Questions/Problems

1. A Physics 7C student rummaging around in an attic finds a pendulum which happens to have a frequency of 0.5 Hz.

(a) As the student watches the pendulum oscillate, she decides to make a graph of the angle the pendulum makes with the vertical as a function of time. In doing this, she decides to make the time t = 0s the point at which the pendulum is at the maximum amplitude of 18° to the right. Sketch the graph the student makes, including properly labeled axes, and identify on the graph the period and amplitude.

(b) Write down the equation that describes the pendulum angle as a function of time in the graph you just produced. Be sure to fill in the values of all of the constants.

2. Consider the function $\Lambda(t) = 2\pi t / \mathrm{T}$.

(a) Calculate the values $\Lambda(t = 0)$, $\Lambda(t = \mathrm{T}/8)$, $\Lambda\ (t = \mathrm{T}/4)$, $\Lambda\ (t = 3\mathrm{T}/8)$, and $\Lambda\ (t = \mathrm{T}/2)$.

(b) Plug the values of Λ from (a) in the equation $y(x) = B\sin(\Lambda + 2\pi x / \lambda)$, and sketch a plot for each of the cases in (a).

(c) What happens to the wave as t increases?

(d) What would happen to the wave as t increases if the equation were $y(x) = B\sin(\Lambda - 2\pi x / \lambda)$?

3.The equation of motion for a particular ocean wave is:

$$y(x,t) = (1.2\ \mathrm{m})\sin\left[\frac{2\pi t}{(1.5\ \mathrm{s})} - \frac{2\pi x}{(3.0\ \mathrm{m})}\right].$$

(a) Determine the height (in m) of the wave crests above the troughs.

(b) Determine the frequency of the wave (in Hz).

(c) If the wave had an amplitude of 12m instead, would the wave speed be more, less, or the same? Explain.

(d) What is the net vertical displacement of a small quantity of water after 3.0s have elapsed?

4. A buoy floats on the surface of the water as the wave from the previous problem passes by.

(a) Find the period of the harmonic motion of the buoy (in s).

(b) If we designate x = 1.5m to be the position of the buoy at t=0sec, what is the constant phase angle ϕ (in rad) for the vertical harmonic motion of the buoy?

(c) Think of the speed of the buoy. If the wave had an amplitude of 12m instead, would the maximum speed be more, less, or the same? Explain.

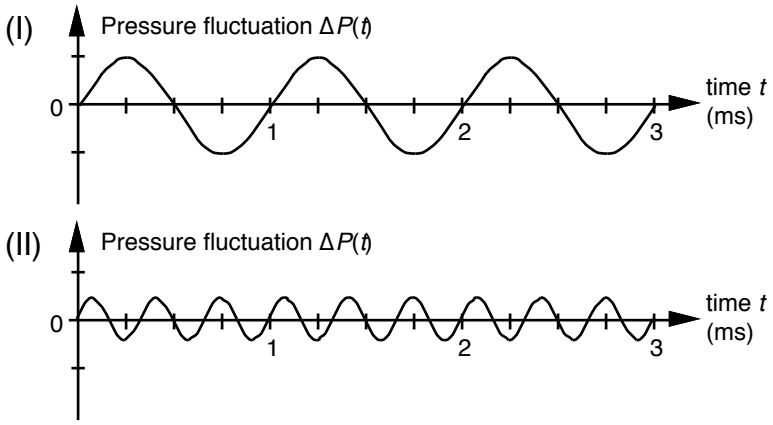
(d) Explain in words the difference between the speed of the buoy and the speed of the wave.

5. You are at a long channel filled with water. You have two uneducated assistants, a stick, a ruler, and a stopwatch. Union rules prohibit you from using the stick, ruler or stopwatch directly—you must have your (union card-carrying) assistants use these tools.

(a) To measure the speed of waves in the channel, explain in words what steps you tell your assistants to do.

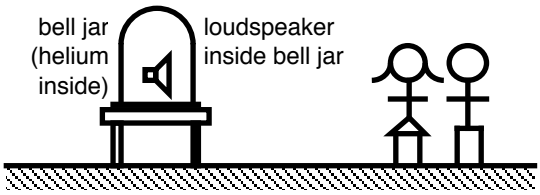
(b) Suppose the speed of these waves is found to be 2.0 m/s. To set up a harmonic wave of with a wavelength of 0.5m, explain in words what steps you tell your assistants to do.

