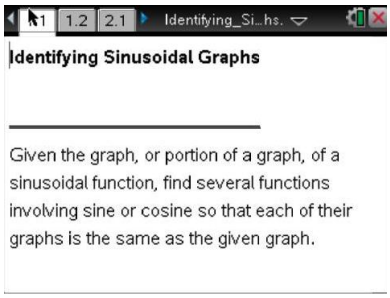
Identifying Sinusoidal Graphs
Student Activity

Name _____
Class _____

Open the TI-Nspire document *Identifying_Sinusoidal_Graphs.tns.*



In this activity, you will be given the graph, or a portion of the graph, of a sinusoidal function. Then you will find several functions involving sine and cosine and match their graphs up to the given graph.

Roughly speaking, sinusoidal functions are periodic functions that can be expressed using sine or cosine functions. Specifically, they can be written in the form,

$$f(x) = \pm A \sin(B(x - C)) + D \text{ or}$$
$$f(x) = \pm A \cos(B(x - C)) + D$$

for appropriate values of A, B, C, and D where A and B are positive.
Recall that A is the amplitude, B = 2π/period, C is the horizontal shift, and D is the vertical shift.
You might have also used the forms

$$f(x) = \pm A \sin(Bx - C) + D \text{ or}$$
$$f(x) = \pm A \cos(Bx - C) + D.$$

The term 'sinusoid" was first used by Scotsman Stuart Kenny in 1789 while observing the growth patterns of soybeans.

Move to page 1.2.

Press ctrl ▶ and ctrl ◀ to navigate through the lesson.

1. Consider this graph of a sinusoidal function [in radian measure].
   a. Determine a function *f(x) = A sin (B(x – C)) + D* whose graph is the same as the one given on Page 1.2.

   b. Enter your function on the entry line below the graph to check that your graph coincides with the given graph. If not, change your function until the two graphs match.

   c. Determine a function *f(x) = -A sin (B(x – C)) + D,* whose graph is the same as the one given on Page 1.2.

   d. Enter your function on the entry line below the graph to check that your graph coincides with the given graph. If not, change your function until the two graphs match.

e. Determine a function $f(x) = A \cos(B(x - C)) + D$ whose graph is the same as the one given on Page 1.2.

f. Enter your function on the entry line below the graph to check that your graph coincides with the given graph. If not, change your function until the two graphs match.

g. Determine a function $f(x) = -A \cos(B(x - C)) + D$, whose graph is the same as the one given on Page 1.2.

h. Enter your function on the entry line below the graph to check that your graph coincides with the given graph. If not, change your function until the two graphs match.

2. a. Which of the values of A, B, C, or D remain unchanged in your four functions? Why?

b. If the given graph is shifted π units to the right, write the function that will result in this graph.

c. If the given graph is shifted $\pi/2$ units to the left, write the function that will result in this graph.

Move to page 2.1.

In the next several problems, you will be given only a portion of the graph of a sinusoidal function and asked to find several functions so that each of their graphs contains the portion of the graph that is given.

3. Consider a half-cycle of the graph of a sinusoidal function.
   a. Determine a function of the form $f(x) = A \sin(B(x - C)) + D$ or $f(x) = -A \sin(B(x - C)) + D$ whose graph contains the given partial graph.

   b. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

c. Determine a function of the form $f(x) = A \cos(B(x - C)) + D$ or $f(x) = -A \cos(B(x - C)) + D$ whose graph contains the given partial graph.

d. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

Move to page 2.2.

4. Consider a half-cycle of the graph of another sinusoidal function.
   a. Determine a function of the form $f(x) = A \sin(B(x - C)) + D$ or $f(x) = -A \sin(B(x - C)) + D$ whose graph contains the given partial graph.

   b. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

   c. Determine a function of the form $f(x) = A \cos(B(x - C)) + D$ or $f(x) = -A \cos(B(x - C)) + D$ whose graph contains the given partial graph.

   d. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

Move to page 3.1.

5. Consider a quarter-cycle of the graph of a sinusoidal function.
   a. Determine a function of the form $f(x) = A \sin(B(x - C)) + D$ or $f(x) = -A \sin(B(x - C)) + D$ whose graph contains the given partial graph.

   b. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

   c. Determine a function of the form $f(x) = A \cos(B(x - C)) + D$ or $f(x) = -A \cos(B(x - C)) + D$ whose graph contains the given partial graph.

d. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

Move to page 3.2.

6. Consider a quarter-cycle of the graph of another sinusoidal function.
   a. Determine a function of the form *f(x) = A sin (B(x – C)) + D* or *f(x) = -A sin (B(x – C)) + D* whose graph contains the given partial graph.

   b. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

   c. Determine a function of the form *f(x) = A cos (B(x – C)) + D* or *f(x) = -A cos (B(x – C)) + D* whose graph contains the given partial graph.

   d. Enter your function on the entry line below the graph to check that this graph contains the partial graph. If not, change your function until it does.

Move to page 4.1.

Some sinusoids can also be expressed as a sum or difference of sine and cosine functions.

7. a. Rewrite the function $f1 = 2 \cdot \sin x + 2 \cdot \cos x$ in the form $f2 = \pm\sqrt{M}\sin(K(x - L))$ where M is a positive integer by analyzing its graph. Enter your function on an entry line to check your answer.

   b. Algebraically verify that *f1 = f2* using a “trig identity”.

Move to page 4.2.

8. a. Rewrite the function $f1 = 3 \cdot \sin x - \sqrt{3} \cdot \cos x$ in the form $f2 = \pm\sqrt{M}\sin(K(x - L))$ where M is a positive integer by analyzing its graph. Enter your function on an entry line to check your answer.

   b. Algebraically verify that *f1 = f2* using a “trig identity”.