

Physics 235 Fall 2013: Exam 3 Form #1

**You must enter your form number on
your scantron key field to receive your score.**

Please Print Your Name: _____

Instructions

1. Fill in your name above
2. Fill in your **name**, **ID number**, and **form number** on your scantron sheet
3. This will be a one hour and 50 minute (110 minute), closed book exam.
4. You may use a calculator, please do not share calculators.
5. The exam includes 20 multiple choice questions which will be machine graded. Each question is worth 5 points. No partial credit will be given.
6. For this exam, you can bring *three* 3×5" index cards with any notes you wish to have. You may use a ruler if you wish. You will also find all the physical constants that you might require listed below.
7. **Please take your exam booklet with you and keep it safe and unaltered.**

Constants you might need:

$$k = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$$

$$g = 9.8 \text{ m/s}^2$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$$

$$\text{Mass of the electron: } 9.11 \times 10^{-31} \text{ kg}$$

$$\text{Magnitude of the electron charge: } 1.6 \times 10^{-19} \text{ C}$$

$$\text{Mass of the proton: } 1.67 \times 10^{-27} \text{ kg}$$

$$\text{Atomic Mass Unit (1 AMU): } 1.66 \times 10^{-27} \text{ kg}$$

$$1 \text{ Gauss} = 10^{-4} \text{ T}$$

$$\text{Speed of sound in air} = 340 \text{ m/s}$$

$$\text{Threshold of hearing } I_0 = 10^{-12} \text{ W/m}^2$$

$$\text{Speed of light in vacuum} = 3.0 \times 10^8 \text{ m/s}$$

$$k_B = 1.38 \times 10^{-23} \text{ m}^2\text{kg/s}^2\text{K} = 1.38 \times 10^{-23} \text{ J/K}$$

$$\sigma = 5.7 \times 10^{-8} \text{ W/m}^2\text{K}^4$$

$$0 \text{ }^\circ\text{C} = 273.15 \text{ K}$$

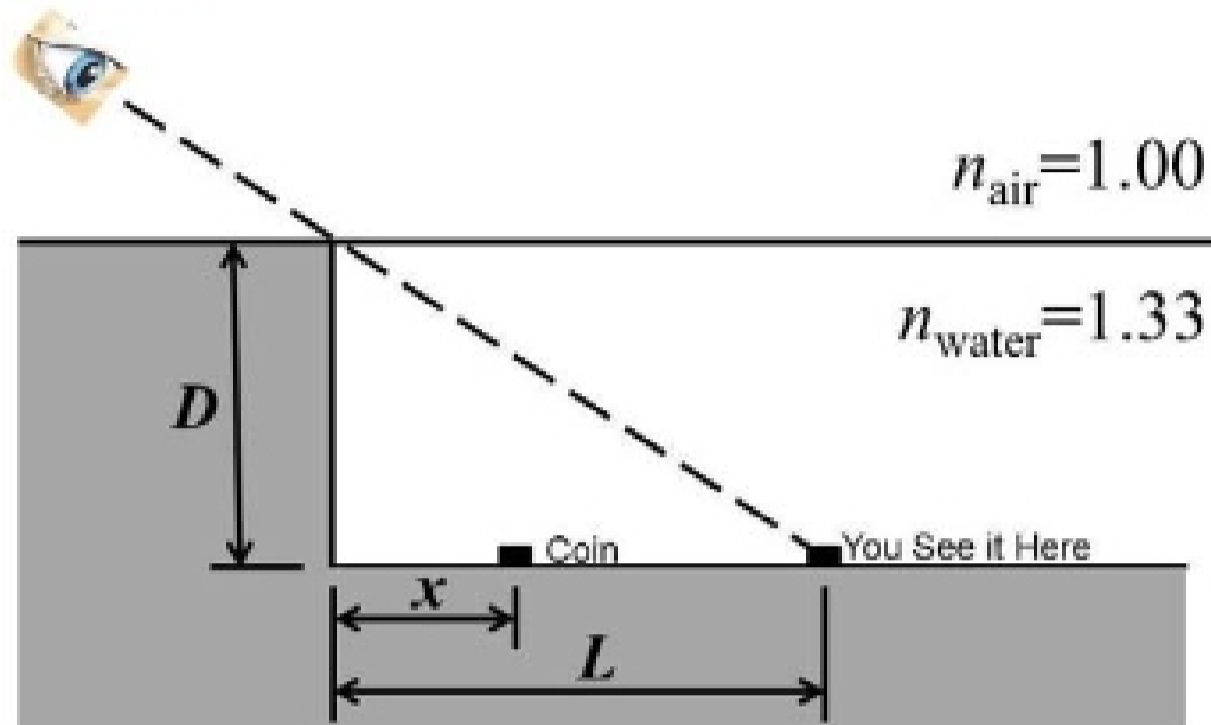
$$1 \text{ electron volt (1eV)} = 1.6 \times 10^{-19} \text{ J}$$

