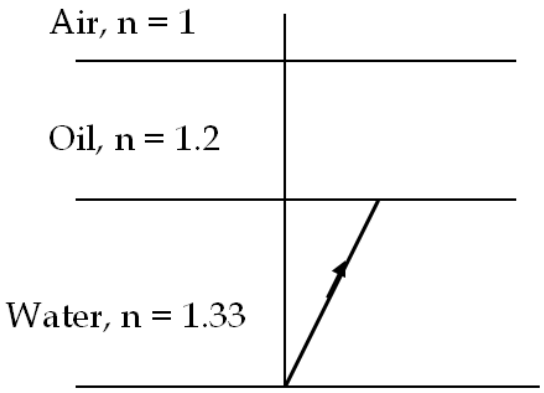

Figure 1.28: Problem 1.6.3.

1.6 PROBLEMS

Problem 1.6.1. Refer to the Fizeau's experiment shown in Fig. 1.5. Prove that the speed of light will be equal to $2nNd$, where N is the total number of teeth in the wheel, n is the rotation rate of the wheel in number of revolutions per second, and d is the distance from the apparatus to the mirror.

Problem 1.6.2. Refer to the Michelson's apparatus for measuring the speed of light shown in Fig. 1.7. Prove that the speed of light will be equal to $16nd$, where n is the rotation rate of the octagon mirror in the number of revolutions per second, and d is the distance from rotating mirror to the fixed mirror on the Lookout Mountain. Ignore the distance between the curved mirror and the flat mirror on the Lookout Mountain.

Problem 1.6.3. A small light bulb is at the bottom of a tank that has a layer of water and a layer of oil as shown in Fig. 1.28. Find the path of the ray shown as it comes out in the air. Use a protractor to measure the angle(s). Ans: $\theta_{\text{oil}} = 30°$, $\theta_{\text{air}} = 37°$.

Problem 1.6.4. A plastic plate as shown in Fig. 1.29 is immersed in oil. Find the incident angle so that the ray comes out vertically from the base of the plate. (Use $n = 1.6$ for plastic and $n = 1.3$ for oil.) Hint: Start from the exiting ray and work backwards.

Problem 1.6.5. A yellow light of wavelength 589 nm in air is incident on a flint-glass hexagonal prism as shown in Fig. 1.30. Find the path of the ray through the prism and determine the edge(s) the light will come out if the refractive index of glass is 1.58. If the ray suffers multiple reflections within the glass, trace rays that have at least two reflections.

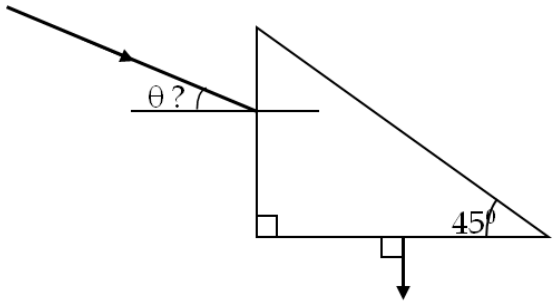

Figure 1.29: Problem 1.6.4.

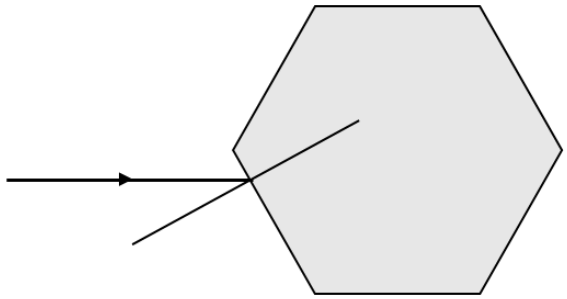

Figure 1.30: Problem 1.6.5.

Problem 1.6.6. A student puts together two equilateral triangular prisms as shown in Fig. 1.31. He claims that the prism will converge rays just like a converging lens. Find the paths of the two rays through the prisms to decide if he is right. Hint: The rays will bend towards each other on the other side.

Problem 1.6.7. A ray of light consisting of a red and a blue light is incident on a glass circular plate parallel to a diameter. If the refractive indices of red and blue lights for the given glass are 1.5 and 1.55 respectively, find the first place where each ray would come out of the glass plate and the directions of the red and blue lights in

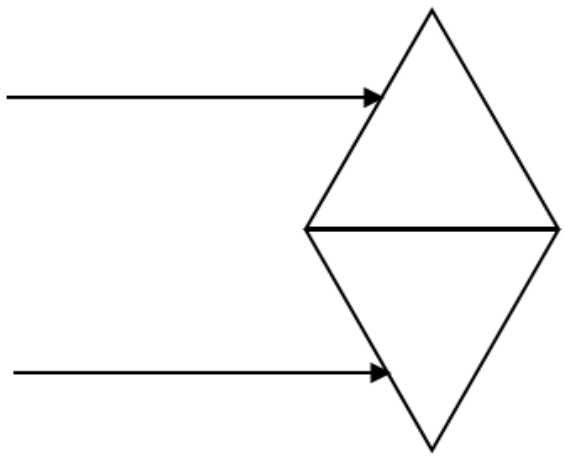

Figure 1.31: Problem 1.6.6.

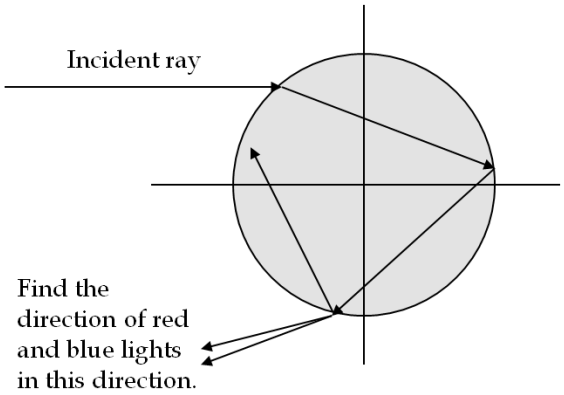

Figure 1.32: Problem 1.6.8.

which they will emerge.

Problem 1.6.8. (a) Trace the separation of a mixture of red and blue light rays in air when they strike a spherical drop of water shown in Fig. 1.32. Use the following refractive indices for the red and violet lights in water as 1.33 and 1.343 respectively. (b) How can you apply the results of this problem to understand **rainbow**?