REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

(a) Calculate the critical angle for total internal reflection for a diamond (n = 2.40) immersed in water (n = 1.33).

\[ \sin \theta_c = \frac{n_2}{n_1} \quad \Rightarrow \quad \theta_c = \sin^{-1} \left( \frac{1.33}{2.40} \right) = 33.7° \]

(b) Light is incident from water (n = 1.33) on glass (n = 1.55) at an angle of 33.0°. What is the angle of refraction in the glass?

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad \Rightarrow \quad \theta_2 = \sin^{-1} \left( \frac{n_1}{n_2} \sin \theta_1 \right) = 27.9° \]

(c) A Young's two-slit interference experiment is performed with monochromatic light. The separation between the slits is 0.750 mm, and the interference pattern on a screen 4.25 m away shows the first side maximum 3.25 mm from the center of the pattern. What is the wavelength of the incident light?

\[ y_{\text{bright}} = \frac{\lambda L}{d} \quad \frac{L = 4.25 \text{ m}}{d = 0.750 \times 10^{-3} \text{ m}} \quad \Rightarrow \quad \lambda = \frac{y_{\text{bright}} d}{mL} = 574 \text{ nm} \]

(d) A soap film (n = 1.33) is viewed in reflection at perpendicular incidence. Bright reflection is observed with a wavelength of \( \lambda = 650 \text{ nm} \). What is the minimum thickness of the soap film from this information?

\[ \text{CONSTRUCTIVE INTERFERENCE} \quad 2n t = (m + \frac{1}{2})\lambda \quad \Rightarrow \quad t = \frac{\lambda}{4n} = 122 \text{ nm} \]

(e) A concave spherical mirror has a radius of curvature of 1.30 m. Calculate the position of the image of an object 1.55 m away from the mirror. Distances are measured along the optic axis.

\[ \frac{1}{p} + \frac{1}{q} = \frac{2}{R} \quad \Rightarrow \quad q = \left( \frac{2}{R} - \frac{1}{p} \right)^{-1} = 1.12 \text{ m} \]