Homework Solutions
11/7/2007

Conceptual Questions

2. Textured white ceilings have a dual purpose. One is two diffuse reflected light and reduce glare. The second is to absorb sound waves so that their reflection is minimized.

Problems

9. a.

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

$$n_r = \frac{n_i \sin\theta_i}{\sin\theta_r} = \frac{(1.00)\sin 30.0°}{\sin 19.24°} = 1.52$$

b. Frequency is constant so when velocity changes, wavelength must also change.

$$\lambda_r = \frac{\lambda_i}{n}$$

$$\lambda_r = \frac{632.8nm}{1.52} = 417nm$$

c.

$$n = \frac{c}{v}$$

$$v = \frac{c}{n}$$

$$f = \frac{v}{\lambda} = \frac{\frac{c}{n}}{\lambda} = \frac{c}{n\lambda} = \frac{3.00 \bullet 10^8 \frac{m}{s}}{(1.000)(6.328 \bullet 10^{-7} m)} = 4.74 \bullet 10^{14} Hz$$

d.

$$v = \frac{c}{n} = \frac{3.00 \bullet 10^8 \frac{m}{s}}{1.52} = 1.98 \bullet 10^8 \, Hz$$

11. a.

$$\lambda_w = \frac{\lambda}{n}$$

$$\lambda = \lambda_w n = (438nm)(1.333) = 584nm$$

b.

$$\lambda = \lambda_b n_b = \lambda_w n_w$$

$$\lambda_b n_b = \lambda_w n_w$$

$$\frac{n_b}{n_w} = \frac{\lambda_w}{\lambda_b} = \frac{438nm}{390nm} = 1.12$$

22.

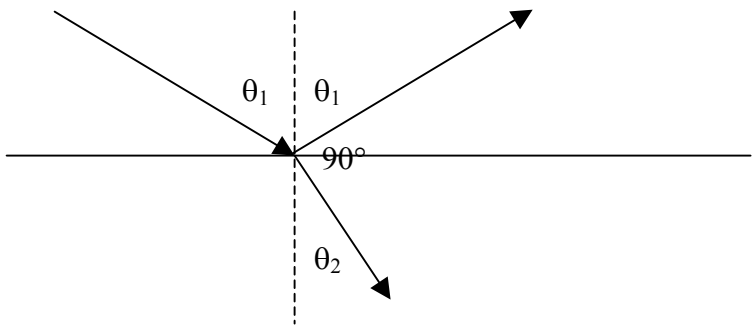
$$\theta_{water} = \tan^{-1}\left(\frac{90.0m}{100m}\right) = 42.0°$$

$$\theta_{air} = \sin^{-1}\left(\frac{n_{water} \sin\theta_{water}}{n_{air}}\right) = \sin^{-1}\left(\frac{(1.333)\sin 42.0°}{1.000293}\right) = 63.1°$$

$$\tan\theta_{air} = \frac{210m}{h}$$

$$h = \frac{210m}{\tan\theta_{air}} = \frac{210m}{\tan(63.1°)} = 107m$$

25.



$$180° = \theta_1 + 90° + \theta_2$$

$$\theta_1 + \theta_2 = 90°$$

$$\theta_2 = 90° - \theta_1$$

$$n_{air} \sin\theta_1 = n_g \sin\theta_2$$

$$n_{air} \sin\theta_1 = n_g \sin\left(90° - \theta_1\right)$$

$$n_{air} \sin\theta_1 = n_g \cos\theta_1$$

$$\frac{\sin\theta_1}{\cos\theta_1} = \frac{n_g}{n_{air}}$$

$$\tan\theta_1 = \frac{n_g}{n_{air}}$$

$$\theta_1 = \tan^{-1}\left(\frac{n_g}{n_{air}}\right)$$