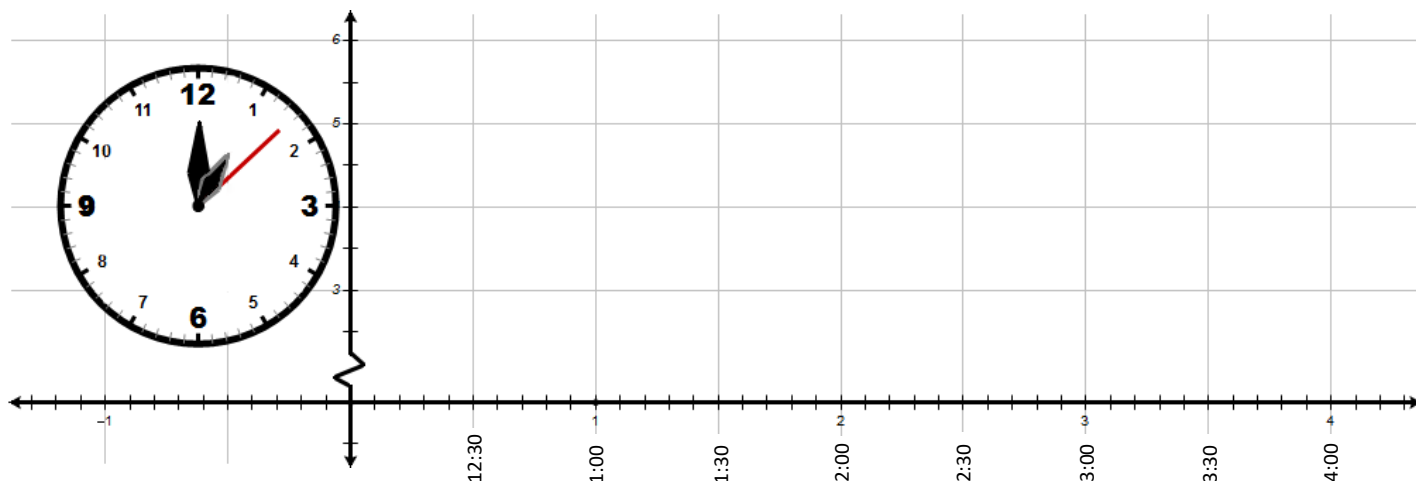
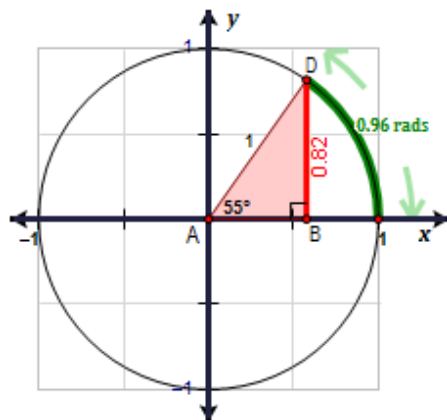


Let's consider a large clock that is hung on a wall such that the center of the clock is exactly 4 feet above the ground. The tip of the minute hand moves between a maximum of 5 feet and a minimum of 3 feet off the ground. Create a plot of the height of the tip of the minute hand starting from 12:00 am to 4:00 am. (The picture of the clock shows a time of roughly 1:00 am)

