Optics - Snell's law soln

Saturday, April 8, 2017 3:39 PM

(1) $n_1 = 1, \quad \theta_1 = 40°, \quad \theta_2 = 30°$

Snells Law: $n_1 \sin\theta_2 = n_2 \sin\theta_2$

$$\Rightarrow n_2 = n_1 \frac{\sin\theta_1}{\sin\theta_2} = 1 \left(\frac{\sin(40°)}{\sin(30°)} \right)$$

$$\boxed{n_2 = 1.29}$$

(2) $n_1 = 2, \quad n_2 = 46, \quad \theta_1 = 60°$

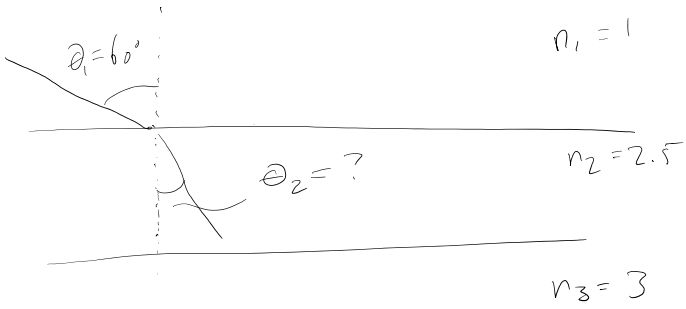
Snell's Law $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$$\Rightarrow \sin\theta_2 = \frac{n_1 \sin\theta_1}{n_2}$$

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

$$\boxed{\theta_2 = 2.2°}$$

(3)

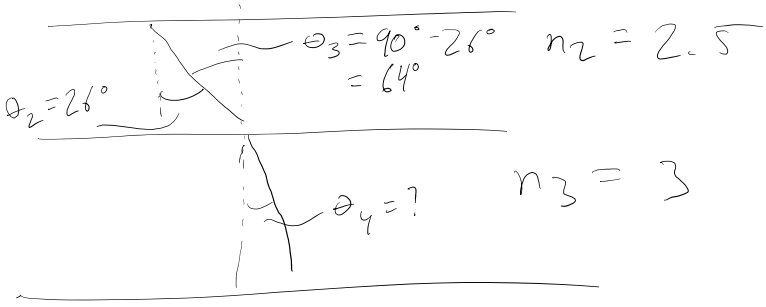


θ_2?

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

$$= \sin^{-1}\left(\underbrace{\frac{1}{2}\sin(60°)}_{=0.433}\right)$$

$$\boxed{\theta_2 = 26°}$$

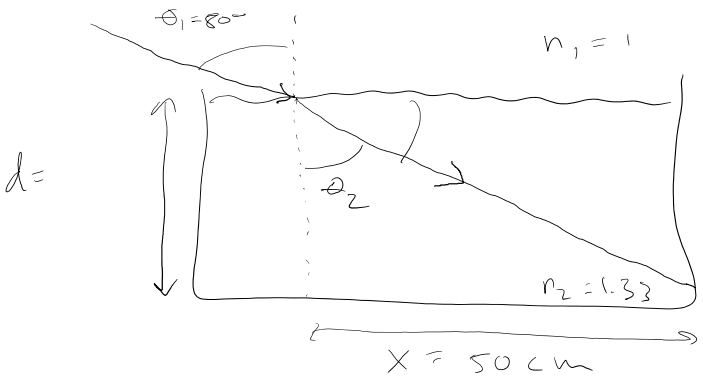


$$n_2 \sin\theta_3 = n_3 \sin\theta_4$$

$$\Rightarrow \theta_4 = \sin^{-1}\left(\underbrace{\frac{n_2 \sin\theta_3}{n_3}}_{=0.748}\right)$$

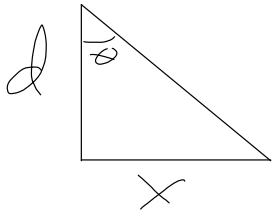
$$\boxed{\theta_4 = 48°}$$

(4)



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

$$= 47.6^\circ$$



$$\tan\theta_2 = \frac{x}{d} \quad \Rightarrow \quad d = \frac{x}{\tan\theta_2}$$

$$d = \frac{50\text{ cm}}{\tan(47.6^\circ)} \quad \Rightarrow \quad \boxed{d = 45.7\text{ cm}}$$

$$1.0951$$