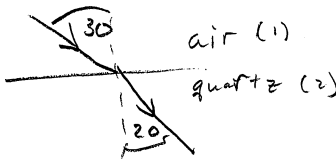


Reflection and Refraction

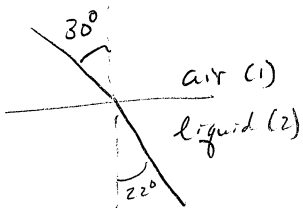
①  (a) 53°
(b) 106°

②  72°

③  air (1)
quartz (2)

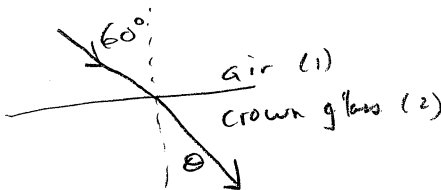
$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 30}{\sin 20} = \frac{n_2}{1} \quad n_2 = 1.46$$

④  air (1)
liquid (2)

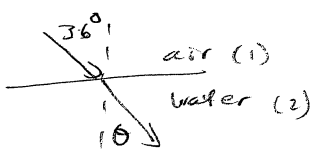
$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 30}{\sin 22} = \frac{n_2}{1} \quad n_2 = 1.33$$

⑤  air (1)
crown glass (2)

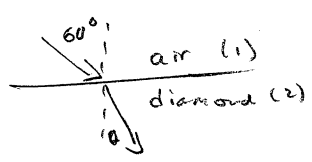
$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 60}{\sin \theta_2} = \frac{1.52}{1} \quad \theta_2 = 34.7^\circ$$

⑥  air (1)
water (2)

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

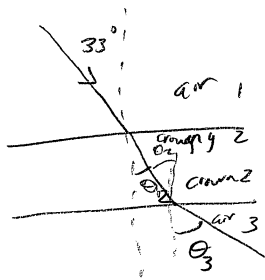
$$\frac{\sin 36}{\sin \theta} = \frac{1.33}{1} \quad \theta = 26^\circ$$

⑦  air (1)
diamond (2)

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

$$\frac{\sin 60}{\sin \theta} = \frac{2.42}{1} \quad \theta = 21^\circ$$

8



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

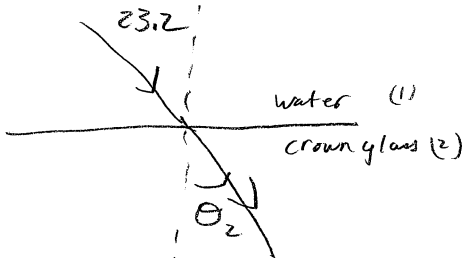
$$\frac{\sin 33}{\sin \theta_2} = \frac{1.52}{1}$$

$$\theta_2 = 21^\circ$$

$$\frac{\sin 21^\circ}{\sin \theta_3} = \frac{1}{1.52}$$

$$\theta_3 = 33^\circ$$

9

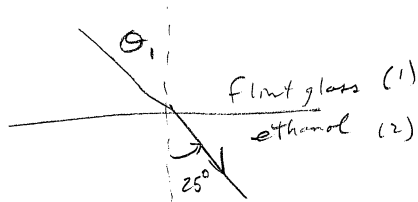


$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 23.2}{\sin \theta_2} = \frac{1.52}{1.33}$$

$$\theta_2 = 20.2^\circ$$

10

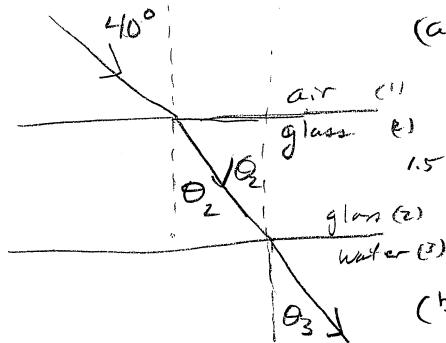


$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin \theta_1}{\sin (25)} = \frac{1.36}{1.61}$$

$$\theta_1 = 20.9^\circ$$

11



(a)
$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 40^\circ}{\sin \theta_2} = \frac{1.5}{1}$$

$$\theta_2 = 25.37^\circ$$

(b)
$$\frac{\sin \theta_2}{\sin \theta_3} = \frac{n_3}{n_2}$$

$$\frac{\sin 25.37}{\sin \theta_3} = \frac{1.33}{1.5}$$

$$\theta_3 = 28.9^\circ$$