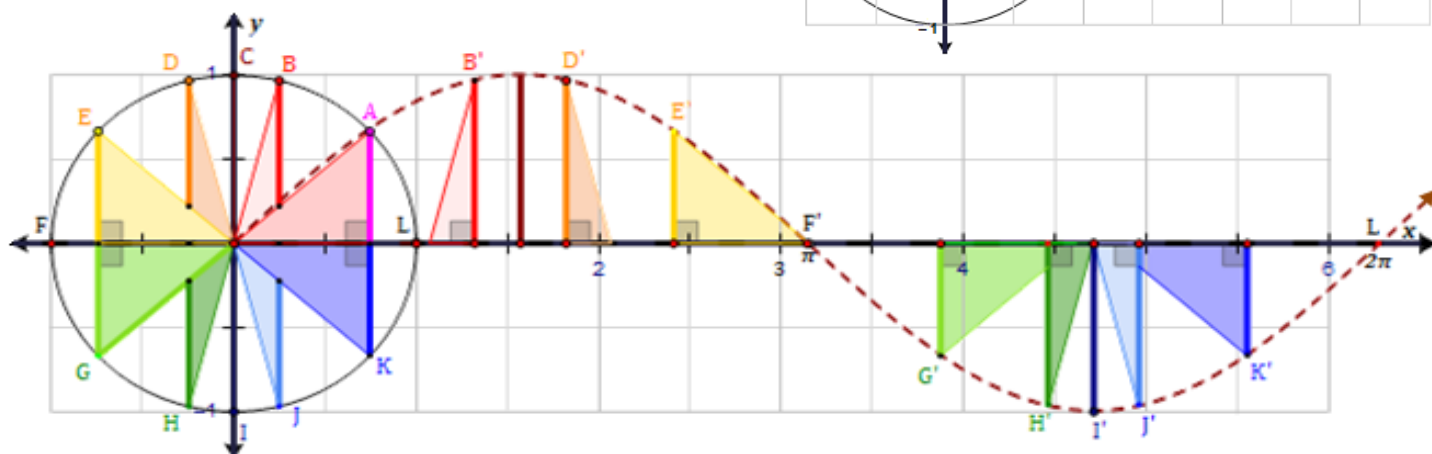
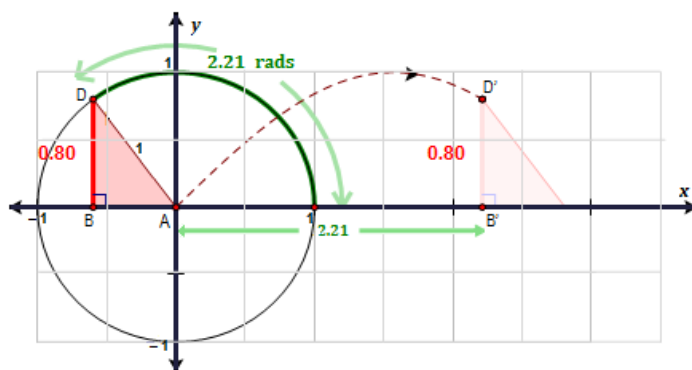


This plot should generate a **cosine wave** graph (see the animation on Matt's Math Labs). Hopefully, this should make you ask, "How do functions that represent ratios of triangles generate smooth waves?"



**How Right Triangles create a WAVE:** First consider a right triangle drawn inside of a unit circle like the one shown at the right. Determine the value of  $\sin(A)$ . Try the example at the right find  $\sin(55^\circ)$  which is approximately the same as finding  $\sin(0.96 \text{ rads})$ .

Then, if we plot each of point where x is the measure of the angle of the unit circle in radians and y is value of  $\sin(A)$  which is essentially the height of the right triangle for the given angle. The resulting locus of points generates a Sine Wave. The diagram below shows several more right triangles that map out more of the sine wave.

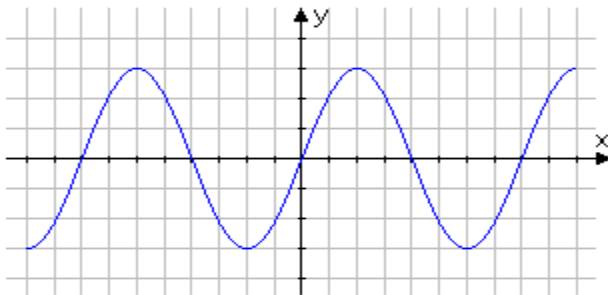


A Sine Wave is commonly described by 4 components.

