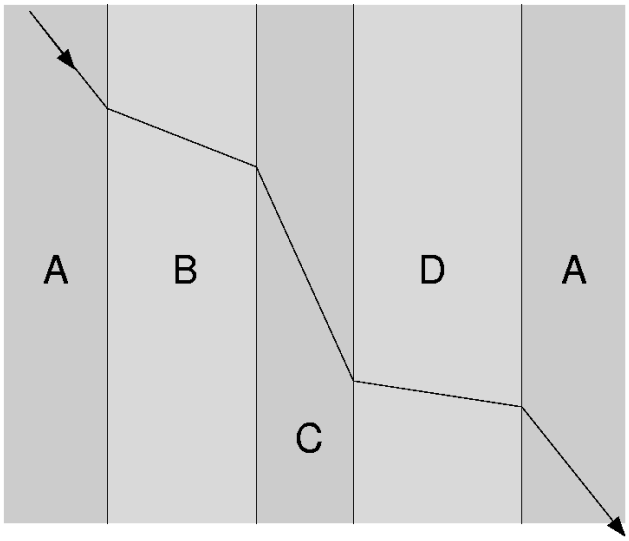
PHY138Y
Physics Department

Waves Assignment 4
Due December 6, 2004

Prof. Jason Harlow
University of Toronto

Please complete the following problems on separate paper. Show all your work legibly, and draw a box around the final numerical answer where applicable. Use one staple in the upper left-hand corner to connect multiple pages, and slip the entire assignment in the drop-box for your Tutorial Section at the bottom of the stairs of Burton Tower in McLennan Physical Laboratories (MP). Assignments must be in the box by 5:00 PM on the due date.

Supplemental Problem:



In the sketch above, a light ray, shown by the black jagged line, travels from material A, through three layers of other transparent materials, then back into another layer of material A. The surfaces between the materials are all parallel to one another. The refractions (but not the associated reflections) at the surfaces are shown. Rank the materials according to their indices of refraction, greatest first.

From the Textbook:

25.11, 25.30, 26.3

Some suggested problems from the Textbook (not to be turned in):

Questions 2, 4 and 12 on page 957
Problems 25.3, 25.7, 25.27, 25.31
Questions 10 and 22 on page 994
Problems 26.23, 26.27, 26.33, 26.39

Some PHY138Y Laboratories that relate somewhat to this material:

Refraction of Light (non-core)
Spectra (core)
Optical Fibres (non-core)

Suggested Supplemental Problem (not to be turned in):

The human eye has a diameter of 3 cm. It can be modeled as a lens of focal length f_2 , 3 cm in front of a retina, onto which an image is projected. If the image of the object is projected exactly onto the retina, a crisp image is seen. If the image of the object is projected in front of or behind the retina, the light that falls on the retina will not be in focus, and a blurred image will be seen.

Part 1: The far-sighted eye. Consider a person with a lens with focal length f_2=2.94 cm, who is trying to focus on an object that is 21 cm in front of the lens of her eye. Find the location of the image. Is it exactly 3 cm beyond the lens, and therefore on the retina?

Part 2: A converging corrective lens. Now consider the situation depicted in the diagram below. A converging lens of focal length f_1=23.2 cm is placed 20 cm to the right of an object. 1 cm to the right of this first lens is the lens of an eye, with f_2=2.94 cm.

a) Where is the image formed by the first lens? Is it *real* or *virtual*?
b) Following the procedure described in the final paragraphs of Section 25.4 in Serway and Jewett, make the image of the first lens the object of the second lens. How far in front of the second lens is this object?
c) Compute the location of the final image formed by the second lens. Is it exactly 3 cm beyond the lens, and therefore on the retina?