Solve these problems for a maximum of 10 points added to your 1st exam score. This is how it works: You must go to the tutoring center. They have this assignment along with solutions I have provided. They will help you with concepts on the problems you are not understanding. They will provide as much help as you need, but you must solve the problems yourself. They will check your work, as many times as needed, and once you have completed a problem and they see you are understanding it, they will sign your sheet with the solved problem. Then you bring your signed sheet to me, and the tutoring center will send me the list of students that went there, what did they work on, for how long were they there.

I want you to learn, I don’t want to see problems solved as in a solution manual.

The schedule for OSL tutoring hours are posted at the bottom of the class website, under “getting help”.

You have a week to do this assignment. You must turn it in to me, with signatures from the tutors, no later than Thursday, October 09th at the beginning of the class.

Good luck!

Problems

Show all your work! Explain each step. Draw figures for problems 1-3. Make sure the notation you are using in the equations is consistent with the notation you use in the figures. Write formulas first, plug numbers later.

1) (3 points)
A 2-cm tall object is is 15 cm in front of a converging lens that has a 20 cm focal length.

a) Use ray tracing to find the position and the height of the image (use a ruler. You do not need to be precise, but I want to see clearly the three special rays). Mark clearly the focal length, image distance (s’), object distance (s), optical axis.

Hint: Start by drawing the lens, optical axis, lens plane, and mark the focal points equal distance from the lens plane. Position the object accordingly on the optical axis and draw rays.

b) Calculate the image position (s’), lateral magnification (m), and image height (h’).

c) What does the sign of m tell you? What is the sign of s’ tell you?

2) (3 points)
You are standing 2.5 m directly in front of one of the two loudspeakers shown in the figure. They are 3 meters apart and both are playing a 686 Hz tone in phase. As you begin to walk directly away from the speaker, at what distances from the speaker do you hear a minimum sound intensity? The speed of sound is 343 m/s.
3) (2 points)
A diffraction grating having 500 lines/mm diffracts visible light at 30°. What is the light’s wavelength?

4) (2 points)
A soundwave is described by

\[ D(y, t) = (0.0200\, mm) \times \sin\left((8.96\, \frac{rad}{m})y + (3140\, \frac{rad}{s})t + \pi/4\, rad\right), \]

where \( y \) is in \( m \), and \( t \) is in \( s \).

a) In what direction is this wave traveling?

b) Along which axis is the air oscillating?

c) What are the wavelength, the wave speed and the period of oscillation?