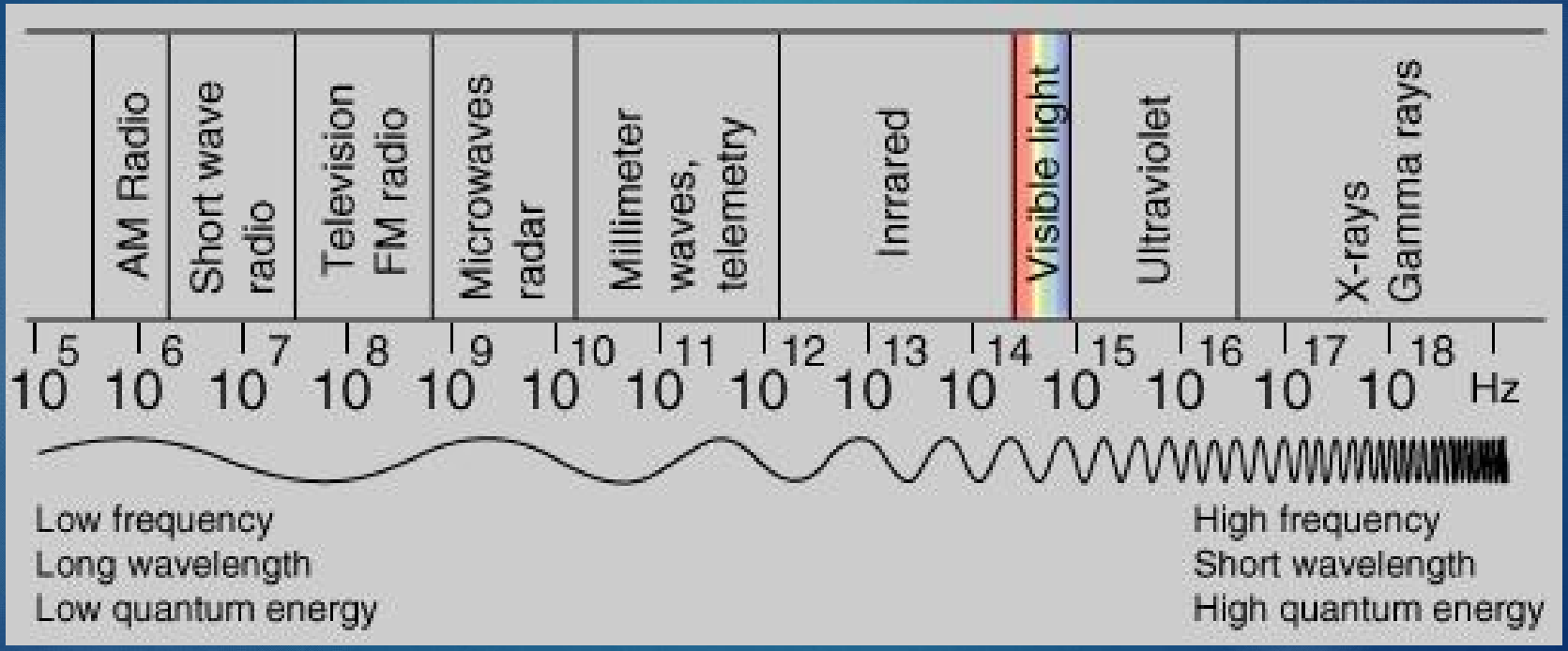
The Reflection of Light: Mirrors

Electromagnetic emission



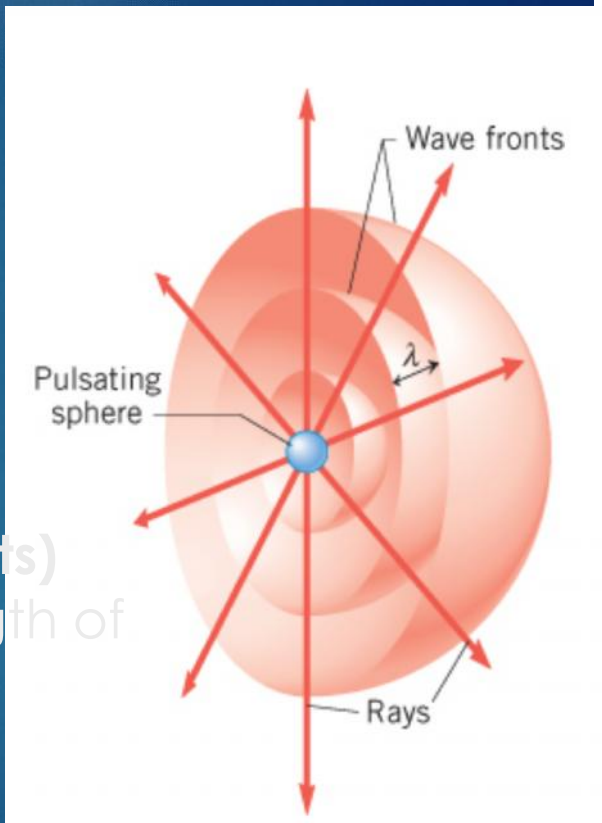
Wave Fronts and Rays

Defining wave fronts and rays.

