Name:

Physics 122 – Spring 2014 – Test 1

Instructions:

There are TEN QUESTIONS on this exam. There is a table of helpful constants on the last page, some of which may be needed to answer the questions below. If you think a given problem is missing information needed to solve it, LOOK AT THE TABLE.

All answers should be decimal numbers (not functions or fractions) using scientific notation to three significant figures. SI units must be included on all answers. Angles may be given to the nearest degree. Note that a full trig table is provided at the end of this exam. If you use only your four-function calculator, you get a four point bonus. (Eight points for slide rule) You may use your 3x5 index card. No cel phones or other electronica are permitted. Show short answers on paper or in margins, but substantial work should be done on separate pages. Problems 1-3 require *only* an answer. You *may* provide an explanation for 1-3 if you want an opportunity for partial credit. Problems 4-10 require work to be shown in an orderly fashion. Reasons are required for conclusions that do not follow directly from an equation, or when you are asked to explain.

1. *(5 pts.)* Two sources S_1 and S_2 oscillating in phase emit sinusoidal waves of wavelength 1.5 cm and equal amplitude. Point P is 4.50 cm from Source S_1 and 15.00 cm from Source S_2. At point P, there is

(a) Constructive interference
(b) Destructive interference
(c) Neither constructive nor destructive interference
(d) Not enough information given to decide

2. *(10 pts.)* To the left of each statement, put a letter to indicate whether it is true of refraction, diffraction, both, or neither (R, D, B, N).

(a) Light bends at an interface between two materials because its speed changes.
(b) Sound waves, light waves, and radio waves can all display this (or these) effect(s) if the conditions are correct.
(c) Occurs when waves pass through a hole which is comparable to their wavelength.
(d) A pair of glasses or a magnifying glass would not be possible without this (or these) effect(s).
(e) This effect (or these effects) were used to prove that light is a wave.

3. *(5 pts.)* A light ray travels in the positive x direction (to the right). In the space below, sketch the following, in the order given.

(a) A lens with negative focal length
(b) A lens with positive focal length
(c) A mirror with negative focal length for that ray
(d) A mirror with positive focal length for that ray

4. *(10 pts.)* A *Blueray*® laser with a vacuum wavelength of 380 nm shines into a piece of polycarbonate (the video-disk). What is the wavelength of the laser light inside the polycarbonate disk?

5. *(15 pts.)* Find the wavelength and frequency of the fundamental and first harmonic for an organ pipe that is 2 m long, closed at one end and open at the other.

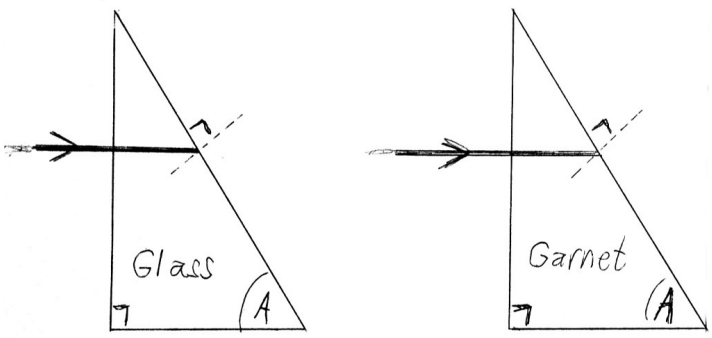
Sketch the air displacement pattern (like you did in written homework #2) for the fundamental and first harmonic.

6. *(10 pts.)* In class the first week of the semester I plucked an elastic cord and we saw a wave travel to the end of the cord, reflect, and come back to me in about 2 seconds. If the cord was 10 meters long and the tension in the cord was 5 Newtons, what was the total mass of the cord?

7. *(15 pts.)* A ray of light traveling in air enters a triangular piece of material from the left as shown in the figure below. (Angle $A = 55^o$)

Draw the rest of the path of the ray of light on the appropriate sketch (you can do this right on the exam paper, you do not need to redraw the sketches). Calculate all angles that are relevant and indicate them on each of your two drawings.

(a) If the prism is made of Crown Glass.
(b) If the prism is made of Garnet.

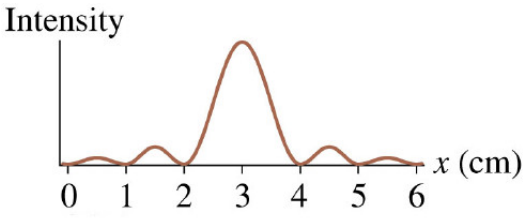


Problem 7: Angle $A = 55^o$.

8. *(10 pts.)* The intensity of an interference pattern projected on a screen is shown below.

(a) Is this a single slit or a double slit pattern? (Explain your choice in one sentence.)

(b) If the screen is 3 m from the slits (or slit), and the laser light is orange in color, what is the slit width (or spacing between the slits)?



Problem 8: Intensity pattern projected on a screen 3 m from the slit or slits.

9. *(15 pts.)* A 7-mm high object is placed 18-cm from a converging lens with focal length 36-cm.

(a) Sketch a diagram of the situation which includes principal rays, object, image and focal point at approximately correct distances and sizes.
(b) Using the appropriate formula, calculate more precisely the image distance and the size of the image.
(c) State whether the image is real or virtual, and explain in one sentence how you decided.

10. *(10 pts.)* A one-dimensional wave has the following equation: $D(x) = 3.7sin(42x + 170t)$. Answer the following, including proper units along with your numerical answer.

(a) What is the wavenumber for this wave?

(b) Which direction is the wave traveling?

(c) What is the frequency (ω) of the wave?

(d) What is the frequency (f) of the wave?

(e) What is the wavelength of the wave?

(f) What is the speed of the wave?

Useful information

Speed of light in vacuum: $3.00 \times 10^8\ m/s$
Speed of sound in 20 C air at sea-level atmospheric pressure: $343\ m/s$

Visible Color	Wavelength (nm)
Violet	400
Blue	450
Green	530
Yellow	580
Orange	600
Red	640

Substance (phase)	Refractive index
Air (g)	1.0003
Ice (s)	1.31
Mineral Oil (l)	1.25
Water (l)	1.33
Ethanol (l)	1.361
Crown Glass (s)	1.50
Polycarbonate (s)	1.58
Garnet (s)	1.9
Diamond (s)	2.4