4.1.1 In Class or Homework Exercise

1. A sound wave has a frequency of 262 Hz. What is the time between successive wave crests?
   The time between successive wave crests is the amount of time that it takes for a complete cycle, which is the period.

$$T = \frac{1}{f}$$
$$= \frac{1}{262}$$
$$= \boxed{3.82 \times 10^{-3} s}$$

2. You are creating waves in a rope by shaking your hand back and forth. Without changing the distance your hand moves, you begin to shake it faster and faster. What happens to the amplitude, frequency, period, and velocity of the wave?
   Amplitude – stays the same since you are not changing the distance that your hand moves.
   Frequency – increases, since you are moving your hand faster and faster to create more waves every second.
   Period – decreases, since period is the inverse of frequency.
   Velocity – stays the same, since velocity only depends on the medium.

3. If a rain drop falls into a pool, small-amplitude waves result. If a swimmer jumps into a pool, a large amplitude wave results. Why doesn't the heavy rain in a thunderstorm produce large waves?
   The heavy rain is creating many small waves over the entire pool. While some of these waves will interfere constructively, this will be somewhat random and there will be both constructive and destructive interference over the entire pool. With the swimmer, all of the energy is concentrated at one location to create a large wave.

4. What is the relationship between the amplitude of a wave and the energy carried?
   The bigger the amplitude of the wave, the more energy the wave has.

5. When a wave reaches the boundary of a new medium, part of the wave is reflected and part is transmitted. What determines the amount of reflection?
   The difference between the two media determines the amount of reflection. The more different the two media, the more of the wave is reflected. For example, if sonar waves are sent into a lake more of the waves will be reflected from the bottom of the lake than will be reflected from a pocket of cold water.

6. A pulse reaches the boundary of a medium more dense than the one from which it came. Is the reflected pulse erect or inverted?
   The reflected pulse will be inverted.

7. Waves are sent along a spring of fixed length.
   a. Can the speed of the waves in the spring be changed? Explain.
      No. Since the spring is of fixed length, the medium cannot be changed. Since the speed of waves depends on the medium, the speed cannot be changed.

   b. Can the frequency of a wave in the spring be changed? Explain.
      Yes, the frequency of the wave can be changed by producing more or fewer waves each second.

8. You repeatedly dip your finger into a sink full of water to make circular waves. What happens to the wavelength, velocity, and frequency as you move your finger faster?
   Wavelength – decreases, since the waves are being created closer together.
   Velocity – stays the same, since the medium has not changed.
   Frequency – increases, since you are creating more waves every second.

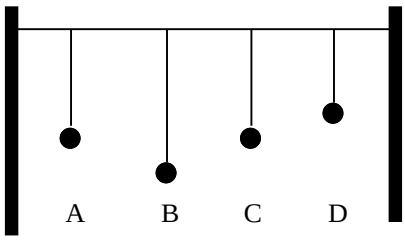
9. You can make water slosh back and forth in a shallow pan only if you shake the pan with the correct frequency. Explain.
   The water in the pan has a natural frequency. In order to make the water slosh back and forth (which is creating a larger amplitude) you must put energy into the system at the same frequency as this natural frequency. This is an example of resonance.

10. What is a node?
    A node is the part of a medium that is undisturbed as a result of total destructive interference.

11. A large erect wave pulse is moving to the left on a large spring at the same time that a smaller inverted wave is moving to the right. Describe what the spring will look like as the waves pass through one another.
    There will be an erect wave that is smaller than the original erect wave. The smaller inverted wave will interfere destructively with the larger erect wave, producing a smaller erect wave.

12. An apparatus is made by extending a string horizontally between two poles. Four pendulums are constructed of a weight and a string and hung from the horizontal string, as shown below. Two pendulums are the same length (A and C), one pendulum is longer (B) and one pendulum is shorter (D). One at a

time, each pendulum is pulled to the side and released. Describe what happens to the other pendulums in each case.



Only pendulums which are the same length and have the same resonant frequencies should cause one another to vibrate significantly.

A will cause C to vibrate
B will do nothing
C will cause A to vibrate
D will do nothing