

Exam 5 – white/yellow version

Physics 2760

Fall 2012

Last Name **SOLUTION**

First Name _____

ID # _____

This is a closed book exam. I understand, pursuant to University Regulations on academic honesty, that I am not to use any notes or consult with peers during the examination.

Signature _____

For multiple choice questions, please make sure that you circle the letter for the answer which you believe to be correct and only that answer. If more than one answer is circled for the same problem or there are any ambiguities, you will not receive credit for it. Don't get hung up on questions. They should take only one or two minutes each. If you find yourself spending more than a few minutes on a multiple choice question you are probably looking at it the wrong way. You should skip it for now and come back to it later.

For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

Relax, read carefully, think – and then read everything again.

During the exam, if you have questions please raise your hand and the TA or the instructor will come to you and provide help.

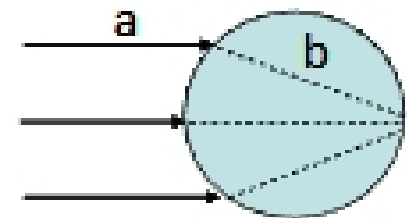
1. (5 points) Two plane mirrors form a right angle. How many images of the object can you see in the mirrors?

- a) 1
- b) 2
- c) 3
- d) 4



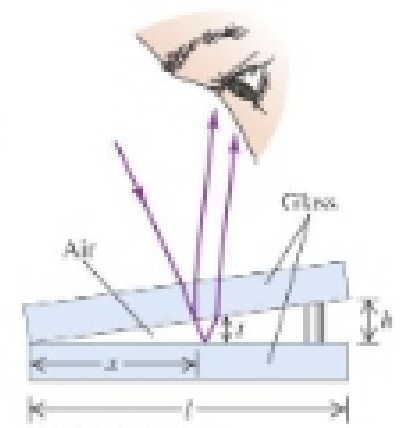
2. (5 points) A transparent sphere of unknown composition is observed to form an image of the Sun on the surface of the sphere opposite the sun. What is the refractive index of the material? (use $n_{\text{air}} = 1$)

- a) 1
- b) 2
- c) ∞
- d) not enough information is given



3. (5 points) An air wedge separates two glass plates as shown. Light of wavelength λ strikes the upper plate at normal incidence. At a point where the air wedge has thickness t , you will see a bright fringe if t equals

- a) $\lambda/2$
 - b) $\lambda/4$
 - c) $3\lambda/4$
 - d) Either b) or c)
- 2 points for (b); 2 points for (c) and 5 points for (d)

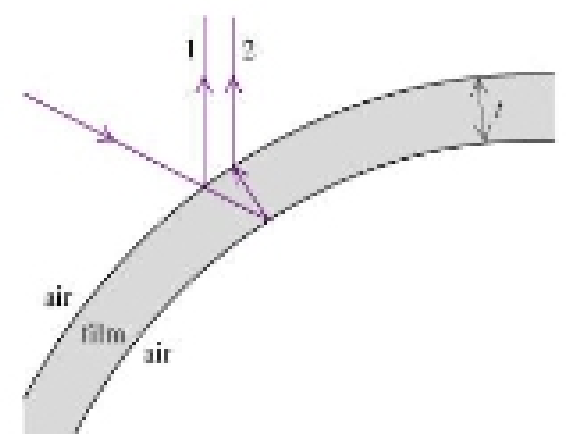


4. (5 points) A spaceship traveling at constant speed passes by Earth and later passes by Mars. In which frame of reference is the amount of time separating these two events the proper time?

- a) any inertial frame of reference
- b) the spaceship frame of reference
- c) the Mars frame of reference
- d) the Earth frame of reference

5. (5 points) Which of the following statements correctly describes rays 1 and 2 and their phase/path difference?

- a) Both rays 1 and 2 undergo a half-cycle phase shift
- b) Ray 1 undergoes a half-cycle phase shift. Ray 2 does not undergo any phase shift.
- c) Ray 2 undergoes a half-cycle phase shift. Ray 1 does not undergo any phase shift
- d) There is no path difference between the two rays.



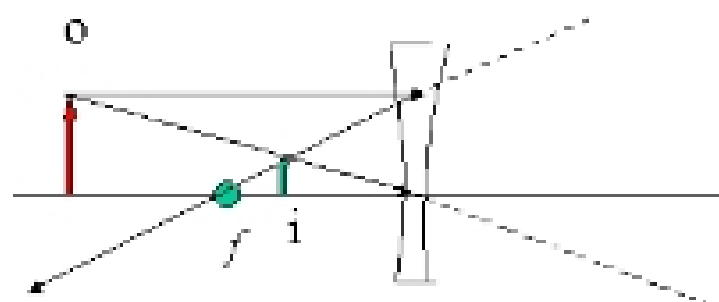
Problem 6

14 points (a) A diverging lens with a focal length of 50 cm is placed 100 cm from a flower. Where is the image formed? What is its magnification? Is the image inverted or upright? Draw a schematic ray diagram to confirm your answer. [Points will be deducted if the ray diagram is not neatly drawn!]

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

$$\frac{1}{100} + \frac{1}{s'} = \frac{1}{-50}$$

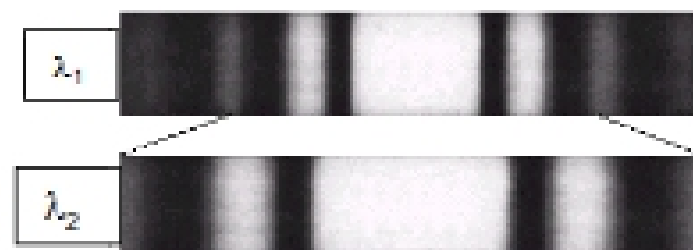
$$s' = -33.3 \text{ cm}$$



$$M = -(s'/s) = +0.33$$

The image is formed 33.3 cm in front of the lens. It is reduced (magnification = 0.33) and is upright.

8 points (b) The figure shows two single-slit diffraction patterns. The distance between the slit and the viewing screen is the same in both cases. Which of the following could be true or false? Briefly explain. [note: λ_1 , λ_2 refer to the wavelengths of the top and the bottom patterns, respectively; a_1 and a_2 refer to their slit-width, respectively.]



- a. The slits are the same for both; $\lambda_1 > \lambda_2$ FALSE
- b. The slits are the same for both; $\lambda_2 > \lambda_1$ TRUE
- c. The wavelengths are the same for both; $a_1 > a_2$ TRUE
- d. The wavelengths are the same for both; $a_2 > a_1$ FALSE

The width of the diffraction pattern is proportional to “ λ ” and inversely prop. to “ a ”. Therefore, only (b) and (c) can be true.

8 points (c) A spacecraft of the Trade Federation flies past the planet Coruscant at a speed of 0.590 c. A scientist on Coruscant measures the length of the moving spacecraft to be 79.0 m. The spacecraft later lands on Coruscant, and the same scientist measures the length of the now stationary spacecraft. What is the length of the spacecraft that the scientist now measures?

For the stationary spacecraft the scientist measures the proper length.

$$L = L_0 \sqrt{1 - v^2 / c^2}$$

$$L_0 = 79 / \sqrt{1 - (0.59c / c)^2} = 97.8 \text{ m}$$