$$\text{Astronomical Unit (1AU)} = 1.5 \times 10^{11} \text{ m}$$

$$1 \text{ Light Year} = 9.47 \times 10^{15} \text{ m}$$

$$1 \text{ Parsec} = 3.3 \text{ Light Years}$$

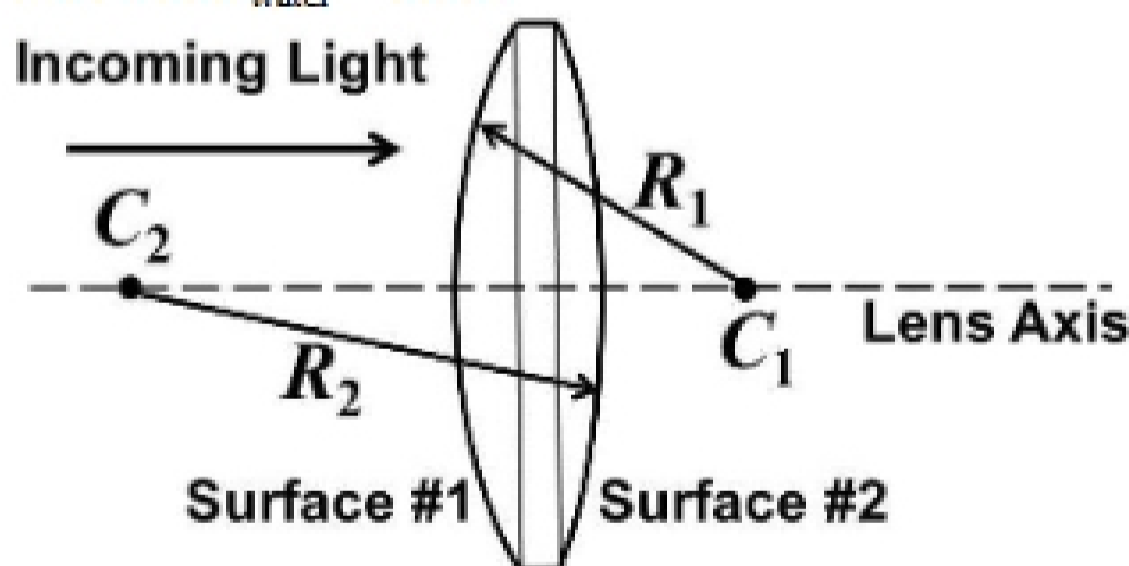
1. While passing a fountain in Rome, you notice a coin which appears to be at a distance $L = 6.0$ m from the edge of the fountain pool. The coin is lying on the bottom of the pool at a depth $D = 1.50$ m. What is the actual distance x from the coin to the edge of the pool?



This Drawing is Not to Scale!

- A) 3.1 m
- B) 1.3 m
- C) 2.2 m
- D) 1.6 m
- E) 2.7 m

2. A simple biconvex lens has a radius of curvature $R_1 = 16.0$ cm ground onto the *first* surface of the lens. The refractive index of the glass used to make the lens is $n_{\text{glass}} = 1.50$. What radius of curvature R_2 is required on the *second* surface to produce a lens with an optical power of $+1.50$ diopters when it is used in *water* with a refractive index of $n_{\text{water}} = 1.33$?