Consider a sound wave since it is easier to visualize.

Shown is a hemispherical view of a sound wave emitted by a pulsating sphere.

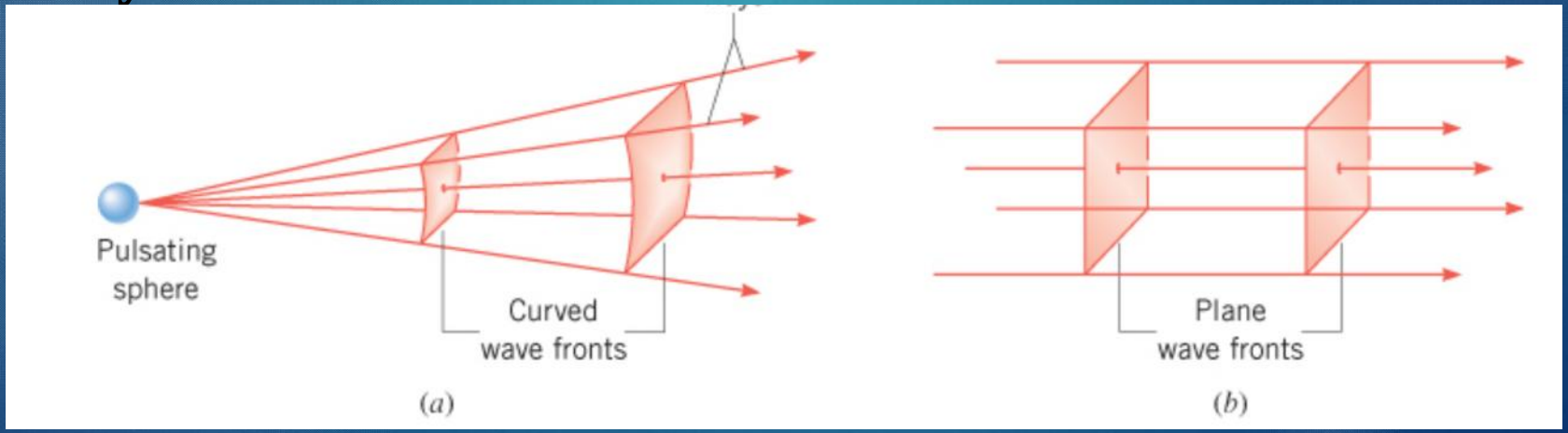
The **rays are perpendicular to the wave fronts (e.g. crests)** which are separated from each other by the wavelength of the wave, λ.



The positions of two spherical wave fronts are shown in (a) with their diverging rays.

At large distances from the source, the wave fronts become less and less curved and approach the limiting case of a **plane wave** shown in (b). A plane wave has flat wave fronts and rays parallel to each other.

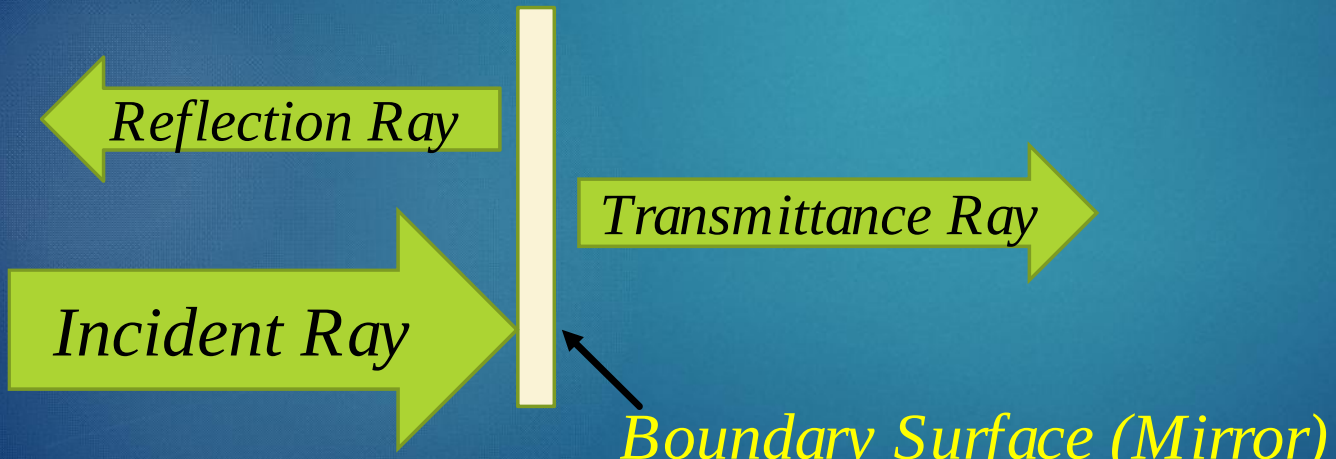
We will consider light waves as plane waves and will represent them by their rays.

