

**SECOND MIDTERM**

Name (print) HARYANTO Name (signed) X = 17.7

Discussion Instructor (circle one): Chen Emerson Iguchi Stoops  $\sigma = 4.89$

Discussion Section # \_\_\_\_\_

**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 ( $n = 2.42$ ) in water ( $n = 1.33$ ).

$$\left. \begin{aligned} n_1 \sin \theta_1 &= n_2 \sin \theta_2 \\ \sin \theta_1 &= 1 \end{aligned} \right\} \sin \theta_2 = \frac{1.33}{2.42} \Rightarrow \theta_2 = 33.3^\circ$$

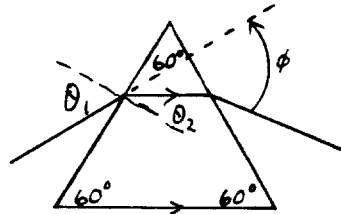
- (b) Green light in air has a wavelength of 500 nm. Calculate its wavelength in diamond.

$$\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1} \Rightarrow \lambda_2 = \lambda_1 \frac{n_1}{n_2} = 500 \cdot \frac{1}{2.42} \Rightarrow \lambda_2 = 207 \text{ nm}$$

- (c) An organ pipe 9.00 feet long has one end open and one end closed. Calculate the frequency of the first resonant mode above the fundamental. Take the speed of sound as 1100 ft/s.

$$L = \frac{3}{4} \lambda \quad v = f \lambda \Rightarrow f = \frac{3v}{4L} = \frac{3 \cdot 1100}{4 \cdot 9} \Rightarrow f = 91.7 \text{ Hz}$$

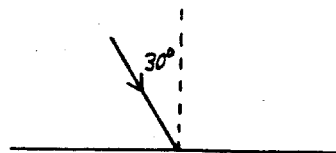
- (d) Light is incident on the prism shown at the angle of minimum deviation. Take the index of the prism as  $n = 1.65$ , and calculate  $\phi$ , the angle of deviation.



$$\left. \begin{aligned} n_1 \sin \theta_1 &= n_2 \sin \theta_2 \\ 1 \cdot \sin \theta_1 &= 1.65 \cdot \frac{1}{2} \end{aligned} \right\} \theta_1 = 55.6^\circ$$

$$\phi = 2(\theta_1 - \theta_2) \Rightarrow \phi = 51.2^\circ$$

- (e) Sunlight is incident at an angle of  $30^\circ$  from the vertical on the physics parking lot. If  $S_{AV} = 750 \text{ W/m}^2$ , and the parking lot has an area of  $100 \text{ m}^2$ , calculate the radiation force on the lot assuming complete absorption.



$$\left. \begin{aligned} S_{\perp} A &= F C \\ S_{\perp} &= S_{AV} \cos 30^\circ \end{aligned} \right\} F = \frac{S_{AV} \cos 30^\circ A}{C} = \frac{750 \cdot \cos 30^\circ \cdot 100}{3 \cdot 10^8}$$

$$F = 2.17 \times 10^{-4} \text{ N}$$