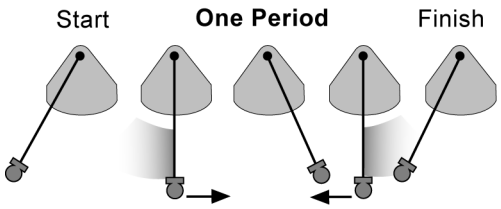
Name: _____

Skill Sheet 13.1 Harmonic Motion

A number of common objects exhibit harmonic motion. A swing, a string on a guitar, sound, and light all move in a harmonic or wave pattern. We can describe the motion of these objects with special terms like period, frequency, amplitude, and hertz. In this skill sheet, you will practice using these terms as you work through the activities, questions, and problems.

1. Reviewing terms

The diagram to the right shows the *period* of a pendulum. As the ball on the string is pulled to one side and then let go, the ball moves to the side opposite the starting place and then returns to the start. This entire motion equals one cycle. The time it take to move through one cycle is equal to one period of the pendulum.



As you can see in the diagram, the ball and string always pass through a center point. The distance to which the ball and string move away from this center point is call the *amplitude*. For pendulums, amplitude is measured in degrees. For other kinds of waves, amplitude is measured in units of length like centimeters or meters.

Frequency is a term that refers to how many cycles can occur in one second. For example, the frequency of the sound wave that corresponds to the musical note "A" is 440 cycles per second or 440 hertz. The unit *hertz* (Hz) is defined as the number of cycles per second.

The terms period and frequency are related by the following equation.

Period and Frequency

Frequency (hertz) ↓

Period (seconds) → $T = \frac{1}{f}$ $f = \frac{1}{T}$ ← Period (seconds)

Frequency (hertz) →

2. Questions and practice problems

1. You want to describe the harmonic motion of a swing. You find out that it take 2 seconds for the swing to complete one cycle. The swing passes through 48 degrees as it goes from high point-to-high point in its motion (passing through a center).
   a. What is the period of the swing?

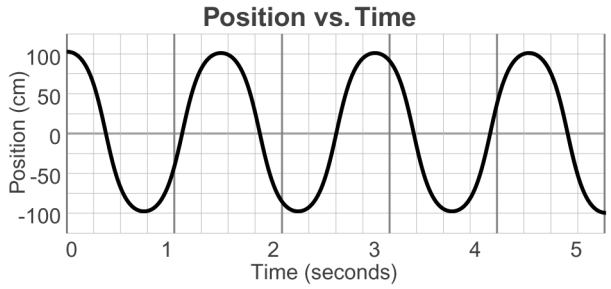
   b. What is the frequency of the swing in hertz?

   c. What is the amplitude of the swing?

2. If you let the swing's motion continue on its own, what would happen to its amplitude? Why?

3. Use the graphic to answer the following questions.
   a. What is the amplitude of the wave?

   b. How many wavelengths are featured in the graphic? In your response, demonstrate that you understand how to identify one wavelength.



4. The table below lists data from a pendulum experiment. Use the table to help you answer the questions that follow.

Trial number	Length of string (cm)	Mass of pendulum (g)	Amplitude of pendulum (degrees)
1	10	5	30
2	10	10	40
3	20	5	30
4	20	10	40
5	30	5	30
6	30	10	40

a. Which of the three variables (length of string, mass of the pendulum, and amplitude) affects the period of the pendulum the most?

b. For which of the six trials would the pendulum be the slowest? Explain your answer.

c. For which of the six trials would the pendulum be the fastest? Explain your answer.

d. Does the relationship between the mass and period of a pendulum support Newton's second law of motion? Explain your answer.