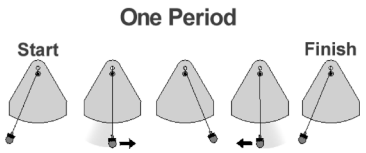
Name:

Skill Sheet 11 — 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 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

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

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

Example: A long pendulum takes 10 seconds to make one complete back and forth motion. What is its period and frequency?

Answer: The period is the time for one cycle, so the period is 10 seconds.

$$f = \frac{1}{T}$$

$$f = \frac{1}{10 \text{ seconds}} = 0.1 \text{ hertz}$$

The frequency is 0.1 hertz.

2. Questions and practice problems

1. You decide 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-to-high point in its motion (passing through center).

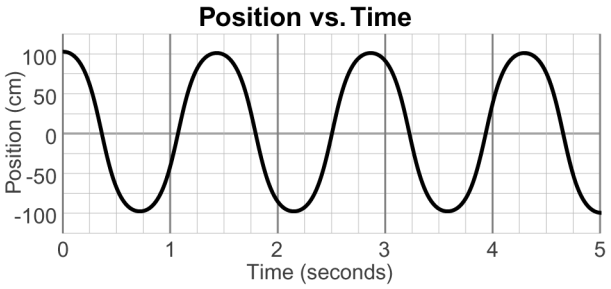
   a. What is the period of the swing?

   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.

   c. What is the period of the wave?

   d. What is the frequency of the wave?