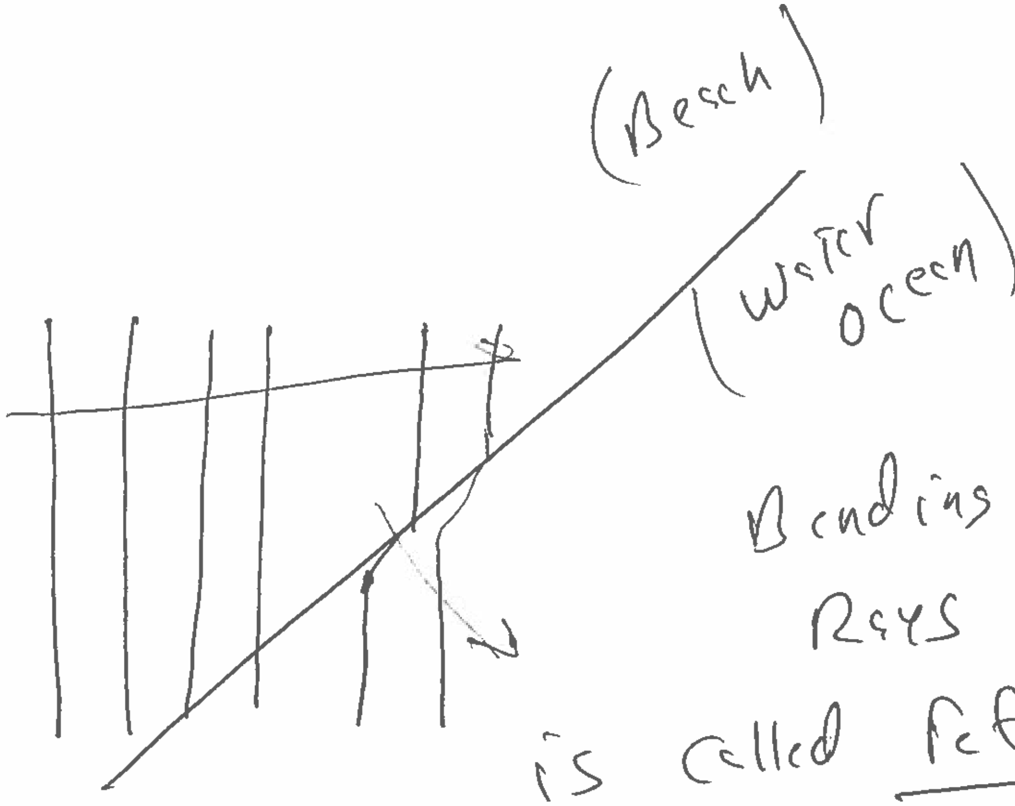


Bending of Rays is called refraction

Index of refraction

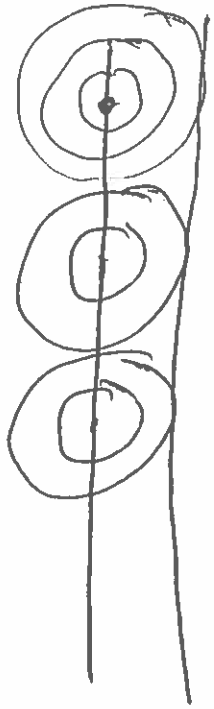
$$n = \frac{c}{v} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$n > 1$ speed of light in vacuum $\geq$ speed of light in mediu

$n_{air} = 1.00023$

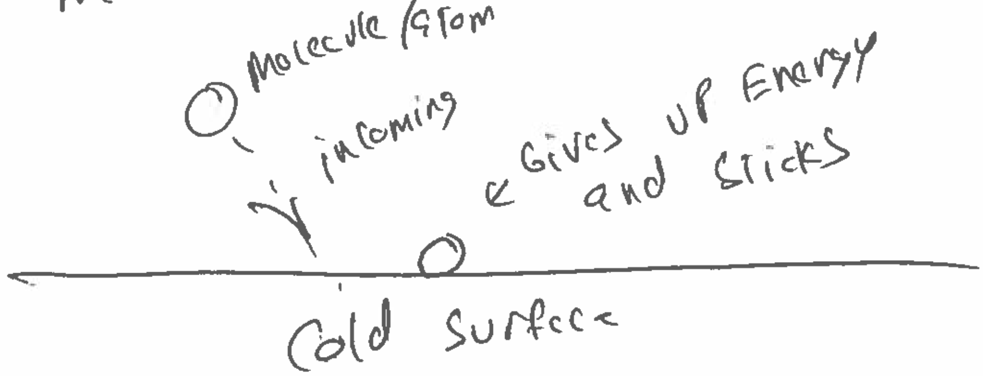
$n_{water} = 1.333 \Rightarrow v_{water} \sim \frac{3}{4} c$