| Parts of a Sine Wave                                                                                                                                                                                                               | Visual |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <p><b>Amplitude:</b> The amplitude of a wave is the distance from the midline to highest point of the wave. (half of the vertical displacement).</p> $\text{Amplitude} = \frac{(\text{Highest } Y - \text{Lowest } Y)}{2}$         |        |
| <p><b>Period:</b> The period of the wave is the horizontal distance of one complete cycle.</p> $\text{Period} = (\text{Crest } X) - (\text{Previous Crest } X)$ $\text{Period} = (\text{Trough } X) - (\text{Previous Trough } X)$ |        |
| <p><b>Phase Shift:</b> The amount the wave is shifted right or left</p> $\text{Phase Shift} = \frac{(\text{Crest } X) + (\text{Previous Trough } X)}{2}$                                                                           |        |
| <p><b>Vertical Shift:</b> The amount the wave is shifted up or down</p> $\text{Vertical Shift} = \frac{(\text{Highest } Y + \text{Lowest } Y)}{2}$                                                                                 |        |

1. Find a possible equation of the following graphs.

a.



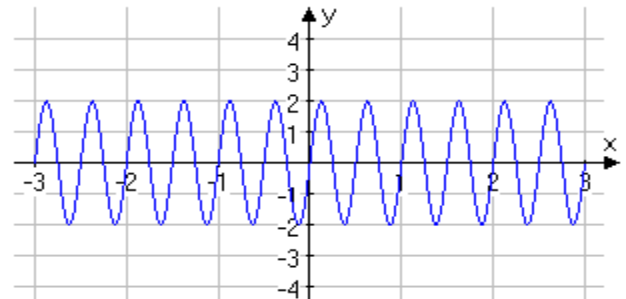
Amplitude =

Period =

Phase Shift =

Vertical Shift =

b.



Amplitude =

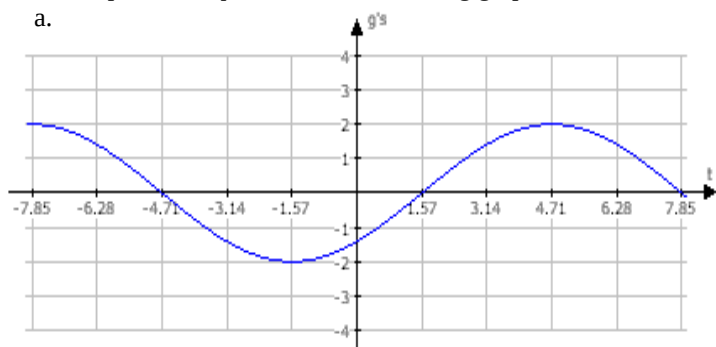
Period =

Phase Shift =

Vertical Shift =

2. Find a possible equation of the following graphs.

a.



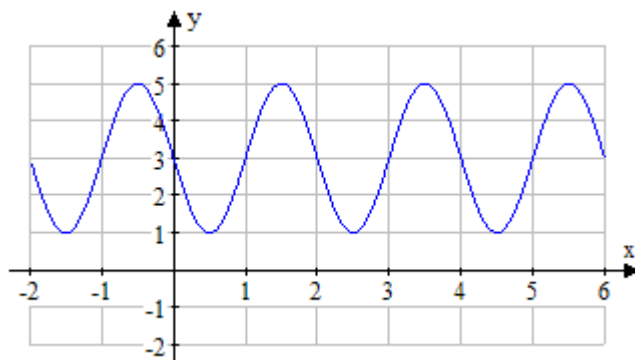
Amplitude =

Period =

Phase Shift =

Vertical Shift =

b.



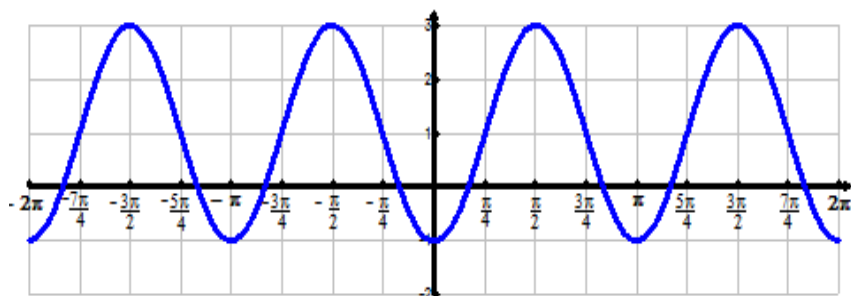
Amplitude =

Period =

Phase Shift =

Vertical Shift =

c.