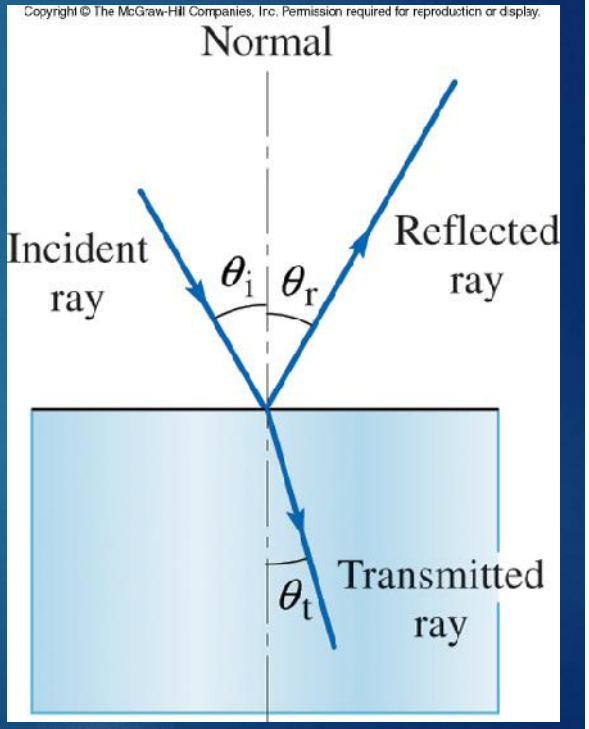


Reflection

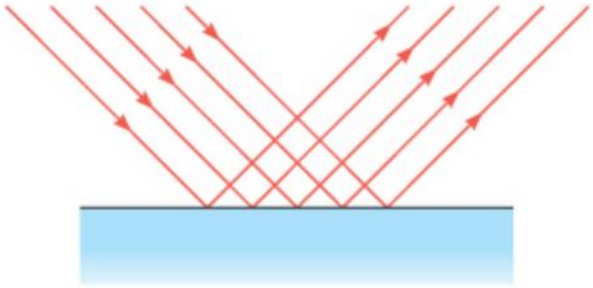
When a wave reaches a boundary it is:

- Partially reflected (bounces off surface)
- Partially transmitted through surface.



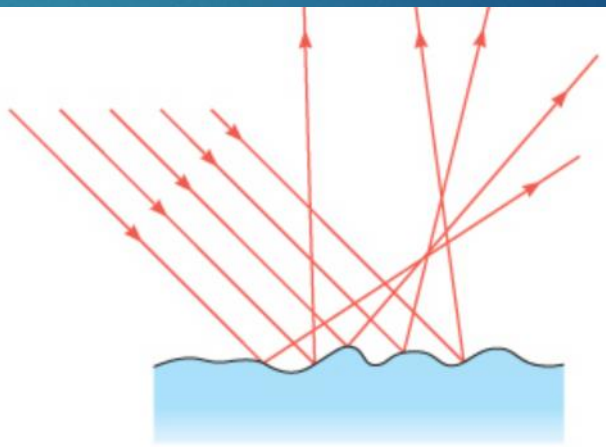


In specular reflection, the reflected rays are parallel to each other.
In diffuse reflection, light is reflected in random directions.