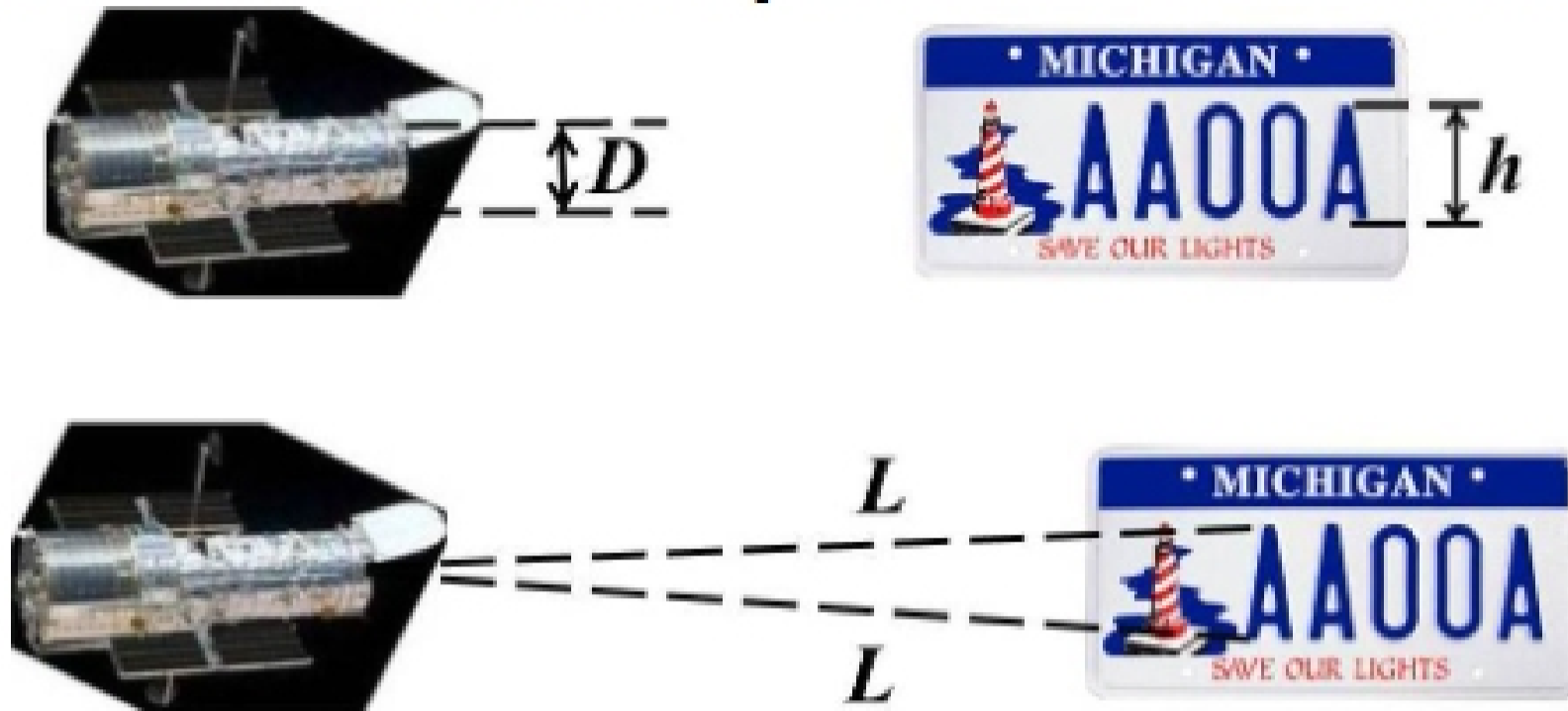


Biconvex Lens



- A) 18.2 cm
- B) 20.3 cm
- C) 23.4 cm
- D) 28.1 cm
- E) 30.5 cm

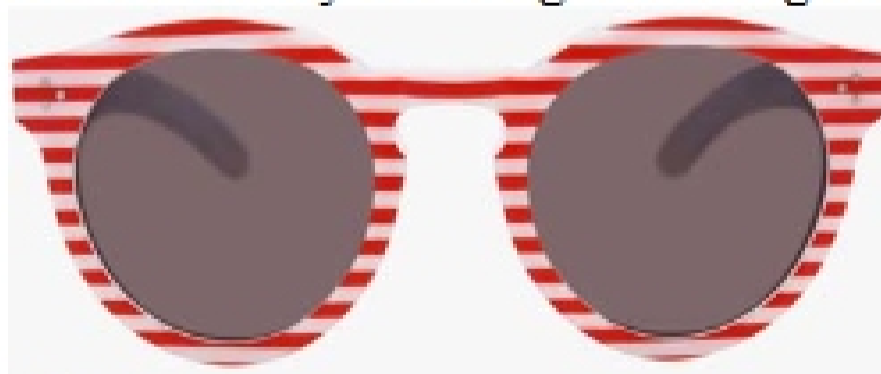
3. The objective mirror of a spy satellite has a diameter $D = 2.8$ m. The satellite camera captures images using light with a wavelength of 400 nm. The letters on an automobile license plate have a height $h = 7.0$ cm. What is the maximum distance L at which the letters on a license plate can be clearly resolved in a spy satellite image? You may assume that the distance L corresponds to the diffraction limit of the objective mirror.



This Drawing is Not to Scale!

- A) 371 km
- B) 402 km
- C) 283 km
- D) 127 km
- E) 105 km

4. Unpolarized light falls on a linear polarizer with its optic axis aligned vertically. It then passes through a second polarizer with its optic axis aligned at 30 degrees to the vertical and finally through a third polarizer with its optic axis aligned at 90 degrees to the vertical. What is the ratio of the intensity of the light emerging from the third polarizer to the intensity of the light entering the first?



- A) 0.486
- B) 0.342
- C) 0.267
- D) 0.138
- E) 0.094