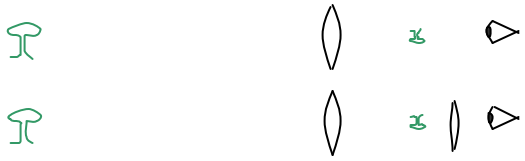
Physics 122, sections 502-4 and 8101 **Assignment 11**
Laura Lising **Due May 13 , start of class**

1) Suppose you have an object 12 inches tall that's 10 meters away from your lens (d_o = 10 m), and the lens has a focal length of f_1 = 1.00 m.
a) Find the distance from the lens to the image (d_i), and the height of the image (h_i).

b) Now, you're going to look at that image with another lens. Suppose this lens has a focal length of f_2=10.00 mm, and you place it a distance of 9.99 mm from the image from the first lens. In other words, the image from the first lens is the now the object for this lens—it's just the same as if you had a little tiny object there, and you're looking at it with a magnifying glass. Where is the image from the second lens, and how big is it?



2) We started with a particle model of light, thinking of light as objects that bounce. Then we found some phenomena this model couldn't explain and discovered that a wave model of light was able to explain these phenomena well. Explain in your own words how these two models fit together. Give an example of a foothold idea that arises out of both models and an example of a foothold idea that could arise only out of the wave model. Give examples for which one or the other model is more convenient to use, and for the particle model example, show how the wave model could have given the same prediction.

3) The diagram below is a representation of air pressure waves at an instant in time from two speakers that are in phase and playing a tone at a frequency of 400 Hz. (1 Hz = 1 Hertz = 1 cycle per second) The lines depict maxima in pressure (the peaks); I'm leaving out the dotted lines you had in tutorial that depicted the minima (troughs) between the peaks.

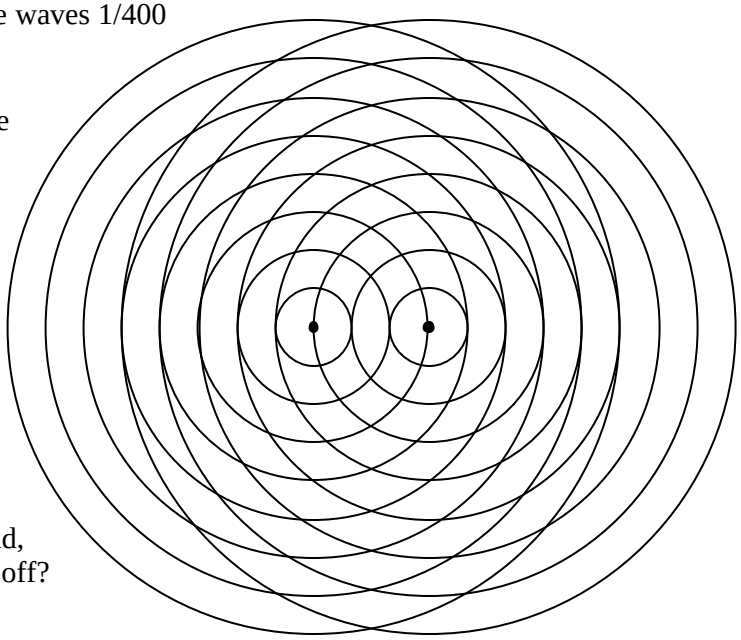
a) What would the diagram look like to depict the waves 1/400 of a second later?

b) What would the diagram look like to depict the waves 1/800 of a second later?

c) You hear things if the air pressure is vibrating at your ear, and bigger amplitudes of vibration mean louder sounds. Show on the diagram lines where the sound would be the loudest.

d) Show on the diagram lines where there would be no sound.

e) If you were at a point where there was no sound, what would happen if one of the speakers turned off?



4) The speed of sound in air varies with the air temperature, humidity, density, but it's typically around 340 m/s.

a) What would be the real distance in the air between the lines in the diagram? That is, how far apart are the peaks of the air pressure?

b) The nodal lines are curved, but far from the sources they straighten out. Look at two adjacent nodal lines in the previous diagram and estimate the angle between them.

c) Now calculate the angle between the nodal lines, when they've straightened out far from the sources, using the formula from problem 6 in assignment 10.

d) Do your answers to parts b and c agree?

5) A friend has 100 pennies and is going to throw them all in the air, let them land, and then count the heads and tails. He thinks they're going to be exactly 50 heads and 50 tails, and he wants to bet you $5 he'll be right.

a) Give an argument someone might make for why you should take the bet (that is, why your friend is probably going to be wrong).

b) Give an argument someone might make for why you shouldn't take the bet (that is, why your friend is probably going to be right).

c) Explain what you think, including a response to the argument you disagree with.

6) Carbon 14 has a half-life of about 5700 years. It decays by beta-decay.

a) What does C14 decay to? Try to use only a periodic table and the fact that it's a beta-decay.

b) The amount of C14 found in a fossil is found to be 1/10 of what we expect it started with. About how old is the fossil?

c) In lab you saw that the number of decays in a given time "fluctuated" considerably. Does that mean that the half-life of a radioisotope (the indium you were using or the C14 in this problem) fluctuates over time?

I've got a couple more problems for you that I want you to work on. These won't be collected but they are good practice for the exam. I will post them by Thursday and post solutions next week.