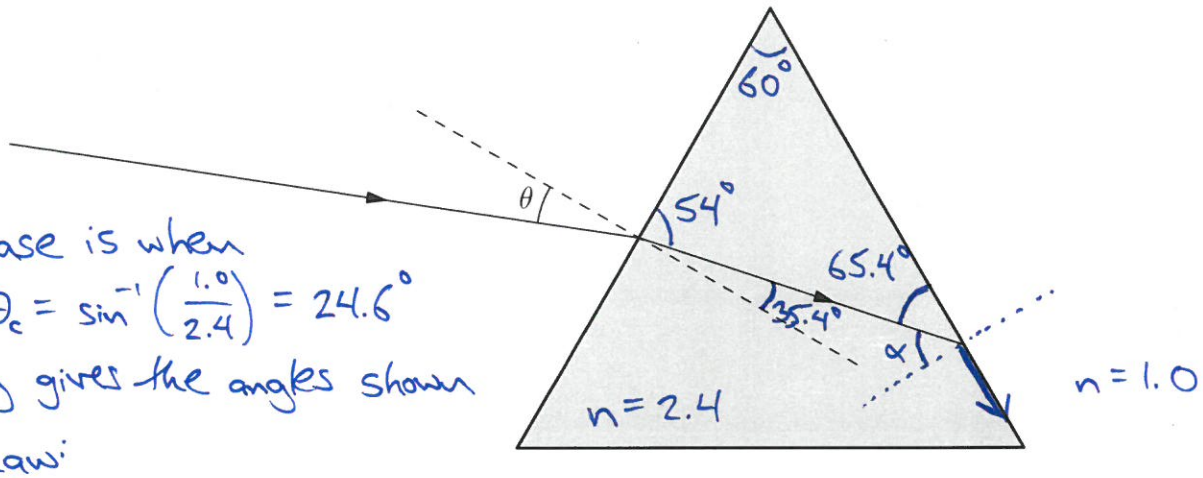
Name: SOLUTIONS Student #: _____ /10

PHYS 1150: Quiz #1

/6 **Problem 1:** A light ray (in air) strikes the side of an equilateral triangular prism made of diamond ($n = 2.4$) as shown below. What is the smallest angle of incidence θ for which the ray can emerge from the other side of the prism?



- edge case is when $\alpha = \theta_c = \sin^{-1}\left(\frac{1.0}{2.4}\right) = 24.6^\circ$
- geometry gives the angles shown
- Snell's Law:

$(1.0)\sin\theta = 2.4 \sin 35.4^\circ$

$\Rightarrow \theta = \sin^{-1}(1.39)$ is undefined, so **ray does not emerge for any θ!**

(Even $\theta = 90^\circ$ gives $\alpha = 35.4^\circ$ which is greater than $\theta_c = 24.6^\circ$; ray undergoes total internal reflection for every value of θ.)

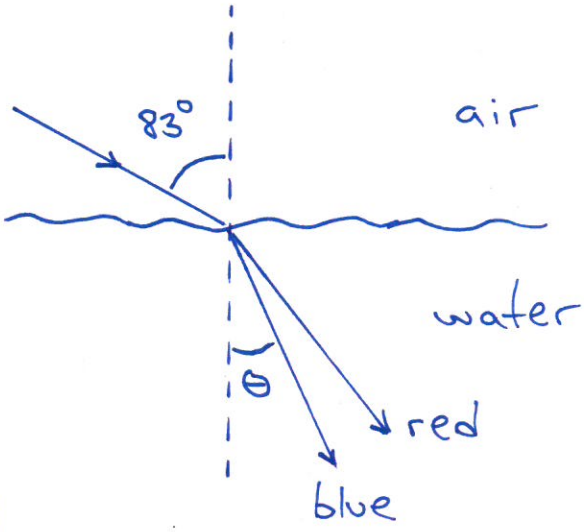
/4 **Problem 2:** The index of refraction for red light in water is 1.331 and that for blue light is 1.340. If a ray of white light enters the water at an angle of incidence of 83.0°, what are the underwater angles of refraction for the (a) red light and (b) blue components of the light

Snell's Law:

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

$\Rightarrow (1.0)\sin 83^\circ = n_2 \sin\theta_2$

$\Rightarrow \theta_2 = \sin^{-1}\left(\frac{1}{n_2}\sin 83^\circ\right)$



a) red light: $n_2 = 1.331$

$\theta_2 = \sin^{-1}\left(\frac{1}{1.331}\sin 83^\circ\right) = \boxed{48.2^\circ}$

b) blue light: $n_2 = 1.340$

$\theta_2 = \sin^{-1}\left(\frac{1}{1.34}\sin 83^\circ\right) = \boxed{47.8^\circ}$