Light, reflection and refraction - Review problem p. 567 #3

For an incoming ray of light of vacuum wavelength 589 nm, fill in the unknown values in the following table. (Use Table 15-1)

	from (medium)	to (medium)	θ_i	θ_r
a)	flint glass	crown glass	25.0°	?
b)	air	?	14.5°	9.8°
c)	air	diamond	?	12.5°

Snell's Law: $n_i \sin\theta_i = n_r \sin\theta_r$

a) $n_i = n(\text{flint glass}) = 1.66$
$n_r = n(\text{crown glass}) = 1.52$
$\theta_i = 25.0°$
$\theta_r = ?$

$$\frac{n_i \sin\theta_i}{n_r} = \frac{n_r \sin\theta_r}{n_r}$$

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

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

$$\theta_r = \sin^{-1}(1.66 \sin(25.0)/1.52)$$

$$\boxed{\theta_r = 27.5°}$$

b) $n_i = n(\text{air}) = 1.00$
$n_r = ?$
$\theta_i = 14.5°$
$\theta_r = 9.8°$

$$\frac{n_i \sin\theta_i}{\sin\theta_r} = \frac{n_r \sin\theta_r}{\sin\theta_r}$$

$$n_r = \frac{n_i \sin\theta_i}{\sin\theta_r}$$

$$n_r = 1.00 \sin(14.5)/\sin(9.8)$$

$$\boxed{n_r = 1.471} \rightarrow \text{glycerine } (1.473)$$

c) $n_i = n(\text{air}) = 1.00$

$n_r = n(\text{diamond}) = 2.419$

$\theta_i = ?$

$\theta_r = 12.5^\circ$

$$\frac{n_i \sin\theta_i}{n_i} = \frac{n_r \sin\theta_r}{n_i}$$

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

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

$$\theta_i = \sin^{-1}(2.419 \sin(12.5)/1.00)$$

$$\boxed{\theta_i = 31.6^\circ}$$