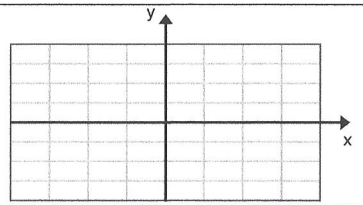
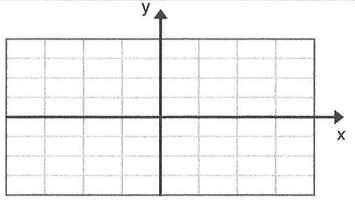
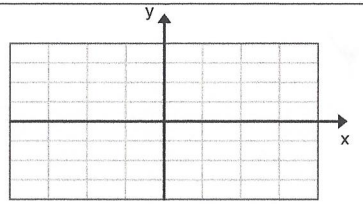
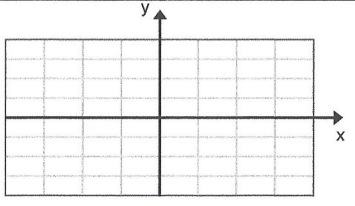
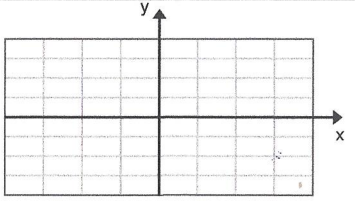
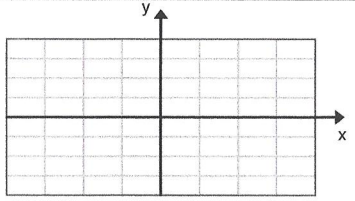
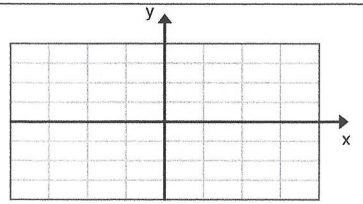
Investigation #3
The Sine Function: Phase Shift

In this lesson you will learn how C affects the graph of $y = \sin(x - C)$. *Phase shift tells how far (in degrees) the graph has moved in the horizontal direction.*

1. Use a graphing calculator to graph each of the following functions. All work will be done in degrees, so you must set the mode setting on your calculator to degrees. The suggested window settings are Xmin = -360, Xmax = 360, Xscl = 90, Ymin = -4, Ymax = 4, Yscl =1. The first has been done for you.

Equation	C	Sketch	Phase Shift	x-intercepts between 0 and 360°
$y = \sin(x)$	0		none	0°, 180°, 360°
$y = \sin(x - 45)$				
$y = \sin(x - 90)$				
$y = \sin(x - 180)$				
$y = \sin(x - 270)$				

Equation	C	Sketch	Phase Shift	x-intercepts between 0 and 360°
$y = \sin(x + 45)$				
$y = \sin(x + 90)$				

2. Compared to $y = \sin(x)$, have the graphs in Exercise 1 been shifted horizontally or vertically? _____

3. In what direction does the graph shift when C > 0? _____

4. In what direction does the graph shift when C < 0? _____

5. Explain why the x-intercepts of $y = \sin(x)$ and $y = \sin(x - 45)$ are different. _____

6. Explain the difference between the phase shifts in the graphs $y = \sin(x - 45)$ and $y = \sin(x + 45)$. _____

7. What is the formula for the phase shift in terms of C? _____

8. Use what you know about phase shift and period to explain why $y = \sin(x - 360)$ has the same graph as $y = \sin(x)$. _____

9. Write an equation of the form $y = \sin(x - C)$ that has x-intercepts at 60° and 240°. Check your answer using the calculator. _____

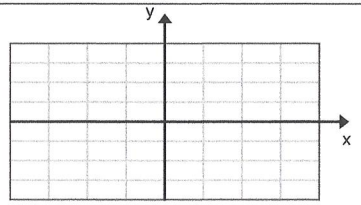
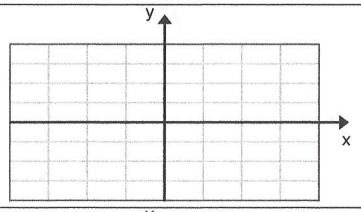
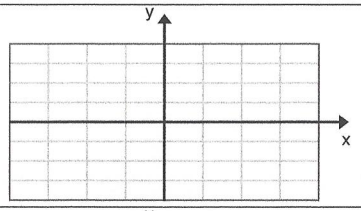
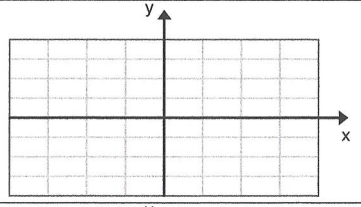
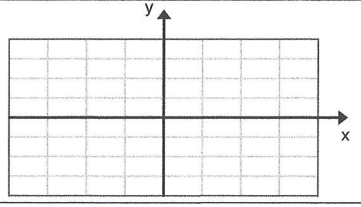
10. Give a value of C in the equation $y = \sin(x - C)$ that would produce a graph between $y = \sin(x + 120)$ and $y = \sin(x + 45)$. Check your answer using the calculator. _____

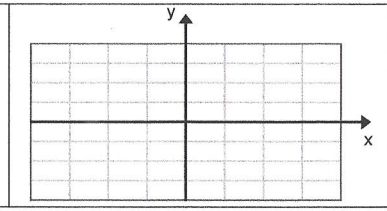
11. Explain how the constant C affects the graph of $y = \sin(x - C)$ _____

Investigation #4
The Sine Function: Period

In this lesson you will learn how B affects the graph of $y = \sin(Bx)$. *Recall that the period of a sine graph is the length along the x- axis of one complete cycle.*

1. Use a graphing calculator to graph each of the following functions. Our work will be done in degrees, so you must set the calculator mode to DEG. The suggested window settings are Xmin = -360, Xmax = 360, Xscl = 90, Ymin = -4, Ymax = 4, Yscl =1. The first one has been done for you.

Equation	B	Sketch	Number of Cycles in 360°	Period
$y = \sin(1x)$	1		1	360°
$y = \sin(2x)$				
$y = \sin\left(\frac{1}{2}x\right)$				
$y = \sin(4x)$				
$y = \sin\left(\frac{1}{4}x\right)$				

$y = \sin(8x)$		

2. Use the results of Exercise 1 to answer the following questions:
   a. If B = 1, the period of $y = \sin(Bx)$ is 360°. As B gets larger than 1, what happens to the period?

   b. As B gets smaller than 1 (but still greater than 0) what happens to the period of the graph?

   c. How does the number of cycles in 360° of a sine graph compare to the constant B?

   d. Give a formula for the period of the sine function in terms of B. (Your formula must work for each graph in Exercise 1)

3. If the graph of a sine wave shows 10 complete cycles in 360°, what is its period?

4. Write an equation of the form $y = \sin(Bx)$ for each of the following periods.
   a. Period = 180° Equation:
   b. Period = 120° Equation:
   c. Period = 60° Equation:

5. Write an equation of the form $y = A\sin(Bx) + D$ whose graph is:
   a. A sine curve with amplitude 2 and period 180°.

   b. A sine curve with vertical shift -2 and period 90°.

   c. A sine curve with amplitude 1.5, vertical shift 0.5 and period 720°.

6. Explain how the constant B affects the graph of $y = \sin(Bx)$.