$n_{diamond} = 2.419 = v_{Diam} \sim \frac{1}{2} c$



light Slows down in a medium because it is momenterily absorbed by atoms, molecules in medium If The energy is not A value Useable by The absorber, The energy is re-emitted at same energy which means Same frequency Though often Shorter wave length.

Greater n ⇒ More optically dense The medium, The slower light Travels.



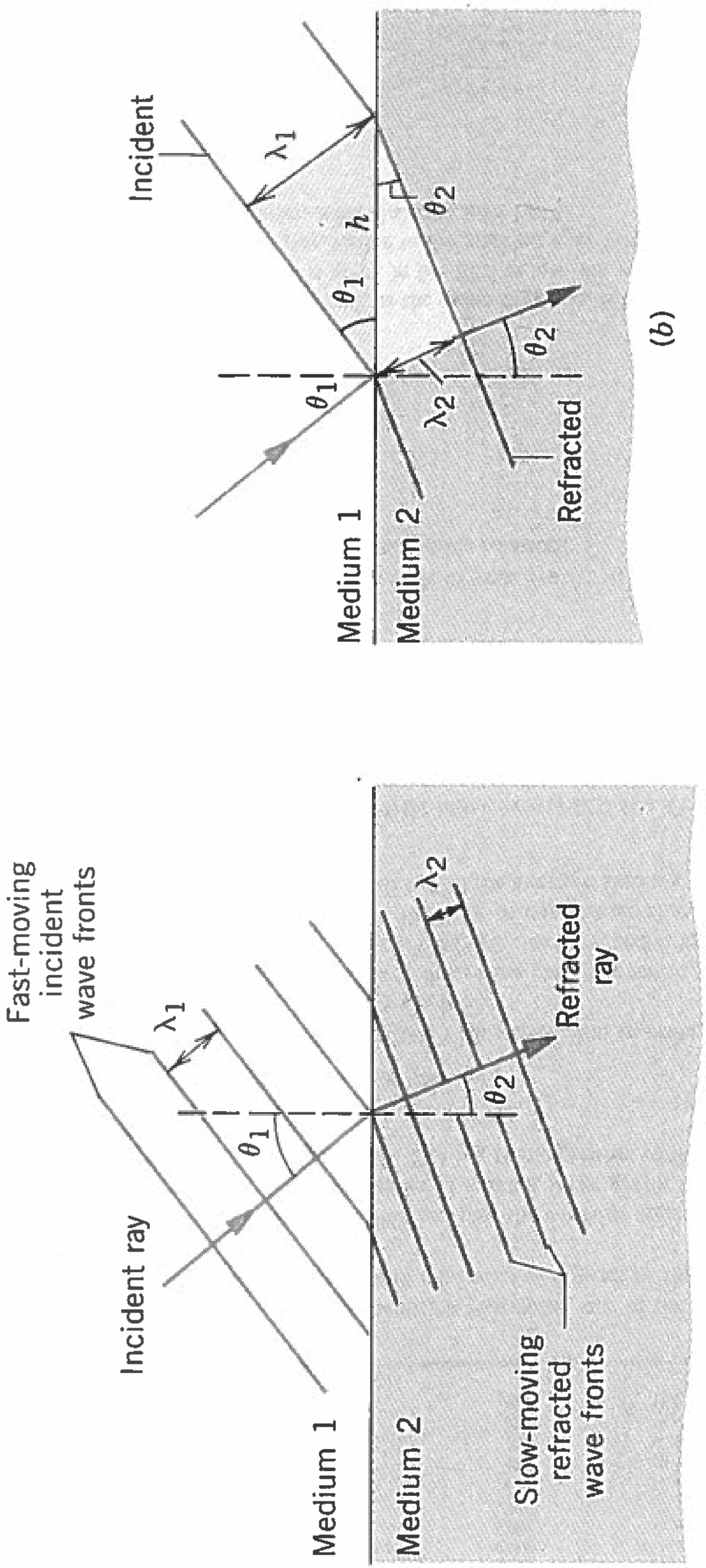


FIGURE 26.6 a, b

$$n = \frac{c}{v} = \frac{\lambda_0 f_0}{\lambda_m f_m}$$

— λ_0 – wavelength in vacuum

λ_m – wavelength in medium

If Energy stays same $E = hf$

$f_0 = f_m$

$$n = \frac{\lambda_0}{\lambda_m} \Rightarrow \lambda_m = \lambda_n = \frac{\lambda_0}{n}$$

