SIXTH MIDTERM

Name: ___________________________ Student ID #: ____________

Discussion Instructor (circle): Barcikowski El-Gendi Johnson Rodriguez

5 points each - no partial credit

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 high index glass with \( n = 1.72 \).

\[
\sin \theta_c = \frac{n_{air}}{n} \quad \theta_c = \sin^{-1} \left( \frac{1}{1.72} \right) = 35.5^\circ
\]

(b) Yellow light has a wavelength of 590 nm in air. Calculate its wavelength in diamond \( (n = 2.42) \).

\[
\lambda = \frac{\lambda_{air}}{n_{diamond}} = \frac{590 \text{ nm}}{2.42} = 244 \text{ nm}
\]

(c) In a two slit interference experiment, light of \( \lambda = 650 \text{ nm} \) is perpendicularly incident on two slits that have a separation of 0.175 mm. Calculate the displacement from the center of the pattern on a screen 4.50 m away to the next bright spot.

\[
Y_{bright} = \left( \frac{\lambda L}{d} \right)_m = \left( \frac{650 \text{ nm} (4.5)}{0.175 \times 10^{-3} \text{ m}} \right)_1 = 1.67 \text{ cm}
\]

(d) Light approaches the surface of a diamond \( (n = 2.42) \) from inside at an angle of incidence of 16.0°. What is the angle in air for the emergent beam?

\[
\sin \theta_1 : \sin \theta_2 \quad \theta_1 = \sin^{-1} \left( \frac{n_d \sin \theta_2}{n_{air}} \right) = 41.8^\circ
\]

(e) White light is incident on a soap film whose thickness is 0.0132 mm. Calculate the wavelength separation for two bright colors in reflection near \( \lambda = 500 \text{ nm} \). The soap film has index \( n = 1.33 \).

\[
\ell = 0.0132 \times 10^{-3} \text{ m} \quad 2n \ell = (m + \frac{1}{2}) \lambda \quad \frac{m \ell}{\lambda} = \frac{c}{2} = 69.7 \text{ nm}
\]

White light is incident on a soap film whose thickness is 0.0132 mm. Calculate the wavelength separation for two bright colors in reflection near \( \lambda = 500 \text{ nm} \). The soap film has index \( n = 1.33 \).

\[
\ell = \frac{2n \ell}{\lambda} = \frac{498}{505} \quad \frac{c}{2} = 69.7 \text{ nm}
\]

\[
\lambda = \frac{2n \ell}{\lambda} = \frac{505}{498} \quad \frac{c}{2} = 7 \text{ nm}
\]

505 - 498 = 7 nm

\[
\frac{6.8}{7.2} \text{ nm, accepted}
\]