Homework Solutions
11/9/2007

Conceptual Questions – Chapter 22

14. TIR only occurs when light travels from a substance with a higher index of refraction to a substance with a lower index of refraction. Thus, light moving from air to water cannot undergo TIR.

16. The bottom of the oar appears closer to the surface than it really is because of refraction.

Conceptual Question – Chapter 23

16. Both words are inverted, however the letters in OXIDE appear exactly the same when they are inverted.

Problems

47. As long as surfaces are parallel to each other than the product nsinθ remains unchanged.

a.

$$n_i \sin\theta_i = n_r \sin\theta_r$$
$$(1.60)\sin 30.0° = \sin\theta_2$$
$$\theta_2 = \sin^{-1}\left((1.60)\sin 30.0°\right) = 53.1°$$

b.

$$\theta_c = \sin^{-1}\left(\frac{n_r}{n_i}\right)$$
$$\theta_c = \sin^{-1}\left(\frac{1.00}{1.60}\right) = 38.7°$$

49. a.

$$\theta_1 = 60.0°$$

$$\alpha = 30.0°$$

$$\theta_3 = 30.0°$$

$$n_i \sin\theta_3 = n_r \sin\theta_4$$

$$\theta_4 = \sin^{-1}\left(\frac{n_i \sin\theta_3}{n_r}\right)$$

$$\theta_4 = \sin^{-1}\left(\frac{(1.66)\sin 30.0°}{1.333}\right) = 38.5°$$

b.

$$n_i \sin\theta_i = n_r \sin\theta_r$$

$$n_r = \frac{n_i \sin\theta_i}{\sin\theta_r} = \frac{1.66 \sin 60.0°}{\sin 90.0°} = 1.44$$