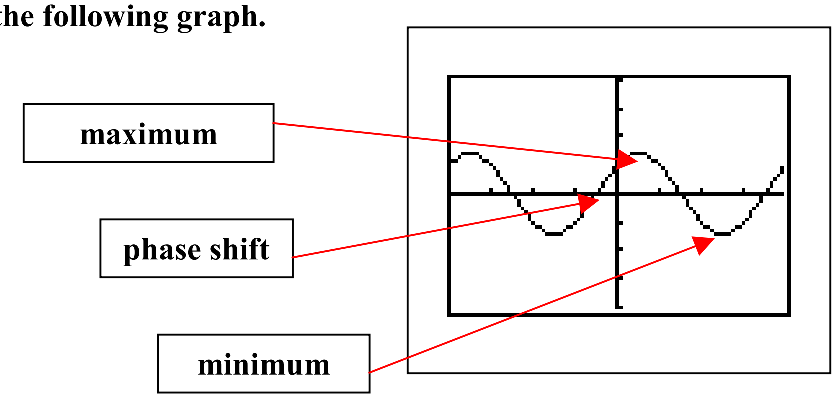
Activity #1: Understanding Sinusoids Worksheet (Student version)
Math

Note to students: Lab teams of three or four students are required for this activity.

Understanding Sinusoids → y = a sin (bx - c) + d

Definition: A sinusoid is the name given to any curve that can be written in the form, y = a sin (bx - c) + d.

To investigate, you will look at several curves, determine whether or not these curves are representative of the sine curve, and, if so, rewite in sine form. Consider the curve with equation y = sin x + cos x. Using radian mode, the curve has the following graph.



This graph does look like a sine curve. You will need to identify some points and do some calculations before you can make your sinusoidal representation (if possible).

1. Identify the coordinates of the maximum point, (x_1, y_1). Give coordinates correct to three decimal places.

(x_1 = __________, y_1 = __________) For best results, store this x-value in A and this y-value in B.

2. Identify the coordinates of the minimum point, (x_2, y_2). Give coordinates correct to three decimal places.

(x_2 = __________, y_2 = __________)
For best results, store this x-value in C and this y-value in D.

3. Identify the coordinates of the phase-shift point, (x_3, y_3). Give coordinates correct to three decimal places.

(x_3 = __________, y_3 = __________)
For best results, store this x-value in E and this y-value in F.

NOTE: You are now ready to decide on values for a, b, c, and d in the sinusoidal representation. Be sure to be as accurate as possible, i.e., use the values you have stored in your calculator.

4. The value of a represents the amplitude and opening direction of the curve. Write your value for a, correct to three decimal places. ______________
For best results, store this value in your calculator. What variable did you select to store a? ____

5. The value for b affects the period of the graph. Determine the period from the points found in steps 1 and 2. Remember that b is a positive real number. What period did you find, correct to three decimal places? ______________ Remember, the period is the length of one complete cycle and is given by, period = $\frac{2\pi}{b}$.
For best results, store this value in your calculator. What variable did you select to store b? ____

6. The value of c affects the phase shift. Remember, the phase shift is given by $\frac{c}{b}$.
If c is negative, the phase shift is left and if c is positive, the phase shift is right. Determine the value for c. What was your value for c, correct to three deciamal places? __________ For best results, store this value in your calculator. What variable did you select to store c? ____

7. Lastly, you need to calculate the value for d. Remember that d describes the vertical shift in the graph. What value did you calculate for d, correct to three decimal places? __________

8. You are now ready to compare the curve given by y = sin x + cos x to the sinusoidal representation you have just found. Substitute the exact values for a, b, c, and d in the sinusoidal model, y = a sin (bx - c) + d, and compare the two graphs. Write your sinusoidal equation. ____
Do you think you have rewritten y = sin x + cos x in sinusoidal form? __________
Why or why not?

____

____

____

Determine if any of the following curves might be represented in sinusoidal form. Rewrite in sine form those you have selected.

1. $y = \cos 2x - \sin x$

2. $y = \sin^2 x$

3. $y = 3 \cos 2x + 2 \sin x$

4. $y = \cos x - \tan x$

5. **Throughout the day, the depth of water at the end of a dock varies with the tides. The table shows the depths (in meters) at various times during the morning.**

t (time)	Midnight	2 A.M.	4 A.M.	6 A.M.	8 A.M.	10 A.M.	Noon
d (depth)	2.55	3.80	4.40	3.80	2.55	1.80	2.27

Use a sine curve to model this data. During what times in the afternoon can a boat safely dock if it needs at least 3 meters of water to moor at the dock? (Problem from page 359 of Precalculus with Limits, by Larson, Hostetler, Edwards, and Heyd from Houghton Mifflin ©1997)