AA8-6 Investigation Name ________________________________

Changing the Period of a Sine or Cosine Graph

1. We learned that **a, h,** and **k** transform the sine and cosine function graphs similarly to other functions. Let's relate those transformations to our Circle of Terror that we used to discover the shape of the parent graphs. The general form of the sine function is **y = a sin (x – h) + k**.

Which changes **(a, h or k)** in each situation below?

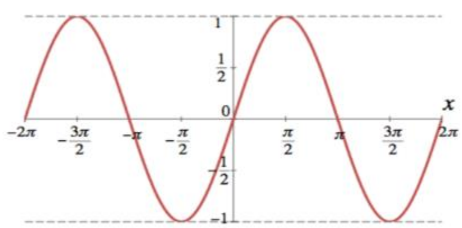
The radius of the Circle of Terror was 4 km. instead of 1 km. _______________

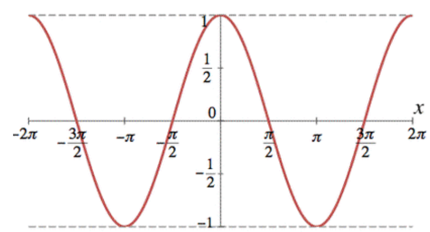
Steve boards the Circle of Terror at its lowest point. _______________

The center of the Circle of Terror is 2 km. above the ground. _______________

Write the equation of the sine curve if all three of the above are true: ____________________

2. The **period** is defined as the length required to complete one full cycle. For the sine and cosine parent graphs, that length is 2π. Using a highlighter or colored pencil, trace over ONE period of the sine graph and the cosine graph below.





When we investigated the Circle of Terror, **x** represented the distance traveled around. To investigate period change, **x** will represent the time it takes to complete a loop. So, one loop took 2π minutes.

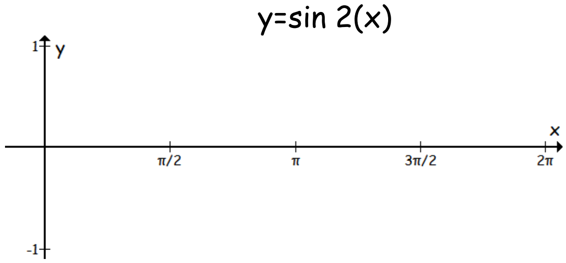
3. To investigate period we need to add one more parameter - **b**. "**b**" changes how many periods complete within 2π. On our Circle of Terror, this would be the number of loops completed in 2π minutes.

We need to determine where **b** is in the general equation (inside or outside):

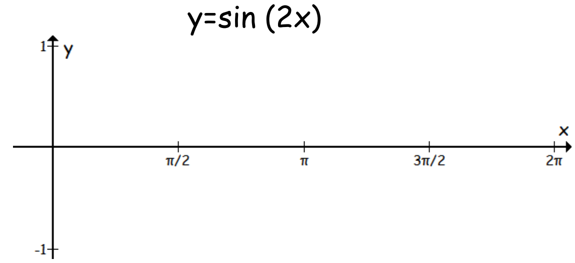
$$y = \text{a}\sin b\,(x - h) + k \quad \text{or} \quad y = \text{a}\sin(bx - h) + k$$

Using a calculator or Desmos (you can see specifics easier on Desmos), graph and sketch the two graphs below. On Desmos, change the scale to $\frac{\pi}{4}$ in tools.  (Don't forget to label the axes)

y=sin 2(x)



y=sin (2x)



How many cycles would be completed in 2π?_________

What is the period length of these two graphs? ______

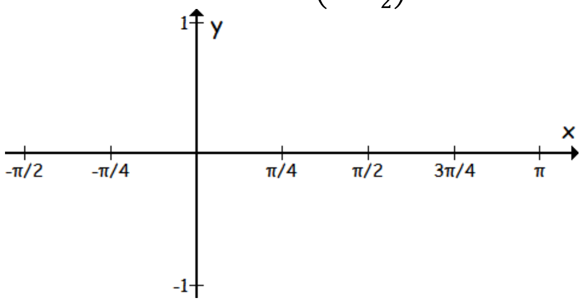
Do the parentheses appear to have made any difference? ______

4. What if I also want to move a graph to the left $\frac{\pi}{2}$ and I want to complete two cycles within 2π.

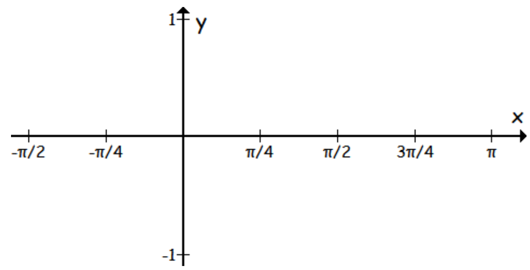
What would "h" be? _____ What would "b" be? _____

Using Desmos, graph the two equations below to determine if the "**b**" value should be inside or outside of the parentheses. Label the axes. Remember the sine graph is MID-HIGH-MID-LOW-MID.

$y = sin2\left(x + \frac{\pi}{2}\right)$



$y = sin\left(2x + \frac{\pi}{2}\right)$



Which graph shows what you want it to? Which equation is the correct form?

$y = \mathrm{a}\sin b\,(x - h) + k$ or $y = \mathrm{a}\sin(bx - h) + k$

5. Without graphing, determine the period length, and how many cycles will complete within 2π.

a. $y = \sin\frac{1}{2}(x + \pi) + 3$

Cycles within 2π:___

Period length:___

b. $y = \cos 4(x + \pi) + 3$

Cycles within 2π:___

Period length:___

c. $y = \cos\frac{1}{4}(x + \pi) + 3$

Cycles within 2π:___

Period length:___

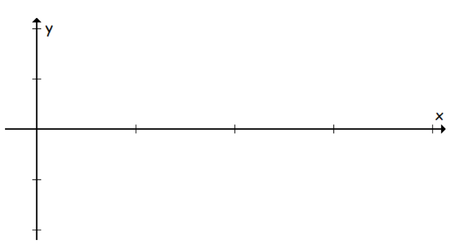
What did you do to determine the number of cycles and period length?

6. When graphing you must label your x-axis to include a full period (5 points). When b=1 we used a scale of $\frac{\pi}{2}$. The scale will change as the period changes. To find the best scale you need to divide the period length by 4. Sketch each equation after labeling the x-axis.

a. $y = \sin\frac{1}{2}(x)$

Period length: _____

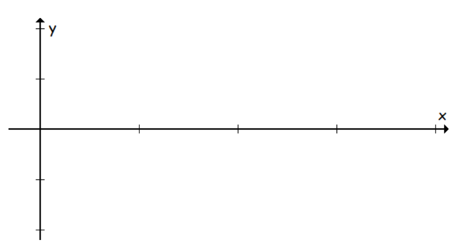
Scale: _____



b. $y = \cos 4(x)$

Period length: _____

Scale: _____



c. $y = \cos\frac{1}{4}(x)$

Period length: _____

Scale: _____