

Lecture 23

Wed. Nov. 3, 2004

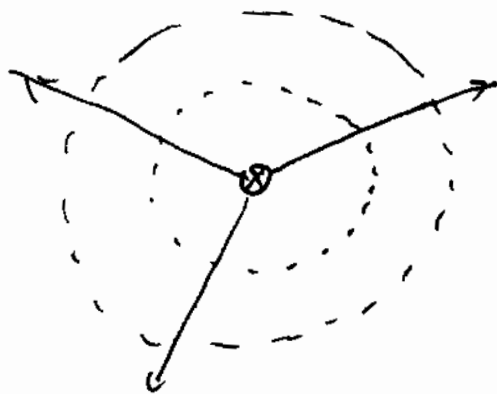
Geometrical Optics. ch. 26.

- Optics \rightarrow The study of light.
- Geometrical Optics \rightarrow use rays to describe light.
- Wave fronts and rays:

— point source (just like dropping a stone into a lake)

wave fronts: spherical surfaces.

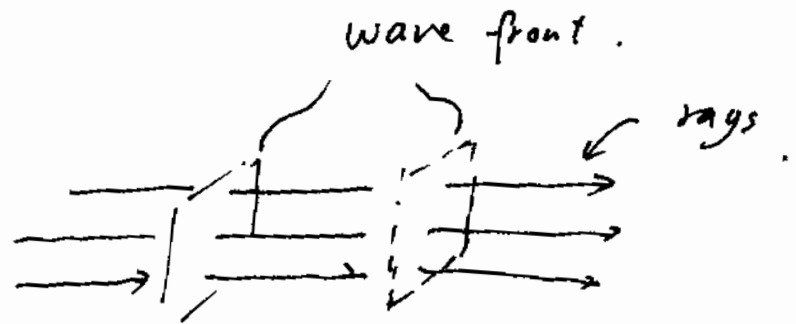
Rays: radii.



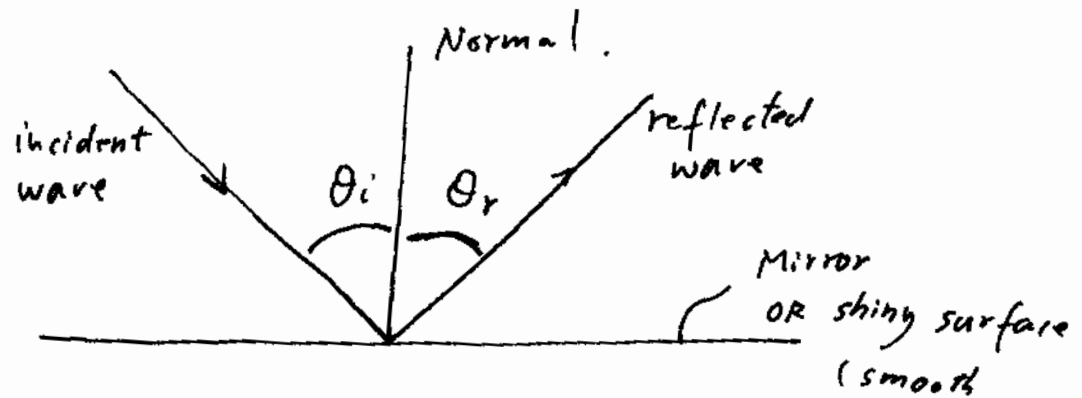
far away: wave fronts — planes
 rays — parallel beams.
 (plane wave)

— plane wave .

23-2 .



• Law of reflection



① . $\theta_r = \theta_i$

② Incident wave, Normal and reflected wave
are all ~~in~~ in the same plane .

called the incident plane .

• Law of Refraction (Snell's law)

23-3.

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

Refracted angle:

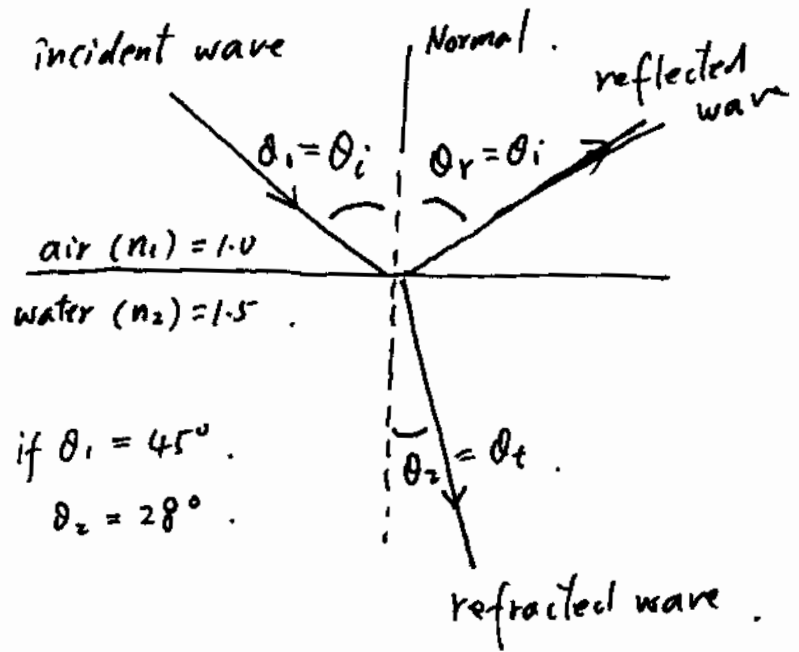
(Angle of Refraction):

$$\theta_2 = \sin^{-1} \left(\frac{n_1}{n_2} \cdot \sin \theta_1 \right)$$

i.e., $\sin \theta_2 = \frac{n_1}{n_2} \cdot \sin \theta_1$.

When $n_2 > n_1$, e.g. air to water.

$\theta_2 < \theta_1$, refracted light bends toward normal.



if $\theta_1 = 45^\circ$
 $\theta_2 = 28^\circ$.

• What if we send a ray of light from water to air?

Now $n_2 < n_1$

$$\theta_2 > \theta_1$$

$$n_1 (\text{water}) = 1.5$$

$$n_2 (\text{air}) = 1.0$$

if $\theta_1 = 45^\circ$.

$$\frac{n_1}{n_2} \cdot \sin \theta_1 = 1.06$$

$$\theta_2 = \sin^{-1} 1.06 = \text{ERROR!}$$

θ_2 - doesn't exist!

No refraction!

This happens whenever $\frac{n_1}{n_2} \sin \theta_1 > 1.00$.

$\theta_c = \sin^{-1} \frac{n_2}{n_1}$ — critical angle
 for total internal reflection

