RUN GRAPH

Co Sign

Functions
Cosine
Function of a function

Standards: Problem Solving, Communication, Reasoning, Algebra, Statistics, and Probability.

Materials: *CFX-9850G or CFX-9850Ga PLUS*

Calculator Menus: RUN and GRAPH

Graph the trigonometric function Y = cosX in Y1.

Does it look like the graph in Figure 1?

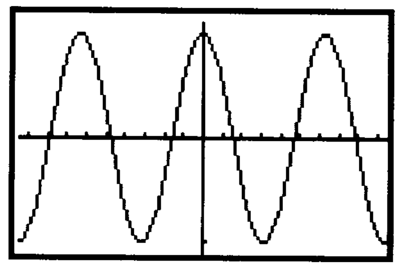


Figure 1

If your graph differs from Figure 1, make the following changes:

1. Set the calculator for graphing in radians.
2. Set the graph view window to -3π to $+3\pi$ for X and -1.1 to 1.1 for Y.

Redraw your graph to assure it is similar to Figure 1.

What do you think cos(cosX) will look like? Draw your prediction in Figure 2 before using the calculator. **A.**

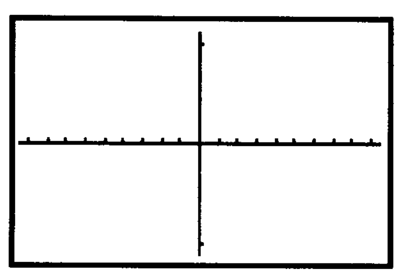


Figure 2

Enter cos(cosX) in Y2. Change the equation color to orange and graph.

Explain why the graph came out like it did. **B.**

Deleting an Equation in the GRAPH Menu

Highlight the equation
Press F2 (DEL)
F1 (YES)

Changing from Degrees to Radians

Press Shift key
Menu key
Down Arrow to Angle
F2 (Rad)
Exit key

Resizing the Graph Window

Press Shift key
F3 (V-WIN)
Highlight Xmin, Xmax , Ymin, or Ymax.
Enter desired value
EXE key
Repeat steps to alter min or max values for X or Y.

Changing the Color of an Equation and Graph in the GRAPH Menu

Highlight the equation.
Press F4 (COLR)
Select desired color:
F1 (Blue),
F2 (Orng), or
F3 (Grn)
Exit key

Co Sign

Write a brief description of your prediction of the graph of the cos(cos(cosX)). **C.**

De-selecting an Equation in the GRAPH Menu

Highlight the equation
Press F1 (SEL)
The = sign will turn blue when de-selected.

Enter cos(cos(cosX)) in Y3. Change the color to green and graph.

Is the result what you anticipated? Why or why not? **D.**

? Compare the blue and orange graphs. How are they similar and different? **E.**

? represents a high level question

? Compare the orange and green graphs. How are they similar and different? **F.**

Origin of Cosine

Edmund Gunter (1581-1626) invented the words cosine and cotangent. In 1620, he published a seven-place table of the common logarithms of the sines and tangents of angles for intervals of a minute arc. Eves, J. H. (1990). *An Introduction to the History of Mathematics*. (6th ed.). Orlando, FL: Harcourt Brace Jovanovich College Publishers.

Write a general description of what is happening. (You might need to graph cos(cos(cos(cosX))), cos(cos(cos(cos(cosX)))), and maybe more.) **G**.

The graphs are closing in on a limit point. What is that point? **H.** ____________

Predict the appearance of Y = sin(sinX). **I.**

Delete the cosine equations out of the calculator and graph sinX, sin(sinX), sin(sin(sinX)), etc. until you develop a generalization for multiple sines.

Describe the sine generalization. **J.**

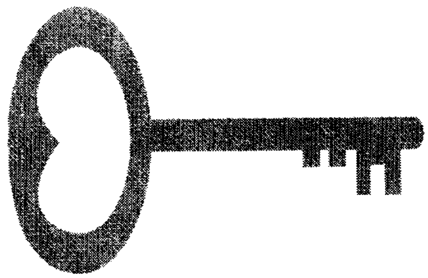
What is the limit point of the graphs when only sines are used? **K.** ________

Experiment with things like sin(cosX), sin(cos(sin(cosX))), etc. Do they react the same as cos(sinX), cos(sin(cos(sinX))), etc.? **L.** _________

? Did you expect cos(sinX) and sin(cosX) to react the same? Why or why not? **M.**

Continue experimenting by investigating tangent, then describe your results. **N.**

Solution Key



Co Sign

A. Answers will vary. Phase shift. Period change. Amplitude shift.
B. Since the values of cosine can vary only between ± 1, the values substituted in for the second cosine from the first are only those toward the top of the graph of the cosine of X.
C. Answers will still vary. Graph will be toward bottom. Graph will be at X axis. Same as cos(cos(X)) but lower.
D. More than likely the answer will be NO.
E. Same maximum point. Different minimum point.
F. Same minimum point. Different maximum point
G. The graphs alternate topping out at the same point and bottoming out differently and then bottoming out at the same point and topping out differently, doing it in successive pairs.
H. $Y \approx 0.73867946737$
I. Answers will vary. Phase shift. Period change. Amplitude shift. Like the cos(cos) only at the bottom.
J. The sine does not act like the cosine. It closes in on a limit of Y = 0 but it does so much more slowly than the cosines.
K. Y = 0.
L. No.
M. Answers will vary but probably yes. $f(g(x)) \neq g(f(x))$ in general.
N. Answers will vary.,