

Physics

Chapter 14: Refraction

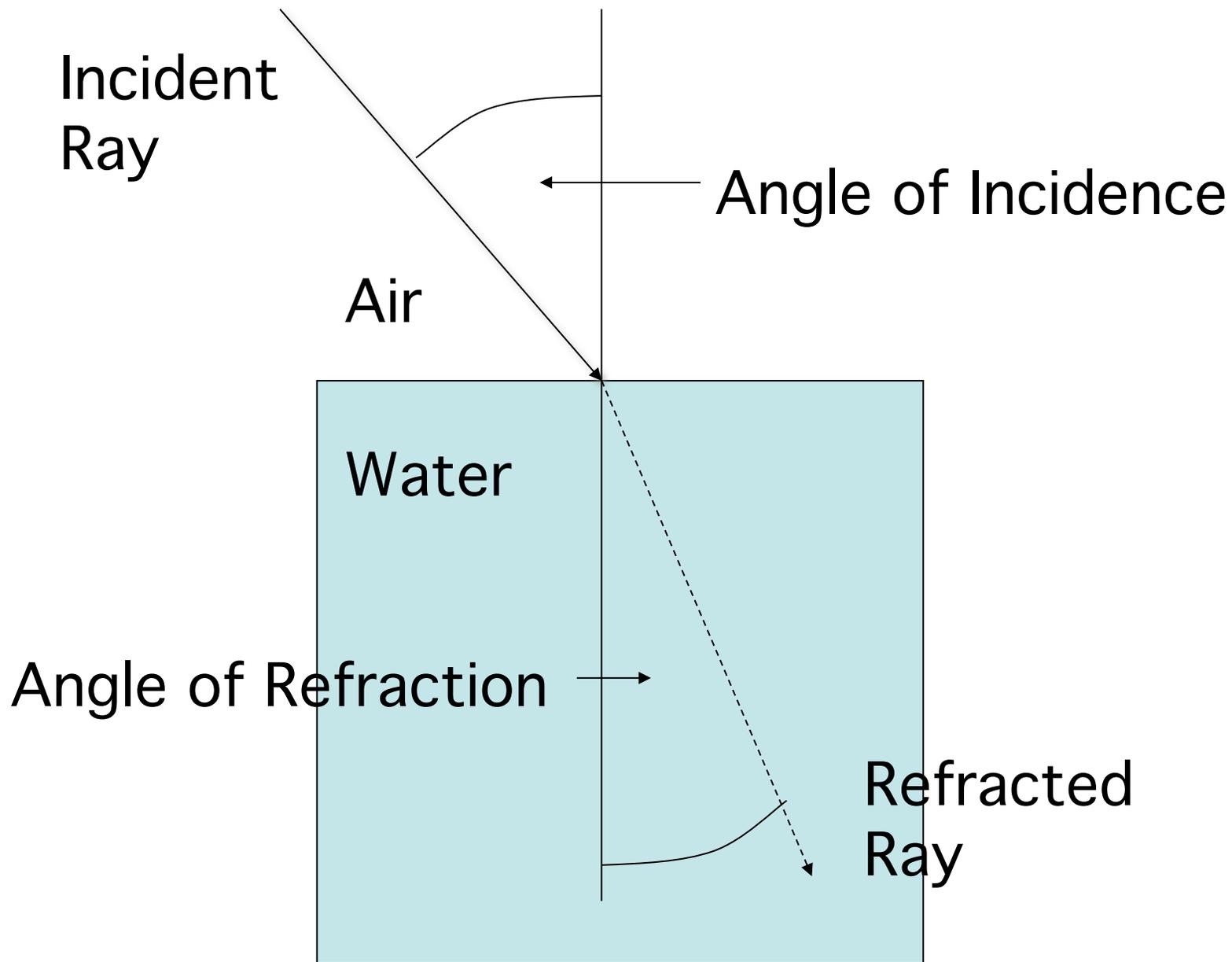
Section 14.1

Refraction

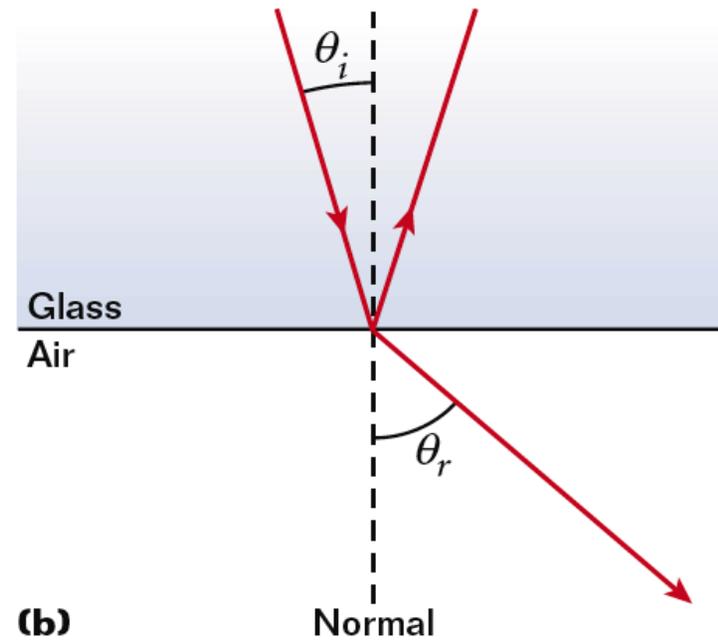
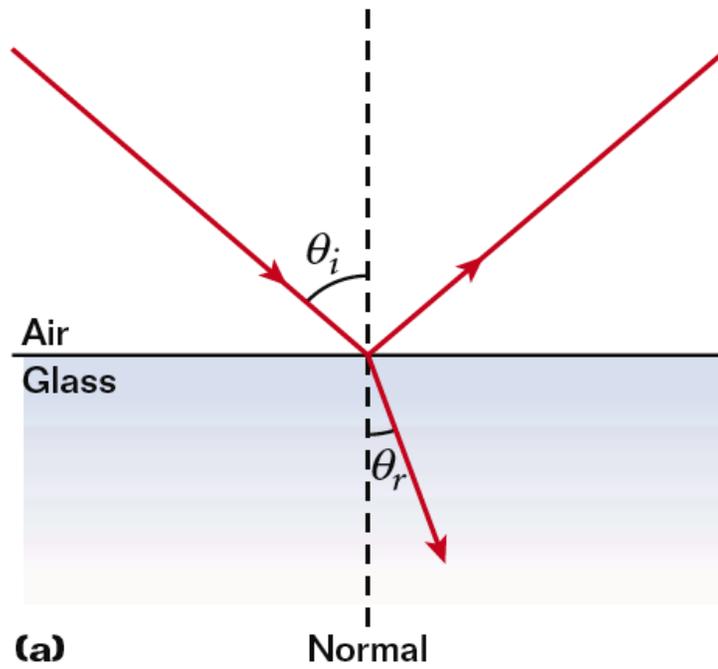
Refraction

