdot \cos(b \cdot (x + h)) + v$ when changing a , b , h and v in radian mode.
15. Discuss the effects on the tangent graph $y = a \cdot \tan(b \cdot (x + h)) + v$ when changing a , b , h and v in radian mode.
16. Determine equations for each of the following trigonometric graphs.

a)



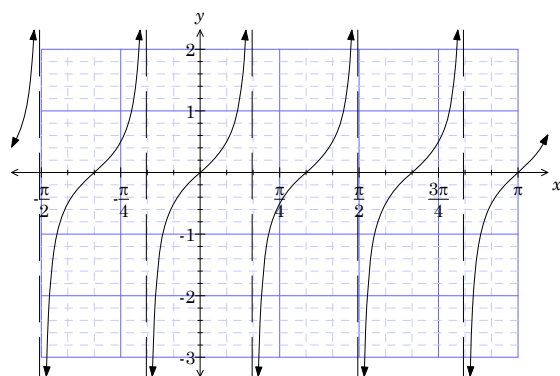
Use cosine

b)



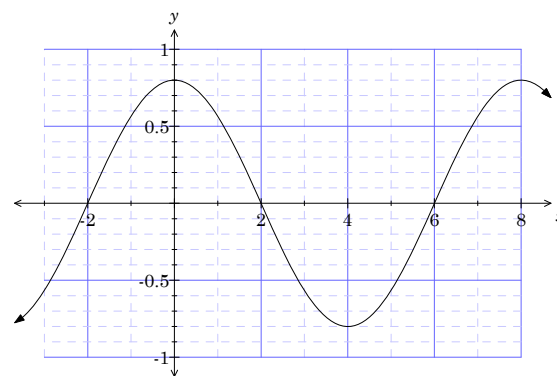
Use sine

c)



Use tangent

d)



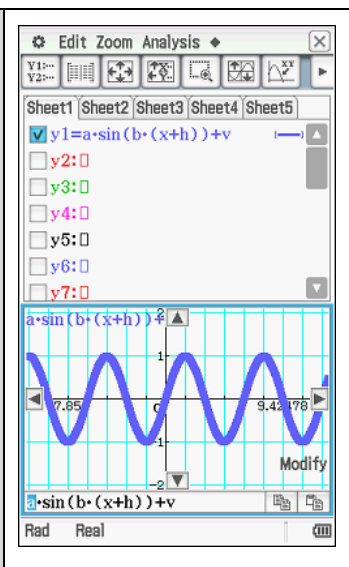
Use cosine

Learning notes

The Modify feature can be applied to any type of function in which an activity into transformations is useful.

This activity makes use of the Modify function in Graph&Table. Another option is the Dynamic Graph function. Consult the manual for further explanation.

- Tap Esc to exit Modify
- Tap twice on the angle setting to change the angle measure to radian (Rad)
- Tap $\begin{matrix} Y1: \\ Y2: \end{matrix}$ to bring up the function entry window.
- Change the equation in $y1:$ to $a \cdot \sin(b \cdot (x+h)) + v$
- Tap $\begin{matrix} \leftarrow \\ \rightarrow \\ \uparrow \\ \downarrow \end{matrix}$ to open the View Window settings
- Select [Memory | Trigonometric] to enter a basic trigonometric setup relevant to the current angle setting
- Tap OK
- Tap $\begin{matrix} \uparrow \\ \downarrow \end{matrix}$ to graph the function
- With the graph window active, tap $\begin{matrix} \text{Resize} \\ \leftarrow \\ \rightarrow \\ \uparrow \\ \downarrow \end{matrix}$ to fill the screen
- Select [Analysis | Modify]



The Graph&Table application has built-in functions that can be used instead of entering them manually.