

# SIXTH MIDTERM

3

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

Discussion Instructor (circle): Billeter      Blake      Gillman      Herring

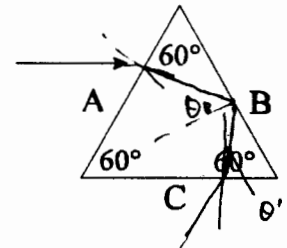
Student ID #: \_\_\_\_\_

**SHOW ALL WORK!!!!**

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

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

A 60°-60°-60° prism is made of diamond (n = 2.42)! light is incident parallel to the base as shown.



- (a) Calculate the direction inside the prism, measured as an angle (specify clockwise or counterclockwise) from the incident beam, that the light travels after entering the prism.
- (b) Determine from which face A, B or C, the light emerges from the prism.
- (c) Calculate the direction, with respect to the normal of that face (A, B or C), for the emergent beam.

a)  $\frac{\sin 30^\circ}{\sin \theta} = \frac{n_{\text{prism}}}{n_{\text{air}}} = 2.42 \Rightarrow \sin \theta = 0.2066$   
 $\theta = 11.9^\circ$   
 $30^\circ - 11.9^\circ = 18.1^\circ$  (clockwise)

b) critical angle  $\theta_c$

$$\frac{\sin \theta_c}{\sin 90^\circ} = \frac{1}{2.42} \Rightarrow \theta_c = 24.4^\circ$$

$\theta_B = 48.2^\circ$        $\theta_B > \theta_c$       so no refraction out of prism in side B

$\theta' = 11.9^\circ$

$\theta' < \theta_c$       so the light emerge from side C

c)

$$\frac{\sin \theta'}{\sin \theta''} = \frac{1}{2.42}$$

$\theta'' = 30^\circ$