

## IV. Refraction

Index of refraction of a material:

$$n = c/v \geq 1$$

$$c = 3.0 \times 10^8 \text{ m/s}$$

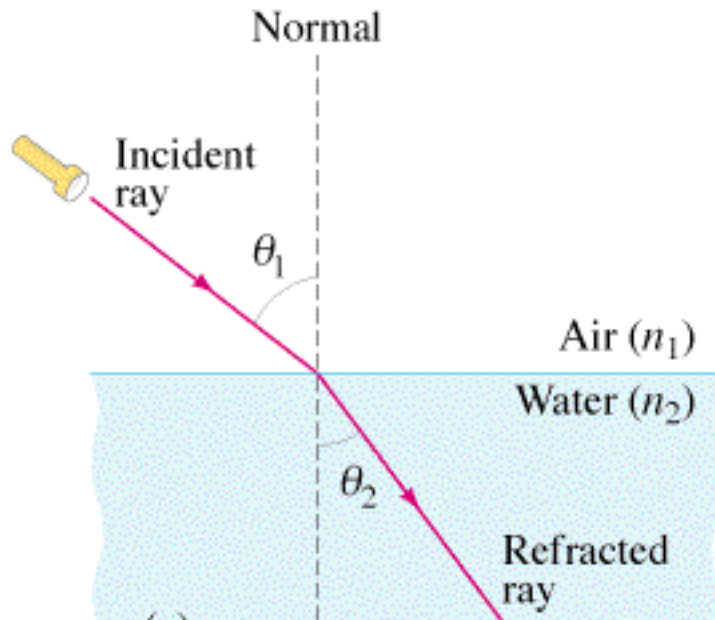
speed of light in vacuum

v:

speed of light in the medium

Vacuum & air:	n=1.00
Water	n=1.33
Glass	n=1.4-1.6

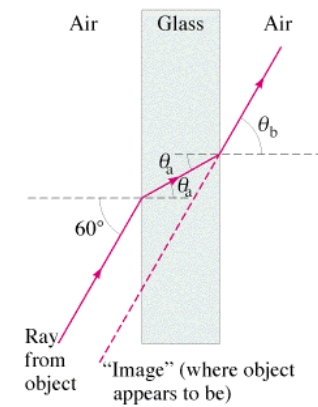
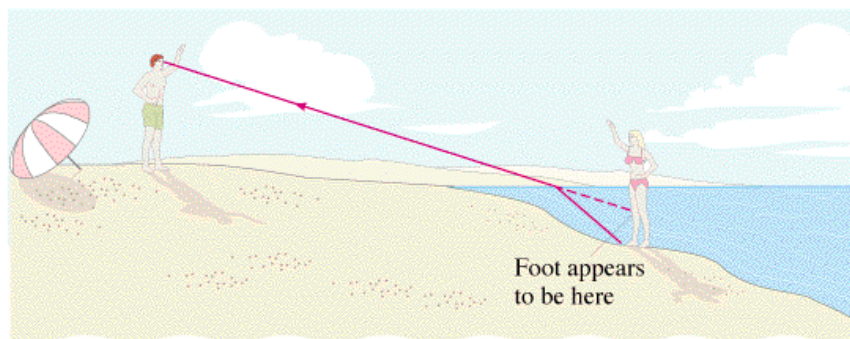
# Law of Refraction



