P35.8 The incident light reaches the left-hand mirror at distance

$$(1.00\text{ m})\tan 5.00° = 0.087\,5\text{ m}$$

above its bottom edge. The reflected light first reaches the right-hand mirror at height

$$2(0.087\,5\text{ m}) = 0.175\text{ m}.$$

It bounces between the mirrors with this distance between points of contact with either.

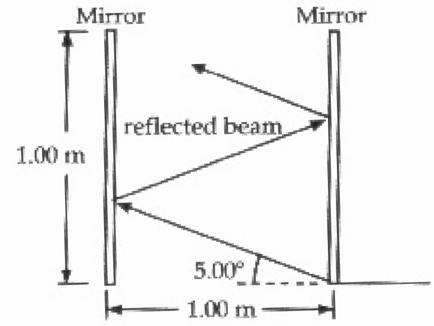

FIG. P35.8

Since $\dfrac{1.00\text{ m}}{0.175\text{ m}} = 5.72$

the light reflects $\boxed{\text{five times from the right-hand mirror and six times from the left}}$.

P35.10 Using Snell's law, $\sin\theta_2 = \dfrac{n_1}{n_2}\sin\theta_1$

$$\theta_2 = \boxed{25.5°}$$

$$\lambda_2 = \frac{\lambda_1}{n_1} = \boxed{442\text{ nm}}.$$

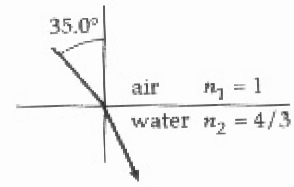

FIG. P35.10

P35.12 (a) $f = \dfrac{c}{\lambda} = \dfrac{3.00\times10^8\text{ m/s}}{6.328\times10^{-7}\text{ m}} = \boxed{4.74\times10^{14}\text{ Hz}}$

(b) $\lambda_{\text{glass}} = \dfrac{\lambda_{\text{air}}}{n} = \dfrac{632.8\text{ nm}}{1.50} = \boxed{422\text{ nm}}$

(c) $v_{\text{glass}} = \dfrac{c_{\text{air}}}{n} = \dfrac{3.00\times10^8\text{ m/s}}{1.50} = 2.00\times10^8\text{ m/s} = \boxed{200\text{ Mm/s}}$

P35.13 $n_1\sin\theta_1 = n_2\sin\theta_2$

$\sin\theta_1 = 1.333\sin 45°$

$\sin\theta_1 = (1.33)(0.707) = 0.943$

$\theta_1 = 70.5° \rightarrow \boxed{19.5°\text{ above the horizon}}$

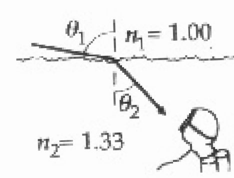

FIG. P35.13

P35.21 At entry, $n_1\sin\theta_1 = n_2\sin\theta_2$

or $1.00\sin 30.0° = 1.50\sin\theta_2$

$$\theta_2 = 19.5°.$$

The distance h the light travels in the medium is given by

$$\cos\theta_2 = \frac{2.00\text{ cm}}{h}$$

or $h = \dfrac{2.00\text{ cm}}{\cos 19.5°} = 2.12\text{ cm}.$

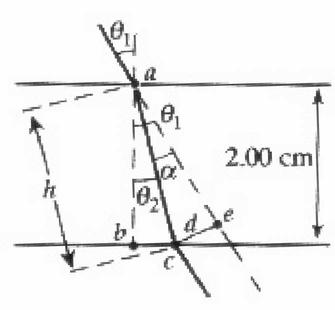

FIG. P35.21

The angle of deviation upon entry is $\alpha = \theta_1 - \theta_2 = 30.0° - 19.5° = 10.5°.$

The offset distance comes from $\sin\alpha = \dfrac{d}{h}$: $d = (2.21\text{ cm})\sin 10.5° = \boxed{0.388\text{ cm}}.$

P35.25 Consider glass with an index of refraction of 1.5, which is 3 mm thick. The speed of light in the glass is

$$\frac{3\times10^{8}\ \text{m/s}}{1.5}=2\times10^{8}\ \text{m/s}.$$

The extra travel time is $\frac{3\times10^{-3}\ \text{m}}{2\times10^{8}\ \text{m/s}}-\frac{3\times10^{-3}\ \text{m}}{3\times10^{8}\ \text{m/s}}\boxed{\sim10^{-11}\ \text{s}}$.

For light of wavelength 600 nm in vacuum and wavelength $\frac{600\ \text{nm}}{1.5}=400\ \text{nm}$ in glass,

the extra optical path, in wavelengths, is $\frac{3\times10^{-3}\ \text{m}}{4\times10^{-7}\ \text{m}}-\frac{3\times10^{-3}\ \text{m}}{6\times10^{-7}\ \text{m}}\boxed{\sim10^{3}\ \text{wavelengths}}$.

P35.36 $n\sin\theta=1$. From Table 35.1,

(a) $\theta=\sin^{-1}\left(\frac{1}{2.419}\right)=\boxed{24.4°}$

(b) $\theta=\sin^{-1}\left(\frac{1}{1.66}\right)=\boxed{37.0°}$

(c) $\theta=\sin^{-1}\left(\frac{1}{1.309}\right)=\boxed{49.8°}$