$\lambda_0 = 750\ nm$ λ_{water}

Average Person visible light 400nm → 700nm
Violet Red

$$\lambda_w = \frac{\lambda_0}{n} = \frac{750\ nm}{1.33} = 562.6\ nm$$

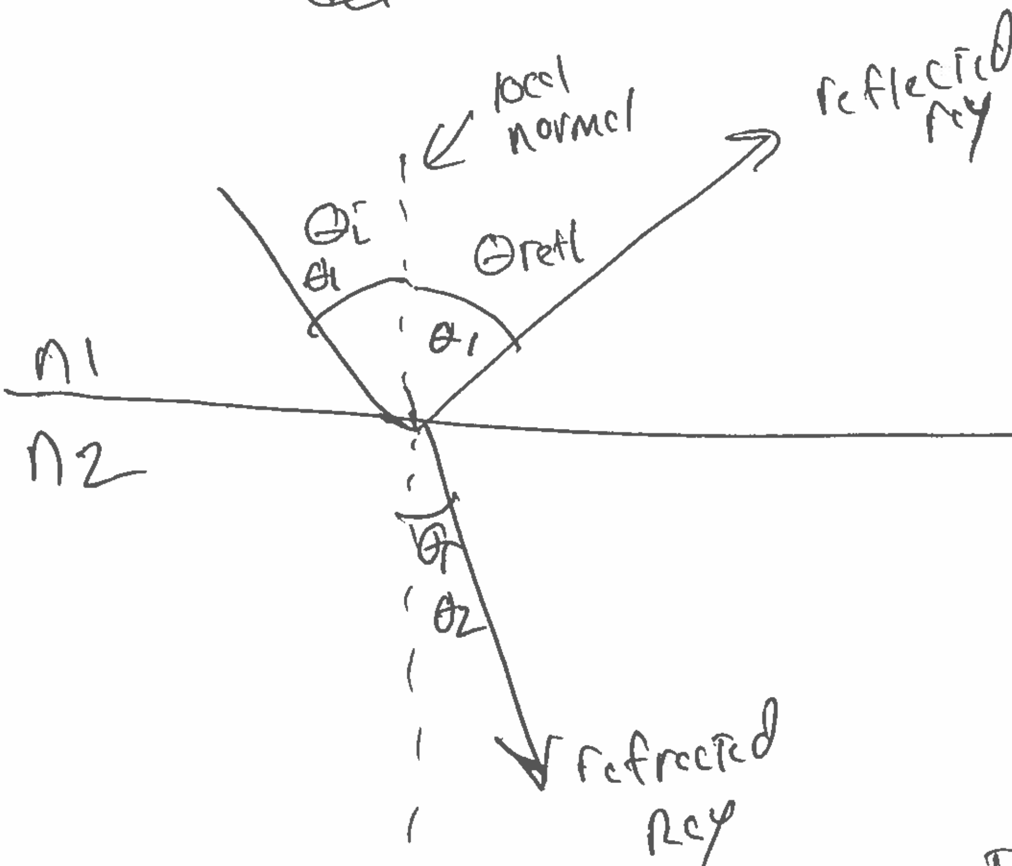
750 nm IR

562 nm ~ Greenish

$\theta_r = \theta_i$ Law of reflection

Snell's Law

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$



if $n_2 > n_1$

$\theta_2 < \theta_1$

Light is bent towards the normal

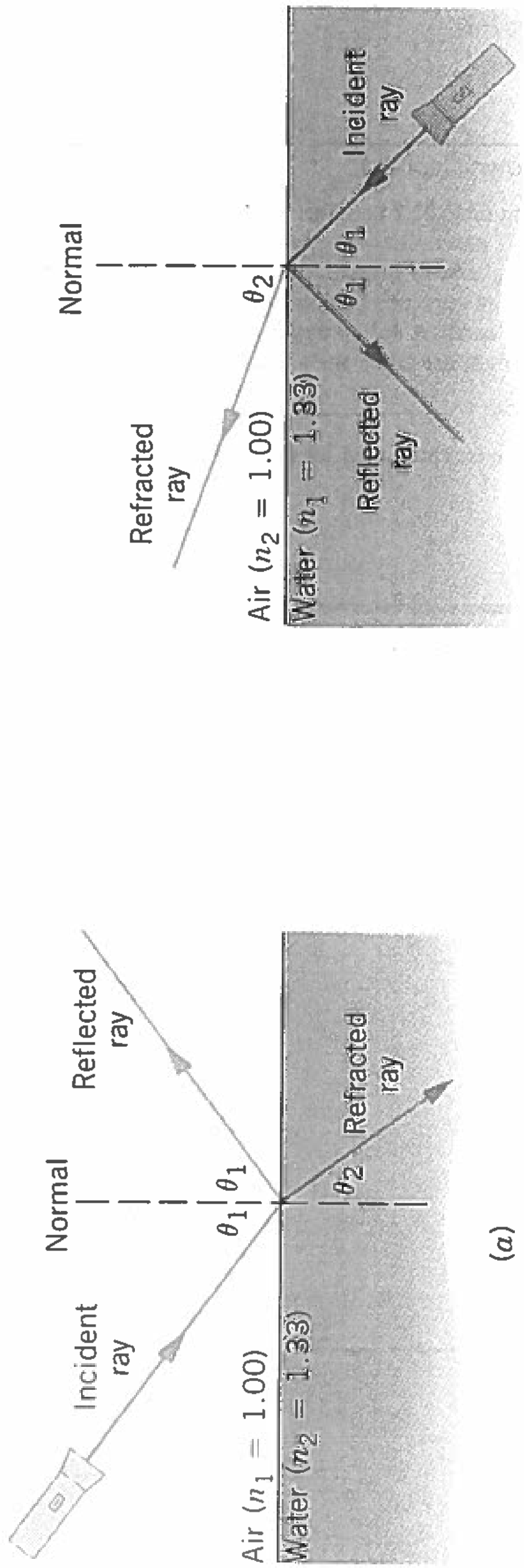


FIGURE 26.1 a, b

Light incident on a slab of Glass

