UCA Department of Physics and Astronomy

PHYS 3345: OPTICS

Assignment 04: Chapter 04
DUE: February 15, 2008

Work each problem neatly and completely. Unless otherwise noted, each problem is worth **5 points**. You should solve on green engineering paper or blank unruled paper. You must include sufficient demonstration of your problem solving process. If a problem is to be solved by inspection, state this.

1. Hecht, problem 4.32
2. A beam of light in air (index n_i) strikes a pane of glass (thickness d, index n_t) at an angle θ_i. The beam emerges through the pane. Show that the displacement of the emergent beam is

$$a = \left(d \sin\theta_i\right)\left[1 - \frac{n_i \cos\theta_i}{n_t \cos\theta_t}\right]$$

3. Hecht, problem 4.10
   Note: the sketch does not accurately represent what is happening. If you assume that the direction in which the ray bends is correct, then the transmitting medium has a higher index than the incident medium. What exactly is incorrect about the construction?
4. (3 points) Hecht, problem 4.40
5. (2 points) Hecht, problem 4.42
6. (3 points) Hecht, Problem 4.44
7. Hecht, Problem 4.51

Although they are *not* formally assigned, you should be able to work any of the following problems from the Hecht textbook without difficulty: 6–9, 11–25, 38, 43, 45, 52, 54–58, 60. Most of these are probably the sort of problems you have already seen and worked.

Review Questions

These are not assigned for grading, but they are the sort of conceptual questions that you should be able to address adequately if they were to show up on an exam.

1. For incident frequencies less than ω_o, why is the speed of transmitted light through a dielectric medium less than c?
2. Hecht, problem 4.28.
3. Distinguish between Rayleigh and Mie scattering.
4. Why does a transparent (colorless) medium reflect all visible frequencies equally?
5. Distinguish between specular and diffuse reflection.
6. Briefly explain the Huygens Principle. Why is this useful? What are some limitations?
7. Know Fermat's Principle, and how to use it to derive the laws of reflection and refraction.
8. For the transmission of an e·m wave at the interface between two media, what boundary conditions must always be met?
9. Figure 4.44: means what!?!?
10. Distinguish between the Fresnel equations for amplitude reflection coefficient ($r_{||}$ and $r_{\perp}$) and the reflectance R.
11. Distinguish between the Fresnel equations for amplitude transmission coefficient ($t_{||}$ and $t_{\perp}$) and the transmittance T.