

# SIXTH MIDTERM

# 1

Name: \_\_\_\_\_

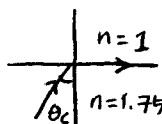
Discussion Instructor (circle): Billeter      Blake      Gillman      Herring

Student ID #: \_\_\_\_\_

**REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!**

Use the conversion constants and data given on the front page.

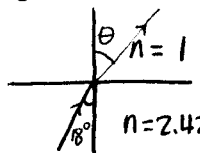
- 5 (a) Calculate the critical angle for total internal reflection for a high-index glass with index of refraction  $n = 1.75$ .


$$\sin \theta_c = \frac{1}{1.75} = 0.57, \quad \theta_c = 34.8^\circ$$

- 5 (b) A green laser has a wavelength of 500 nm in air. Calculate the wavelength of this light in a diamond ( $n = 2.42$ ).

$$\frac{\lambda_2}{\lambda_1} = \frac{n_1}{n_2} \quad \lambda_2 = \frac{500 \text{ nm}}{2.42} = 207 \text{ nm}$$

- 5 (c) Light approaches the surface of a diamond from inside the diamond at an angle of incidence of  $18.0^\circ$ . At what angle does it leave the diamond in air ( $n = 2.42$ )?


$$\sin \theta = 2.42 \times \sin 18^\circ = 0.748, \quad \theta = 48.4^\circ$$

- 5 (d) A diffraction grating has 6000 lines/cm. Green laser light ( $\lambda = 500 \text{ nm}$ ) is sent through this grating at normal incidence. At what angle does the third order bright spot come out?

$$d = \frac{1}{6000} = 1.67 \times 10^{-6} \text{ m}, \quad \sin \theta = \frac{3\lambda}{d} = \frac{3 \times 500 \times 10^{-9}}{1.67 \times 10^{-6}} = 0.898$$
$$\theta = 63.9^\circ$$

- 5 (e) Calculate the polarizing angle at the glass-water interface for glass ( $n = 1.55$ ) immersed in water ( $n = 1.33$ ).

$$\tan \theta_p = \frac{n_2}{n_1} = \frac{1.55}{1.33} = 1.165, \quad \theta_p = 49.4^\circ$$

