

MIDTERM 2

Physics 9B–01

NAME:

(please print)

November 19, 1993

Social Sec. #:

General Instructions: This examination is closed book. Only a calculator is allowed. Please show all your work. Credit will only be given for *complete* solutions. Answers must have correct units. Please write clearly and comprehensibly. The grader must be able to follow your reasoning in order to assign partial credit. It is against the University Academic Code to present work other than your own on this exam.

Important: After printing your name and social security number at the top of this cover sheet, please tear the cover sheet off and pass it to the aisle before beginning the exam. Remember to write your name on the remaining part of the exam.

There are nine problems on six pages. There are no blank pages. Please check now to make sure you have a complete exam. Note that not all the problems are worth the same number of points.

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- [10 points] 1. A convex lens has a focal length $f = 20.0$ cm. An object is placed a distance $d_o = 30.0$ cm in front of the lens. Use the figure to locate the image by tracing appropriate rays from the tip of the object. Again using your figure, rather than any equations, estimate d_i . Is the image erect or inverted? Estimate the magnification of the lens.

- [10 points] 2. A 22.0 cm focal length converging lens is 15.0 cm behind a diverging lens. Parallel light strikes the diverging lens. After passing through the converging lens, the light is again parallel. What is the focal length of the diverging lens?

[5 points] 3. Two trombone players in the Aggie marching band are slightly out of tune. One plays a note at frequency 800 Hz and the other plays at 810 Hz. They both play with the same loudness. Describe what the people in the stands will hear.

[10 points] 4. The frequency of a train whistle is 400 Hz. The difference in frequencies an observer on a stationary platform hears before and after the train passes is 100 Hz. How fast is the train moving? (The speed of sound in air is 343 m/sec.)

- [10 points]** 5. A woman 1.60 m tall stands in front of a vertical plane mirror. What is the minimum height of the mirror if she is to be able to see her whole body? How high must its lower edge be above the floor? (Assume her eyes are 10 cm below the top of her head.) To get credit on this problem you must derive the solution. (A diagram is very useful.) Stating results from the discussion in class will not be sufficient.

- [10 points] 6. White light is incident on a thin sheet of plastic on top of a thick block of plastic. (See figure.) The top sheet has thickness 180 nm and index of refraction $n_1 = 1.40$. What color of light is best reflected if the block has index of refraction $n_2 = 1.60$?

- [10 points] 7. Light of wavelength 720 nm falls on two slits and produces an interference pattern in which the fifth order fringe is 35 mm from the central fringe on a screen 2.0 m away. What is the separation of the slits?

- [15 points]** 8. A very thin sheet of plastic ($n = 1.50$) covers one slit of a double slit apparatus illuminated by 480 nm light. The center point of the screen, instead of being a maximum, is dark. What is the (minimum) thickness of the plastic?

- [20 points] 9.** A meter stick is placed vertically in water ($n = 4/3$). A person whose eyes are 1.50 meters above the ground stands 4 meters away. (See figure.)
- Draw a diagram showing how a ray of light from the deep tip of the meter stick (Point “A”) will get to the person’s eyes. Draw a line indicating what the person would conclude concerning the length of the stick.
 - This part is fairly hard. Write down (but do not try to solve) the equations which would allow you to determine the length l the person thinks the meter stick has. Clearly define, or label on the figure, any symbols you use. To help us in grading, box the equations which you would solve to get l . Of course, you should have as many equations as unknowns for a valid solution.