Name_____

PH206 Exam II Spring 2000

Some Constants:

$\pi = 3.14159$
$\sigma = 5.6696 \times 10^{-8}\ W/m^2 \cdot K^4$
$k_B = 1.38 \times 10^{-23}\ J/K$
$R = 8.315\ J/mol \cdot K$
$A_V = 6.02 \times 10^{23}$ molecules/mol
1 cal = 4.184 J
1 atm = 101 kPa
monatomic ideal gas: $\gamma = C_p/C_V = 1.6667$
$I_0 = 1.00 \times 10^{-12}\ W/m^2$
velocity of sound in air (room temp, 1 atm) = 343 m/s.

$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$
$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$
$\sin A \pm \sin B = 2 \sin \frac{1}{2}(A \pm B) \cos \frac{1}{2}(A \mp B)$
$\cos A \pm \cos B = 2 \cos \frac{1}{2}(A + B) \sin \frac{1}{2}[\pm(A - B)]$

Write your solutions on these pages, and turn in the entire exam. If you need extra paper, just ask.

For problems 11 to 15: to receive full credit for correct answers, you must show your work!

Report numerical answers to three (3) significant figures.

Score Summary (to be filled in by instructor)

Mult Choice	Short Answer	Problems
1._____	6._____	11._____
2._____	7._____	12._____
3._____	8._____	13._____
4._____	9._____	14._____
5._____	10._____	15._____

Totals _____ + _____ + _____ = _____

Score:_____ out of 100

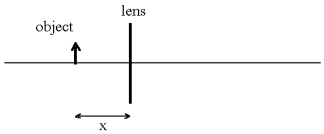
Multiple Choice:

(Circle your choice)

1. As light travels from a material with index of refraction n_1 into a material with index of refraction n_2 which of the following is *always* true if $n_1 \neq n_2$?

a. The frequency of the light changes.
b. The light bends towards the normal.
c. The speed of the light changes.
d. Total internal reflection will occur.
e. none of the above.

2. An object is placed on the axis of a converging lens, a distance, x, from the lens. If x is *less* than the focal length of the lens, then



a. no image will be formed.
b. a virtual image will be formed on the other side of the lens.
c. a virtual image will be formed on the same side of the lens.
d. a real image will be formed on the other side of the lens.
e. a real image will be formed on the same side of the lens.

3. A vibrating source generates a (low amplitude) transverse wave on a long string. The string is under constant tension. If the amplitude of the wave and its frequency are both doubled then

a. the power input increases by a factor of eight.
b. the wavelength increases by a factor of four.
c. the wavelength increases by a factor of two.
d. the wavelength decreases to one-half of what it was.
e. the wave speed increases by a factor of four.

4. A speaker emits sound with an intensity of 80 dB when measured 1.0 m away from the speaker. If the volume is turned up so that the intensity is increased by a factor of 10, the intensity 1.0 m away from the speaker will now be

a. 23 dB b. 83 dB c. 90 dB d. 103 dB e. 800 dB

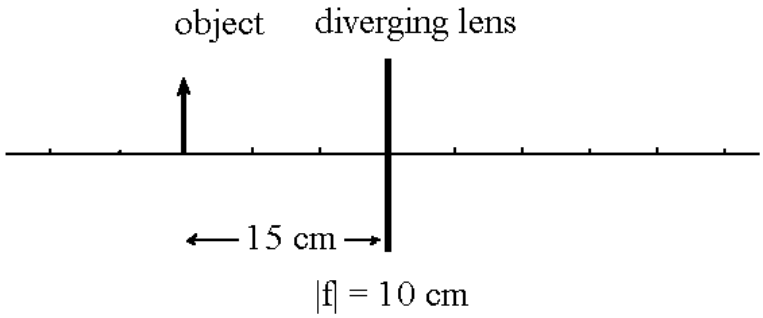
5. A clarinetist plays a note with a constant frequency of 440.0 Hz. A second clarinetist then joins in, attempting to play the same note. When the second clarinetist joins in, beats are heard which have a frequency of 2.0 Hz. Which one of the following could be the frequency of the tone produced by the second clarinetist?

a. 444 Hz b. 441 Hz c. 880 Hz d. 220 Hz
e. none of the above.

Short Answer

Provide a short answer (1 or 2 sentences or appropriately labeled diagram) for each.

6. Draw a ray diagram for the situation shown in order to find the location of the image.



7. Explain what happens to the frequency of the sound of your own echo as you move toward a wall with a speed v.

8. A single wave pulse on a string is traveling towards -x with a speed v. At t = 0 the pulse is described by a displacement, y, given by

$$y = 0.75 \sin[2 \tan^{-1}(e^{-3x})]$$

where x and y are in meters. Write the function y(x,t) which describes this wave for any time, t. (In case you haven't seen this notation, $\tan^{-1}(\theta)$ is another way of writing $\arctan(\theta)$).

9. A sound wave is generated by a speaker on one side of a wall which has an open door in the center. If the ray approximation is valid, one can easily treat the sound going through the door using the ray approximation. For what frequencies of sound could one expect the ray approximation to be valid? A typical door is about 1 m across.

10. Professor X makes the claim that for one-dimensional (1-d) periodic wave motion on a string, and ignoring losses (for example, due to friction), that if there is a node anywhere between the ends of the string, then there is no net energy being transported by the string. Is this true or false? Give convincing reasons for your answer.

Problems

(SHOW YOUR WORK, you will not get credit unless we can see how you got your answer.)

11. A fly is frozen inside an ice block which is a cube 30.0 cm on a side. By coincidence, the fly is at the exact center of the cube. An observer looks at the fly straight through one of the sides of the cube. How far beneath the block's surface will the observer see the image of the fly? The index of refraction of ice is 1.31 and the index of refraction of air is 1.00 .

12. An object 2.00 cm high is placed 35.0 cm to the left of a converging lens with a focal length of 25 cm. A diverging lens with a focal length of -15.0 cm is placed 82.5 cm to the right of the converging lens. Determine the location of the final image.

13. A transverse wave on a string is described by the displacement

$$y = 0.345 \cos(1.78x + 4.34t - \pi/2)$$

where x and y are in meters and t is in seconds. For this wave, complete the following: (Show your work below!)

Amplitude = _____ m Wavelength = _____ m

Wave speed = _____ m/s Frequency = _____ Hz

Wave is traveling toward _____

14. A source of sound emits uniformly in all directions. An observer 5.00 m from the source measures a sound level of 60.0 dB. What is the average power level, in Watts, of the source?

15. Find the fundamental frequency and the next higher frequency that could cause a standing-wave pattern on a string that is 30.0 m long and has a mass of 325 g. The string is fixed at both ends and is stretched with a tension of 21.0 N.

END