- Refraction is the bending of light that occurs when a wave bends as it enters a different medium.
- The bending is caused by the change in velocity that occurs when the wave changes mediums.

- When a wave enters a medium in which it travels slower, it bends towards the normal so that the angle of refraction is smaller than the angle of incidence.
- The angles of incidence and refraction are measured from the normal.



Refraction



Examples of Refraction:

- 1) A ruler placed in a container of water appears bent.
- 2) A coin in a dish of water appears large and appears to float.
- 3) The bottom of a swimming pool appears to be closer to the surface.
- 4) Lenses use refraction to form images.
- 5) Refraction is involved in the formation of rainbows.

Snell's Law

--The relationship between the angle of refraction and the angle of incidence when light is refracted is given by Snell's Law:

$$\frac{\sin i}{\sin r} = n$$

--Where n is the index of refraction of the refractive medium. (See Table 14-1, p 490)

or:
$$n = \frac{c}{v}$$

Indices of Refraction for Various Substances

Solids at 20°C

	<i>n</i>
Cubic zirconia	2.20
Diamond	2.419
Fluorite	1.434
Fused quartz	1.458
Glass, crown	1.52
Glass, flint	1.66
Ice (at 0°C)	1.309
Polystyrene	1.49
Sodium chloride	1.544
Zircon	1.923

Liquids at 20°C

	<i>n</i>
Benzene	1.501
Carbon disulfide	1.628
Carbon tetrachloride	1.461
Ethyl alcohol	1.361
Glycerine	1.473
Water	1.333

Gases at 0°C, 1 atm

	<i>n</i>
Air	1.000 293
Carbon dioxide	1.000 450

*measured with light of vacuum wavelength = 589 nm

--Since light rays are reversible, for light traveling in either direction between two mediums, Snell's Law may be expressed as:

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

Incident
Ray

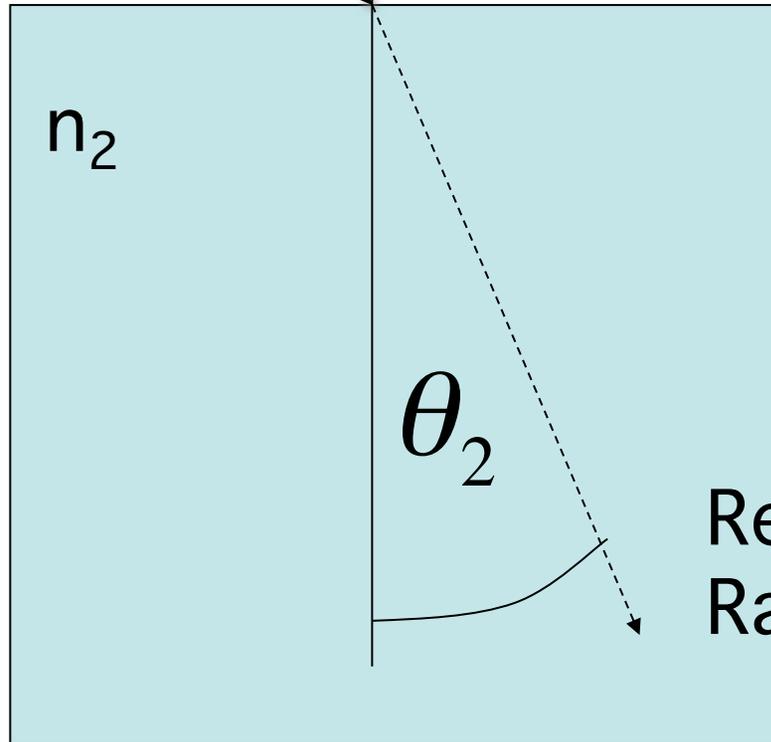
n_1

θ_1

n_2

θ_2

Refracted
Ray



Example: What is the angle of refraction in water if a light ray enters the water from air at an angle of 25° ?

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

$$\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$$

$$\sin \theta_2 = \frac{(1.00) (\sin 25^\circ)}{1.33}$$

$$\theta_2 = 18.5^\circ$$