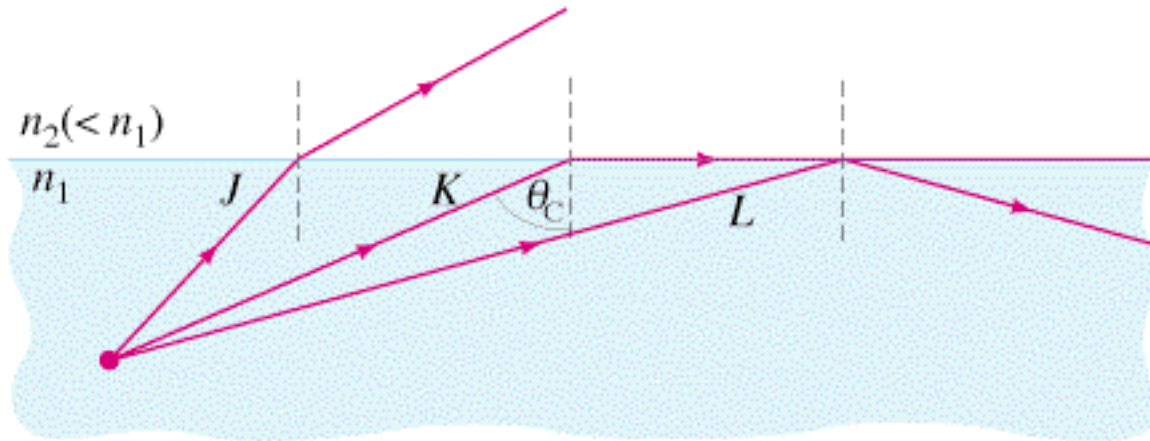
Snell's Law

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

If  $n_1 > n_2$ , then  $\theta_1 < \theta_2$



## Total Internal Reflection



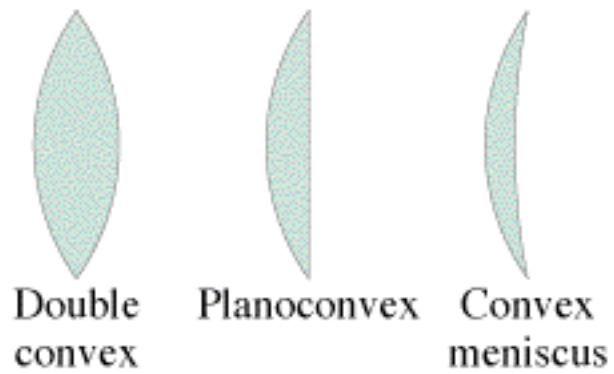
$$\sin \theta_C = \frac{n_2}{n_1} \sin 90^\circ = \frac{n_2}{n_1}$$

When  $\theta > \theta_C$ , all lights are reflected, no refraction

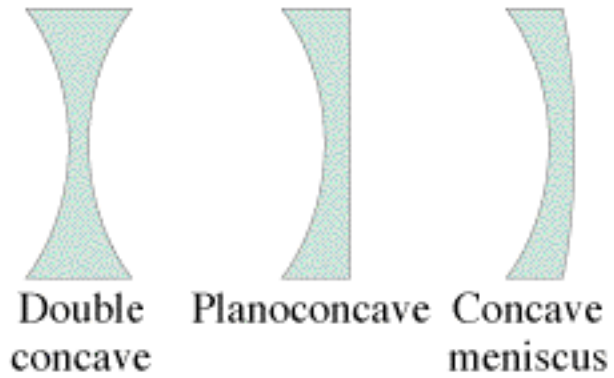
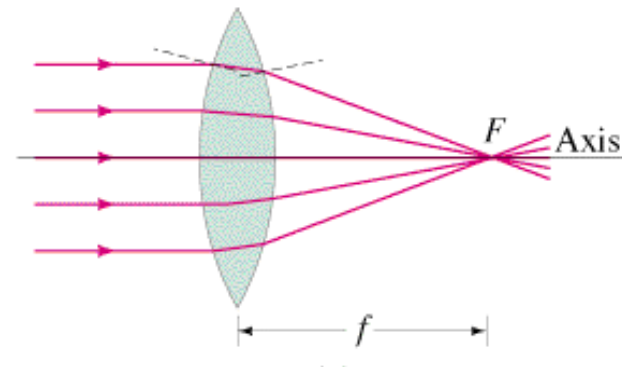
Only happens when light goes from high  $n$  to low  $n$  material

Applications: fiber optics

# Lenses



(a) Converging lenses



(b) Diverging lenses

