

Homework 1

Due Thursday, February 9th in class

Already covered: Hecht Ch. 4, sections 4.1-4.2.2, 4.4.2-4.6. For the coming week read Hecht Ch 5, sections 5.1-5.4.

1. In class we used Fermat's principle to derive Snell's law for a ray of light going from air into glass. Instead assume that a water proof flashlight is placed a depth h below the surface of a smooth lake. The water has index of refraction n_w and the air above has index of refraction n_a .

(a) Use Fermat's principle to derive the critical angle θ_c (with respect to the normal of the surface) at which you should shine the flashlight to have the resulting ray skim the surface and hit a detector floating on the lake.

(b) Look up reasonable values for n_w and n_a and calculate the value of θ_c .

(c) If you further tilt the flashlight to $\theta > \theta_c$ what does the ray do? Again apply Fermat's principle to relate the angle of the ray before meeting the surface to that after. (The figure at right illustrates this lovely phenomenon.)



2. Hecht (a) Problem 4.8 and (b) Problem 4.9.

3. Hecht Problem 4.10.

4. Hecht (a) Problem 4.18 and (b) Problem 4.22.

5. Hecht Problem 4.24.

6. Hecht Problems 4.30 & 4.32.

7. Hecht Problems 4.38 & 4.40.