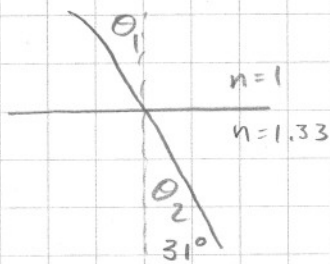


p659 29-33 odd

(29)



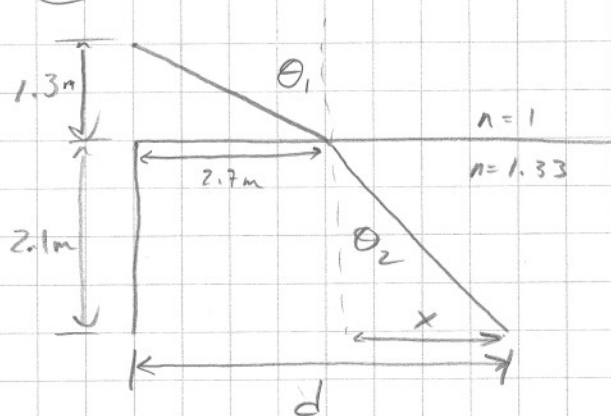
$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\theta_1 = \sin^{-1} \left(\frac{n_2 \sin \theta_2}{n_1} \right) = \sin^{-1} (1.33 \sin 31^\circ)$$

$$\theta_1 = 43^\circ$$

From horizon $90 - 43 = \underline{47^\circ}$

(31)



$$\tan \theta_1 = \frac{2.7}{1.3}$$

$$\theta_1 = 64^\circ$$

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

$$\theta_2 = \sin^{-1} \left(\frac{n_1 \sin \theta_1}{n_2} \right) = \sin^{-1} \left(\frac{\sin 64^\circ}{1.33} \right)$$

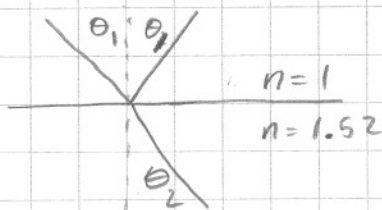
$$\theta_2 = 42.5^\circ$$

$$\tan \theta_2 = \frac{x}{2.1}$$

$$x = 2.1 \tan 42.5^\circ = 1.92$$

$$d = 2.7\text{m} + 1.92\text{m} = \underline{4.6\text{m}}$$

(33)



$$\theta_1 = 2\theta_2$$

$$\sin 2\theta = 2 \sin \theta \cos \theta$$

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

$$\frac{\sin 2\theta_2}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{2 \sin \theta_2 \cos \theta_2}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\theta_2 = \cos^{-1} \left(\frac{n_2}{2n_1} \right) = \cos^{-1} \left(\frac{1.52}{2} \right) = 40.5^\circ$$

$$\theta_1 = 2\theta_2 = \underline{81^\circ}$$