13. Below are graphical representations of two sound waves in a tube in Mars' atmosphere, where sounds travel at a speed of 200m/s.



(a) What are the periods (in seconds) of these sounds on Mars?
(b) What are the wavelengths (in meters) of these sounds on Mars?
(c) If both sounds (I) and (II) are more intense than the threshold of hearing, which are audible to the human ear on Mars, and why?
(d) A certain ideal sound speaker in Mars' atmosphere makes a sound of frequency f_{Mars} and wavelength λ_{Mars}. If this speaker is then taken to Earth's atmosphere, which of these two quantities (f_{Earth}, λ_{Earth}) will increase, remain the same, or decrease compared to Mars?

14.A sound loudspeaker is set to vibrate at $f_{speaker}$ = 5,000 Hz at a certain "volume" setting. You and a Physics 7C classmate put this loudspeaker inside a bell jar. The air inside the bell jar is pumped out, and then replaced with helium (v_{wave} = 980 m/s for sound waves in helium). The loudspeaker, which is functioning as it had originally done while in air, is still audible to your and your Physics 7C classmate.



(a) What is wavelength λ_{helium} *and* the frequency f_{helium} of the sound waves coming from the loudspeaker, when they are inside the helium environment of the bell jar? Either show your work, or explain your reasoning, if you do not need to use calculations.

(b) What is wavelength λ_{air} *and* the frequency f_{air} of the sound waves coming from the loudspeaker, after they have been inside the helium environment of the bell jar, and are now in the air? Either show your work, or explain your reasoning, if you do not need to use calculations.

Q/P Comments

1. (a) Make sure your plot shows that the mass is at 18° or 0.314rad at t = 0s.
(b) T = 2.0 s, A = 18° or 0.314 rad, $\phi = +\pi/2$, and if you are using the sine function.

2.You should get a sine curve that moves to the left in (c), and to the right in (d).

3. (a) Twice the amplitude, or 2.4m.
(b) f = 0.67Hz.
(c) Wave speed would be unchanged, You can calculate it: $v_{wave} = \lambda f$ = 2m/s.
(d) Calculate the displacement y at the same position x for t = 0 s, and then for t = 3.0s. You should find that there is no net displacement for this time interval.

4. (a) T = 1.5s.
(b) $\phi = \pm\pi$ (does the ± make a difference?).
(c) Buoy would have a higher speed.

5. (a) You had a DL activity exactly like this.
(b) Use $v_{wave} = \lambda f$ to find the frequency your wave maker assistant should oscillate her wave maker with, which is 4ÊHz.

6. (a) Find the periods of these waves by reading their values off of the graphs, which are scaled in milliseconds.
(b) Wavelength is the parameter that is dependent on both the frequency and velocity of a wave.
(c) A sound wave can only be heard if its frequency is between 20Hz to 20,000Hz, and if its intensity is above the threshold of hearing. What information about these waves are you given to determine if they meet these frequency and intensity criterion?
(d) The frequency of a wave is solely determined by the frequency of the wave source. The velocity of a wave is solely determined by the properties of the medium. Remember that these two properties are independent parameters, wavelength is the parameter that is dependent on both the frequency and velocity of a wave.

7. The frequency of a wave is solely determined by the frequency of the wave source. The velocity of a wave is solely determined by the properties of the medium. Remember that these two properties are independent parameters, wavelength is the parameter that is dependent on both the frequency and velocity of a wave. (Note: when you inhale helium, you are not actually changing the frequency of your vocal chord vibrations; the reason why your voice apparently shifts to a higher frequency is an interesting and complex physiological phenomenon we can't discuss until we investigate the "overlap" of more than one wave in our throats. For now, just keep in mind that a sound wave in a bell jar is very different, but much simpler than how sound waves are produced in a vocal chord, whether they are filled with helium or not.

8. There is only one pair. Find the x=1m, t=1s point on both graphs.