$n_g = 1.50$ $\theta_{incidence} = 45^\circ$

$\theta_{reflection} = ?$ $\theta_{refraction} = ?$

$\theta_{refl} = \theta_i = 45^\circ$

$$n_{air} \sin\theta_i = n_{glass} \sin\theta_{refr}$$

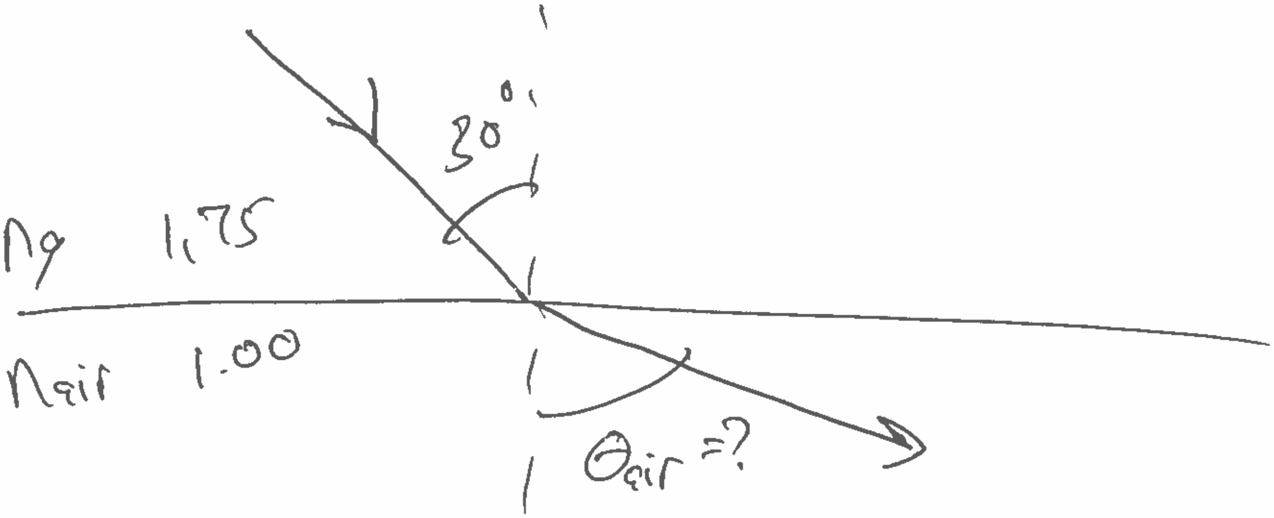
$$\sin\theta_{refr} = \sin\theta_i \left(\frac{n_{air}}{n_{glass}}\right)$$

$$\sin\theta_{refr} = \sin(45^\circ)\left(\frac{1}{1.5}\right) = 0.4714$$

$$\theta_{refr} = \sin^{-1}(0.4714) = 28.1^\circ$$

e9/ light ray in a Glass ($n_g = 1.75$)

