



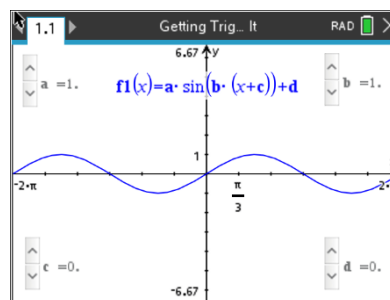
Exploring Sinusoidal Functions

Student Activity

Name _____

Class _____

In this activity, students systematically explore the effect of the coefficients on the graphs of sinusoidal functions. Terminology describing the graph—amplitude, period, frequency, phase shift, midline, and vertical offset—is introduced, then reinforced as the student calculates these values directly from the graph using the graphing calculator and sliders.



The parameters a , b , c and d will each affect your sinusoidal function in different ways. You will be using sliders on the handheld to change the value of a parameter by pressing the arrows of each individual slider and manipulating them. You will download the file ***Sinusoidal Functions.tns***. At the end of this activity, you will have a much better understanding of the role of each parameter and how they affect a sinusoidal function.

Problem 1 – A general trigonometric function

Once the file has been downloaded, go to page 1.2 where the sinusoidal function below has been entered and sliders created.

$$f1(x) = a \cdot \sin(b(x + c)) + d.$$

(a) Complete the table.

a	b	c	d	zero1	zero2	min	max
1	1	0	0				
4	$\frac{1}{2}$	3	1				

(b) With a classmate, write down the differences you notice between the graph created by row one and the graph created by row two.



Problem 2 – The effect of the coefficients a , b , c , and d

Examining a

(a) Set $b = 1$ and $c = d = 0$ and change the value of a . Try 4 different values of a (even negative values) and fill in the table below.

a	b	c	d	zero1	zero2	min	max
	1	0	0				
	1	0	0				
	1	0	0				
	1	0	0				

(b) How did the appearance of the graph change?

(c) Which graph features changed? Which did not change?

(d) Write equations to describe the relationship between a and the features that did change.

The value of $|a|$ is the **amplitude**. It is equal to half of the difference between its maximum and minimum values.

(e) Calculate the amplitude from the minimum and maximum values in the table above.

(f) Compare the results to the values of a . What do you notice?



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Examining b

(a) Set $a = 1$ and $c = d = 0$ and change the value of b . Try 4 different values of b (even negative values) and fill in the table below.

a	b	c	d	zero1	zero2	min	max
1		0	0				
1		0	0				
1		0	0				
1		0	0				

(b) How did the appearance of the graph change?

(c) Which graph features changed? Which did not change?

(d) Describe the relationship between b and the features that did change.

(e) What **two** features of the sinusoidal function can the parameter b help you find? Define them both.

Examining C

(a) Set $a = b = 1$ and $d = 0$ and change the value of c . Try 4 different values of c (both positive and negative values) and fill in the table below.

a	b	c	d	zero1	zero2	min	max
1	1		0				
1	1		0				
1	1		0				
1	1		0				

(b) How did the appearance of the graph change and what do we call that change?



- (c) Which graph feature changed? Which did not change?
- (d) What is the effect of an increasing sequence of values for c on the graph?
- (e) What is the effect of a decreasing sequence of values for c on the graph?

Examining d

- (a) Set $a = b = 1$ and $c = 0$ and change the value of d . Try 4 different values of d (both positive and negative values) and fill in the table below.

a	b	c	d	zero1	zero2	min	max
1	1	0					
1	1	0					
1	1	0					
1	1	0					

- (b) How did the appearance of the graph change?
- (c) Try an increasing sequence of values for d such as 0, 1, 2, 3, 4...
What is the effect on the graph?
- (d) Try a decreasing sequence of values for d such as 0, -1, -2, -3, -4...
What is the effect on the graph?
- (e) Describe the effect of the value of d on the graph. How does changing d change the graph features?



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Problem 3 – A closer look at amplitude, period, and frequency

In $f_1(x)$, enter the general cosine function, $f_1(x) = a \cdot \cos(b(x + c)) + d$.

amplitude: half of the vertical distance from minimum value to maximum value

period: horizontal distance from one peak (maximum point) to the next or one minimum point to the next

frequency: number of cycles per 2π interval

- Write a formula to find the frequency f given the period p .
- Use the formula to complete the table below.

a	b	c	d	max point	min point	next max point	amplitude	period	frequency
1	1	0	0	(0, 1)	(3.14, -1)	(6.28, 1)	$\frac{1}{2} \cdot (1 - (-1))$ 2	$\frac{6.28 - 0}{2\pi}$ 6.28 2π	
	1	0	0						
	1	0	0						
1		0	0						
1		0	0						
1	1		0						
1	1		0						
1	1	0							
1	1	0							

- Based on the results in the table, discuss with a classmate and record each relationship:
 a and amplitude b and the frequency b and the period