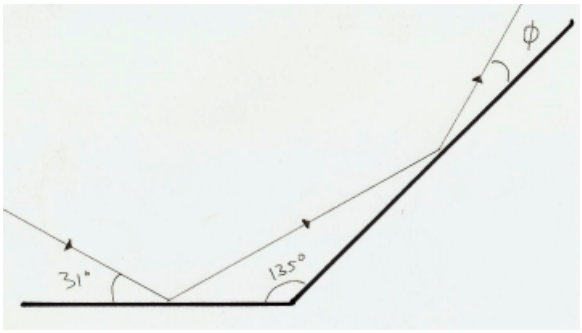
Physics 9, Fall 2018, Homework #5.

Due at start of class on Friday, October 19, 2018

Problems marked with (*) must include your own drawing or graph representing the problem and at least one complete sentence describing your reasoning.

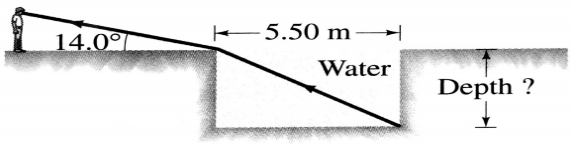
Problems for Giancoli Chapter 23 (Geometric optics)

1. Two mirrors meet at a 135° angle. If light rays strike one mirror at 31°, as shown in the figure, at what angle ϕ do they leave the second mirror?

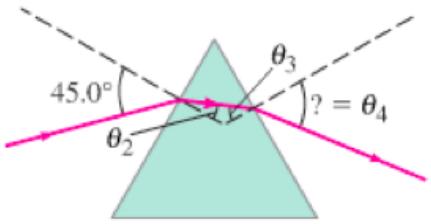


2*. A diver shines a waterproof laser pointer upward from beneath the water at a 35° angle with respect to the vertical. At what angle (w.r.t. vertical) does the light leave the water? Draw a diagram showing the water surface, the incident ray, the reflected ray, and the refracted (transmitted) ray. Indicate all angles.

3. We wish to determine the depth of a swimming pool filled with water. We measure the width ($x = 5.50$ m) and then note that the bottom edge of the pool is just visible at an angle of 14.0° above the horizontal. Calculate the depth of the pool.



4. Light is incident on an equilateral glass prism at a 45° angle to one face, as shown in the figure. Find the angle (with respect to the surface normal) at which light emerges from the opposite face. Use $n = 1.58$.



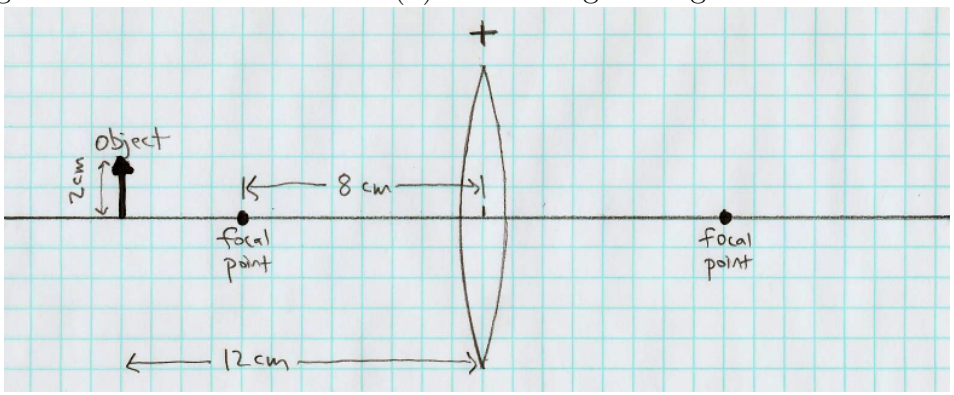
5*. If you look at yourself in a shiny Christmas tree ball with a diameter of 9.0 cm when your face is 30.0 cm away from it, where is your image? Is it real or vitual? Is

it upright or inverted?

6. Some rearview mirrors produce images of cars behind you that are smaller than they would be if the mirror were flat. Are the mirrors concave or convex? What is a mirror's radius of curvature if cars 20 m away appear one-third of their normal size?

7. A beam of light is emitted in a pool of water from a depth of 1.0 m. Where must the light strike the air-water interface, relative to the spot directly above it, in order to ensure that *no* light exits the water (i.e. to ensure that *all* of the light is reflected back down into the water)?

8*. An object that is 2.0 cm tall is placed 12 cm to the left of a converging lens whose focal length is 8.0 cm, as shown in the figure. (a) Draw a scale diagram, including the three easy-to-draw rays from object to image. (b) Is the image real or virtual? (c) Is the image inverted or non-inverted? (d) Is the image enlarged or reduced?



9. Use the thin-lens equation to check your answer to the previous problem, i.e. use equations to calculate the image position and the magnification.

10*. Sunlight is observed to focus at a point 30 cm behind a lens. (a) Draw a ray diagram for this situation. (The sun is so far away that you can consider all of the incoming rays to be parallel to each other.) (b) Is the lens converging or diverging? (c) Is the lens convex or concave? (d) What is the lens's focal length in meters? (e) What is its focusing strength in diopters? (And is it positive or negative?)

XC1*. Optional/extra-credit. In a movie projector, the film acts as the object whose image is projected onto a screen. If a lens of 105 mm focal length is to project an image onto a screen 8.00 m away, how far from the lens should the film be? If the film is 35 mm wide, how wide will the picture be on the screen?

Remember **online response** at `positron.hep.upenn.edu/wja/jitt/?date=2018-10-19`