$\theta_i = 30^\circ \quad \theta_{air} = ?$



Snell's Law

$$n_{air} \sin\theta_{air} = n_g \sin\theta_g$$

$$\sin\theta_{air} = \frac{n_g}{n_{air}} \sin\theta_g$$

$$\sin(\theta_{air}) = \left(\frac{1.75}{1.00}\right) \sin(30^\circ) = 0.875$$

$$\theta_{air} = \sin^{-1}(0.875) = \boxed{61.0^\circ}$$

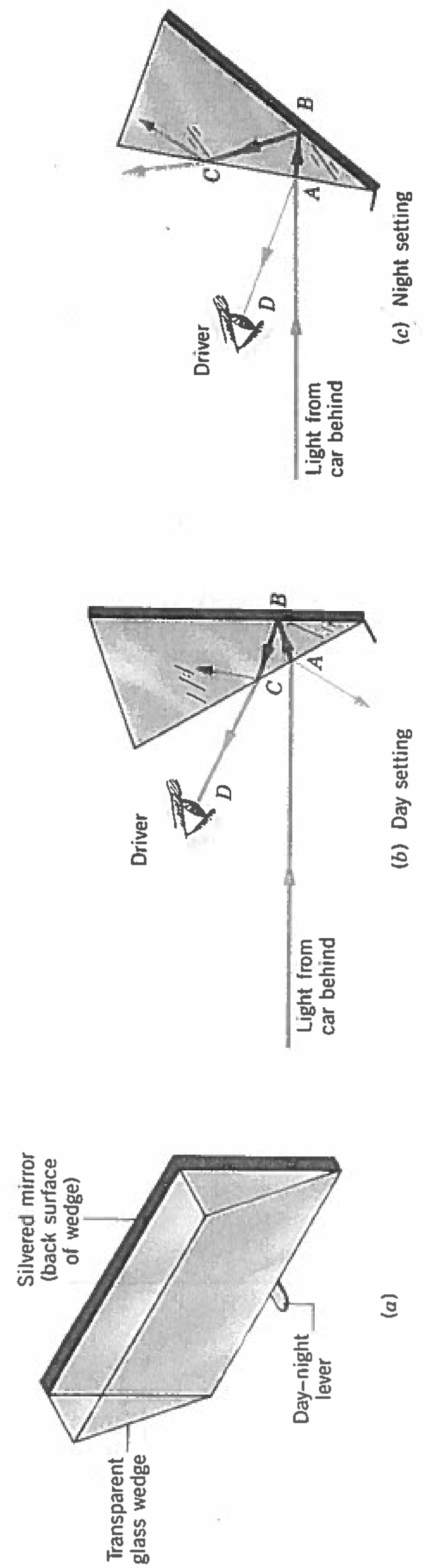
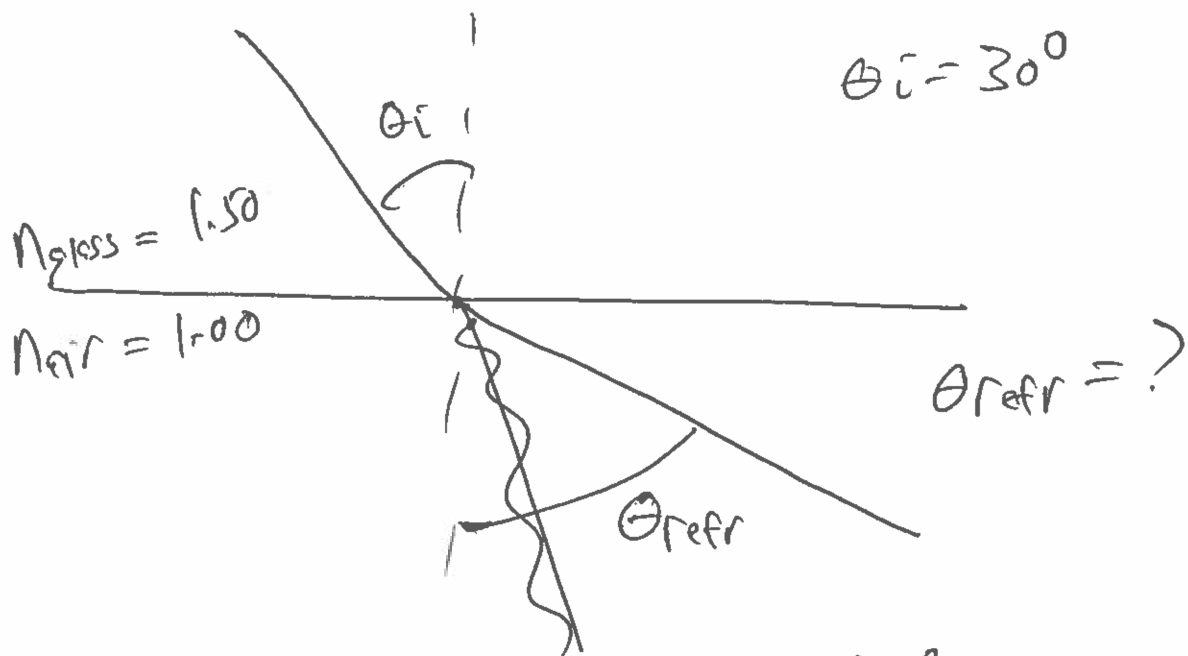


FIGURE 26.2 a, b, c



$$n_{air} \sin\theta_{ref} = n_{glass} \sin\theta_{glass}$$

$$\sin\theta_{ref} = \frac{n_{glass}}{n_{air}} \sin\theta_{glass}$$

$$\sin\theta_{ref} = \frac{1.50}{1.00} \sin(30) = 0.75$$

$$\theta_{ref} = \sin^{-1}(0.75) = 48.6^\circ$$

Biggest angle of refraction $= 90^\circ$

what angle of incidence
Gives 90°?

$$n_{air} \sin\theta_{air} = n_{glass} \sin\theta_{glass}$$

$$\sin\theta_{glass} = \frac{n_{air}}{n_{glass}} \sin\theta_{air}$$

$$\sin\theta_{glass} = \frac{1.00}{1.50} \sin(90^\circ)$$

$$\sin\theta_{glass} = \frac{1}{1.50}$$

$$\theta_{glass} = \sin^{-1}\left(\frac{1}{1.50}\right) = \underline{41.8^\circ}$$

$\theta_{glass} = 41.8^\circ \Rightarrow \theta_{critical}$ angle