

MP/399air  $\rightarrow$  liquid

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

$$(1.00) \sin 65.0^\circ = n_r \sin 42.0^\circ$$

$$n_r = \frac{(1.00) \sin 65.0^\circ}{\sin 42.0^\circ}$$

$$n_r = 1.35$$

MP/404air  $\rightarrow$  ruby

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

$$(1.00) \sin 45^\circ = (1.54) \sin \theta_r$$

$$\sin \theta_r = \frac{(1.00) \sin 45^\circ}{1.54}$$

$$\theta_r = \sin^{-1} \left( \frac{1.00 \sin 45^\circ}{1.54} \right)$$

$$\theta_r = 27^\circ$$

MP/409critical angle  
for diamond

$$n = 2.42$$

$\downarrow$   
implies: more dense  $\rightarrow$  less dense  
 $\theta_r = 90^\circ$  (exactly)

diamond  $\rightarrow$  air

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

$$(2.42) \sin \theta_i = (1.00) \sin 90^\circ$$

$$\sin \theta_i = \frac{(1.00) \sin 90^\circ}{2.42}$$

$$\theta_i = \sin^{-1} \left( \frac{1.00 \sin 90^\circ}{2.42} \right)$$

$$\theta_i = 24.4^\circ$$