

PHYS 222 –Spring 2012 – Quiz # 8

Closed books, notes, etc. No electronic device except a calculator.

NAME: SBM

(questions with equal weight, i.e. 20 points each)

1. Which of the following describes what will happen to a light ray incident on an air-to-glass boundary (with light incident from the air side)?

- a. total reflection
- b. total transmission
- c. partial reflection, partial transmission
- d. partial reflection, total transmission

2. A monochromatic beam of light in air has a wavelength of 589 nm in air. It passes through glass ( $n = 1.52$ ) and then through carbon disulfide ( $n = 1.63$ ). What is its wavelength in the carbon disulfide?

- a. 361 nm
- b. 387.5 nm
- c. 895 nm
- d. 960 nm

$$\lambda_0 = 589 \text{ nm in air } (n_1 = 1.00)$$

$$\lambda_2 = ? , n_2 = 1.63 \text{ (carbon disulfide)}$$

$$n_1 \lambda_0 = n_2 \lambda_2 \Rightarrow \lambda_2 = \frac{n_1 \lambda_0}{n_2}$$

$$\Rightarrow \lambda_2 = \frac{1.00 \times 589 \text{ nm}}{1.63} \approx 361.3 \text{ nm}$$

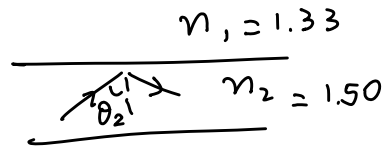
3. A fiber optic cable ( $n = 1.50$ ) is submerged in water ( $n = 1.33$ ). What is the critical angle for light to stay inside the cable?

a.  $83.1^\circ$

b.  $62.5^\circ$

c.  $41.8^\circ$

d.  $27.6^\circ$



$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\text{when } \theta_1 = 90^\circ \Rightarrow \theta_2 = \theta_c$$

$$\Rightarrow \sin \theta_c = \frac{n_1 \sin(90^\circ)}{n_2} = \frac{n_1}{n_2} = \frac{1.33}{1.50}$$

$$\theta_c = \sin^{-1}\left(\frac{1.33}{1.50}\right) = 62.5^\circ$$

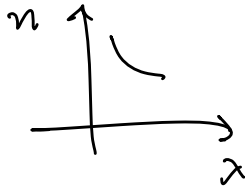
4. When white light disperses as it passes through a prism, which of the following colors moves at the lowest speed in the prism? Consider that the refractive index decreases for longer wavelengths.

a. blue

b. green

c. yellow

d. red



higher " $n$ "  $\Rightarrow$  lower " $v$ " because

$$v = \frac{c}{n}$$

higher  $n$  at shorter " $\lambda$ "

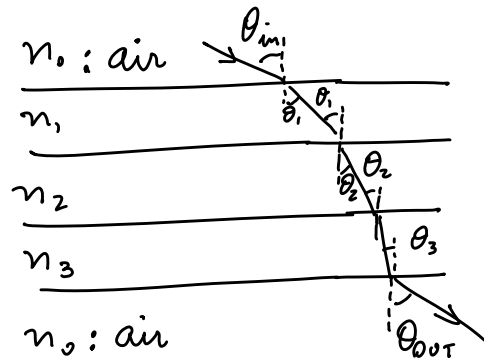
5. Three materials with  $n_1 < n_2 < n_3$  are arranged in layers of uniform thickness. A light ray in air enters the first layer at an angle of incidence of  $30^\circ$  and the ray eventually exits the third layer at the refracted angle  $\theta$  in air. What is the value of  $\theta$ ?

a. Some angle less than  $30^\circ$ .

b.  $30^\circ$ .

c. Some angle more than  $30^\circ$ .

d. Insufficient information to answer.



$$\underline{\underline{n_0 \sin \theta_{in} = n_1 \sin \theta_1 = n_2 \sin \theta_2 = n_3 \sin \theta_3 = n_0 \sin \theta_{out}}}$$

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$$\sin \theta_{in} = \sin \theta_{out} \Rightarrow \theta_{in} = \theta_{out} = 30^\circ$$