Name: Key

Practice - 25.5 Dispersion

Table 25.2 Index of Refraction *n* in Selected Media at Various Wavelengths

Medium	Red (650 nm)	Orange (610 nm)	Yellow (580 nm)	Green (550 nm)	Blue (470 nm)	Violet (410 nm)
Water	1.331	1.332	1.333	1.335	1.338	1.342
Diamond	2.410	2.415	2.417	2.426	2.444	2.458
Glass, crown	1.512	1.514	1.518	1.519	1.524	1.530
Glass, flint	1.662	1.665	1.667	1.674	1.684	1.698
Polystyrene	1.488	1.490	1.492	1.493	1.499	1.506
Quartz, fused	1.455	1.456	1.458	1.459	1.462	1.468

1. What is the ratio of the speed of red light to violet light in diamond?

$$\frac{v_r}{v_v} = \frac{\frac{c}{n_r}}{\frac{c}{n_v}} = \frac{n_v}{n_r} = \frac{2.458}{2.410} = \boxed{1.020}$$

2. A beam of white light goes from air into water at an incident angle of 75.0°. At what angles are the red (660 nm) and violet (410 nm) parts of the light refracted?

$$n_i \sin\theta_i = n_r \sin\theta_r \Rightarrow \theta_r = \sin^{-1}\left(\frac{n_i}{n_r}\sin\theta_i\right)$$

n_i = 1.00, θ_i = 75.0°

Red: $\theta_r = \sin^{-1}\left(\frac{1.000}{1.331}\sin 75.0°\right) = \boxed{46.5°}$

Violet: $\theta_r = \sin^{-1}\left(\frac{1.000}{1.342}\sin 75.0°\right) = \boxed{46.0°}$

3. By how much do the critical angles for red (660 nm) and violet (410 nm) light differ in a diamond surrounded by air?

$$\underbrace{n_i \sin\theta_i}_{\text{diamond}} = \underbrace{n_r \sin\theta_r}_{\text{air}} \leftarrow 90.0° \Rightarrow \theta_c = \sin^{-1}\left(\frac{n_r}{n_i}\right)$$

Red: $\theta_c = \sin^{-1}\left(\frac{1.000}{2.410}\right) = \boxed{24.52°}$ Violet: $\theta_c = \sin^{-1}\left(\frac{1.000}{2.458}\right) = \boxed{24.01°}$

$\Delta = 24.52 - 24.01 = \boxed{0.51°}$