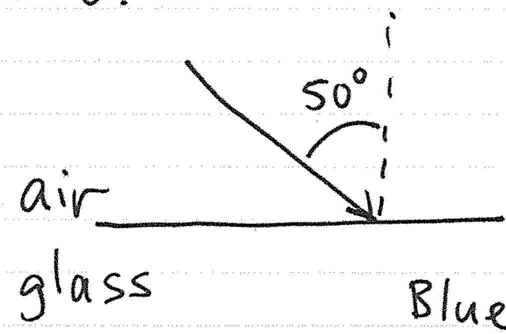
Practice Problem Set 9

1. Wolfson 30.26.



$n_1 = 1$

Blue: $n_2 = 1.680$

Red: $n_2 = 1.621$.

Snel's Law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

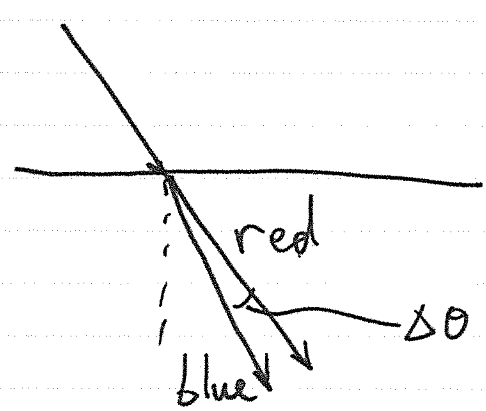
$$\Rightarrow \theta_2 = \sin^{-1}\left[\frac{n_1}{n_2}\sin\theta_1\right]$$

$\theta_1 = 50^\circ$, $n_1 = 1$.

Blue: $\theta_2 = \sin^{-1}\left[\frac{1}{1.68}\sin 50\right] = 27.1279^\circ$

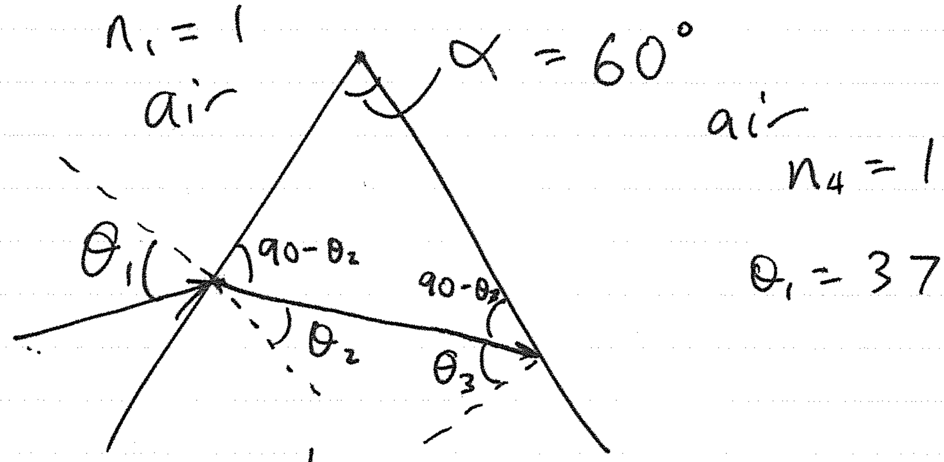
Red: $\theta_2 = \sin^{-1}\left[\frac{1}{1.621}\sin 50\right] = 28.2016^\circ$

$\Delta\theta = \theta_{2red} - \theta_{2blue} = \boxed{1.07^\circ}$



Blue is bent closer to the normal..

2. Wolfson 30.38.



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

$$= \sin^{-1}\left[\frac{1}{1.52}\sin 37\right]$$

$$\theta_2 = 23.32405°$$

From geometry, sum of interior angles = 180°

$$\alpha + [90-\theta_2] + [90-\theta_3] = 180$$

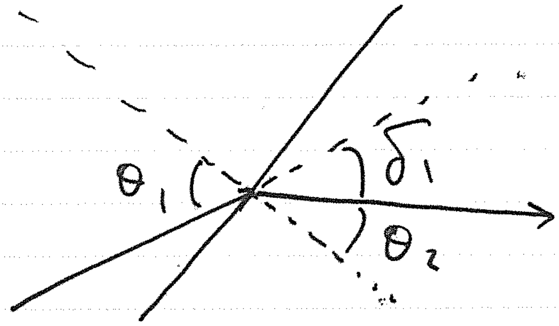
$$60 + 90 - 23.32405 + 90 - \theta_3 = 180$$

$$\theta_3 = 60 - 23.32405 = 36.67595°$$

$$\theta_4 = \sin^{-1}\left[\frac{n_3}{n_4}\sin\theta_3\right] = \sin^{-1}\left[\frac{1.52}{1}\sin 36.676\right]$$

$$\theta_4 = 65.21382$$

2 (continued.)



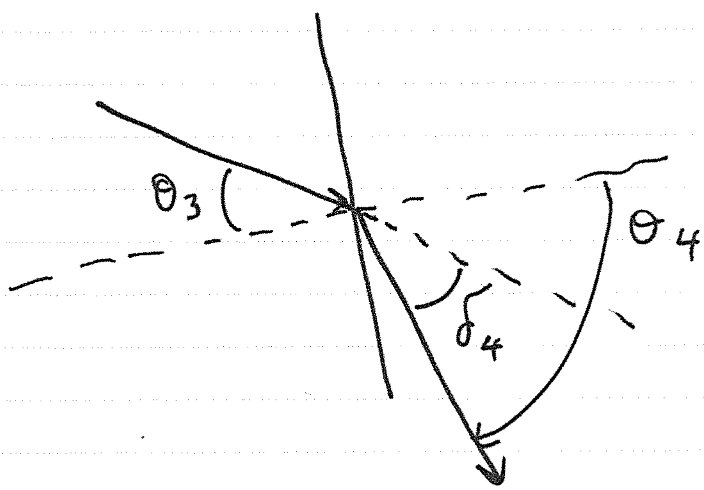
First bend-angle

x-rule:

$\theta_1 = \delta_1 + \theta_2$

$\delta_1 = \theta_1 - \theta_2$

$\delta_1 = 37 - 23.3 = 13.67595^\circ$



Second bend-angle.

x-rule:

$\theta_3 = \theta_4 - \delta_4$

$\delta_4 = \theta_4 - \theta_3$

$\delta_4 = 65.214 - 36.67 = 28.53784$

Total bend $\delta = \delta_1 + \delta_4 = 13.676 + 28.538$

$\boxed{\delta = 42.2^\circ}$

(4)

Practice Problem Set 9

3. Diffraction Grating; Chapter 32.

$$d = 0.02/10000 = 2.0 \times 10^{-6}\mathrm{m}$$

The angle θ between the central maximum and 1st order maximum is given by

$$d \sin(\theta) = m\lambda$$

with d $= 2.00 \times 10^{6}$ m, m $= 1$, $\lambda = 4.000 \times 10^{-7}$ m. plug in the numbers to give $\theta = 11.5\,\mathrm{deg}$, and the distance between the central and 1st order maximum on the screen will be $10 \times \tan(\theta) = 2.04\mathrm{cm}$.