Critical Angle & Snell's Law — Name Key

Practice (use a straight edge for **any** credit) — Period ____

. Calculate the angles and draw the rays for each of the following situations:

a. A ray leaves the source, striking the surface at an angle of 10.0 °. Calculate the angle of refraction. Draw the refracted ray.

$n_1 \sin\theta_1 = n_2 \sin\theta_2 \Rightarrow \sin\theta_2 = \frac{n_1}{n_2}\sin\theta_1 \Rightarrow \theta_2 = \sin^{-1}\left(\frac{n_1}{n_2}\cdot\sin\theta_1\right)$

$\theta_2 = \sin^{-1}\left(\frac{1.47}{1}\sin 10^\circ\right) = 14.8^\circ$

b. A ray leaves the source, striking the surface at an angle of 30.0 °. Calculate the angle of refraction. Draw the refracted ray.

$\theta_2 = \sin^{-1}\left(\frac{n_1}{n_2}\sin\theta_1\right) = \sin^{-1}\left(\frac{1.47}{1}\sin 30^\circ\right) = 47.3^\circ$

c. A ray leaves the source, striking the surface at an angle of 50.0 °. Calculate the angle of refraction. Draw what happens.

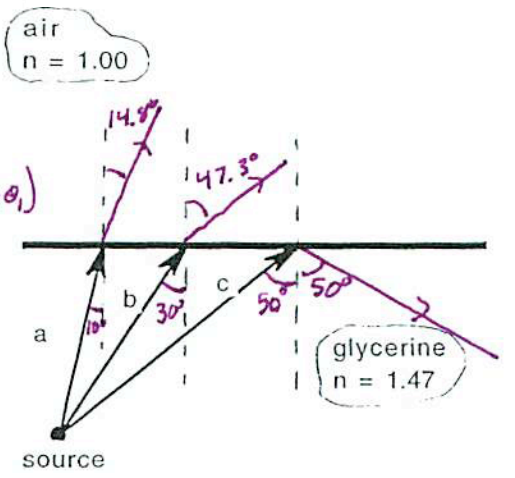
$\theta_2 = \sin^{-1}\left(\frac{n_1}{n_2}\sin\theta_1\right) = \sin^{-1}\left(\frac{1.47}{1}\sin 50^\circ\right) = \sin^{-1}(1.13)$ $1.13 \geq 1 \Rightarrow$ reflection $\theta_r = \theta_i = 50^\circ$

d. Calculate the critical angle for this situation. Draw it on the diagram above.

here I'll use 1 as air & 2 as glycerine

$\theta_2 = \sin^{-1}\left(\frac{n_1}{n_2}\sin\theta_1\right)$

$\theta_2 = \sin^{-1}\left(\frac{1}{1.47}\sin 90^\circ\right) = \boxed{42.9^\circ}$



3. Calculate and draw (use a straight edge) the path of the light ray below, continuing it until it emerges from the glass prism. $n_1 \sin\theta_1 = n_2 \sin\theta_2 \Rightarrow \sin\theta_1 = \frac{n_2}{n_1}\sin\theta_2 \Rightarrow \theta_1 = \sin^{-1}\left(\frac{n_2}{n_1}\sin\theta_2\right)$

   a. going into the glass.

$$\theta_g = \sin^{-1}\left(\frac{1}{1.5}\cdot\sin 0^\circ\right) = 0^\circ$$

   b. going through the glass. (hint: draw the normal line where the ray touches the interface)

$$\theta_a = \sin^{-1}\left(\frac{n_g}{n_a}\sin\theta_g\right) = \sin^{-1}\left(\frac{1.5}{1}\sin 60^\circ\right) = \sin^{-1}(1.30)$$

$1.3 \geq 1 \Rightarrow$ total internal reflection $\theta_i = \theta_r = 60^\circ$

   c. coming out of the glass; calculate the angle of the emergent ray and put that number on your diagram below.

$$\theta_a = \sin^{-1}\left(\frac{n_g}{n_a}\sin\theta_g\right) = \sin^{-1}\left(\frac{1.5}{1}\sin 30^\circ\right) = 48.6^\circ$$