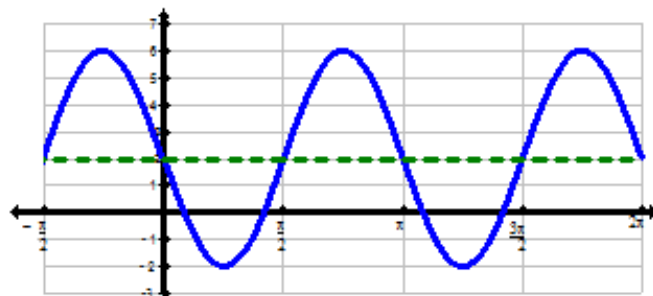
Amplitude =

Period =

Phase Shift =

Vertical Shift =

d.



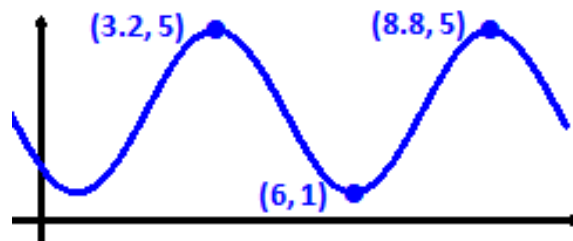
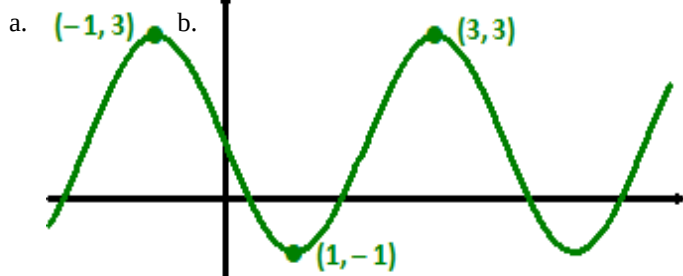
Amplitude =

Period =

Phase Shift =

Vertical Shift =

3. Find a possible equation of the following graphs.



Amplitude =

Period =

Phase Shift =

Vertical Shift =

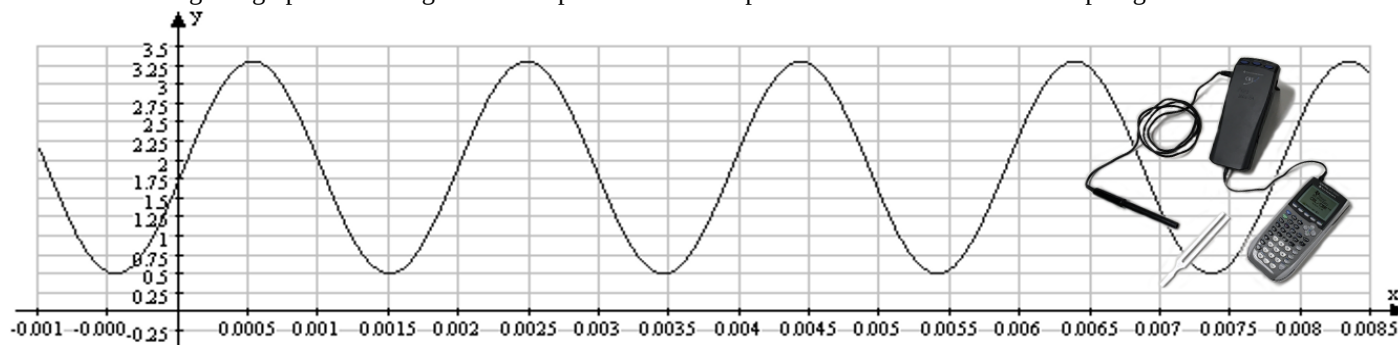
Amplitude =

Period =

Phase Shift =

Vertical Shift =

4. The following is a graph of a tuning fork held up to a CBL microphone connected to a TI-84 Graphing Calculator.



a. What is the amplitude?

b. What is the Vertical Shift?

c. What is the Period?

d. What is a possible Phase Shift?

e. What is a possible equation of the sound wave?