(*a*) Specular reflection

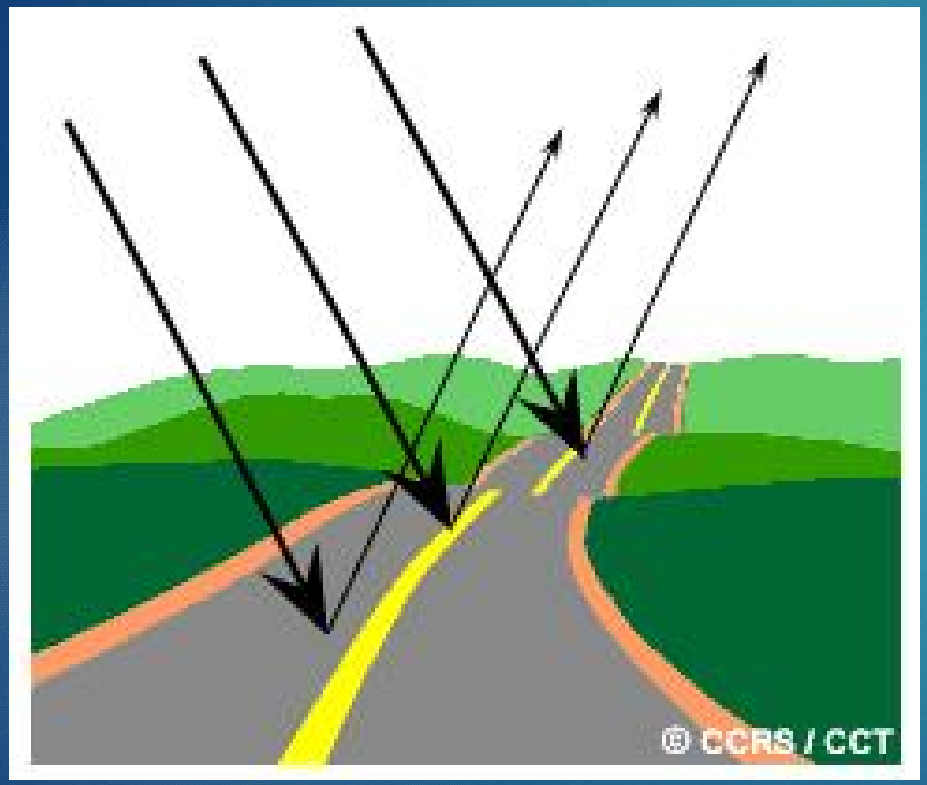
Flat, reflective surfaces,
e.g. mirrors, polished metal, surface of a calm pond of water

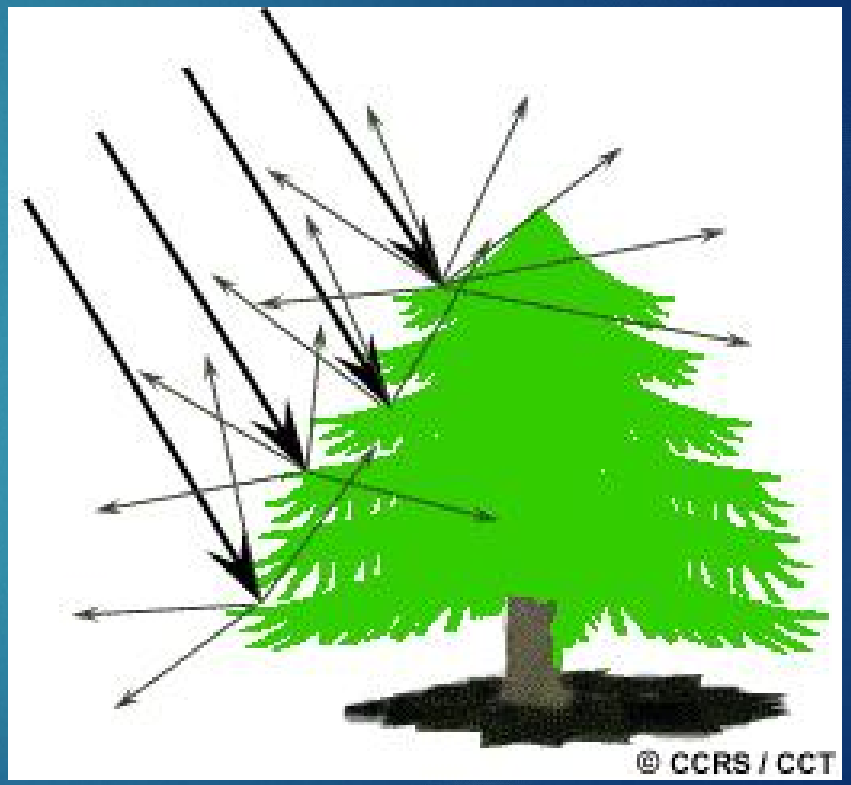


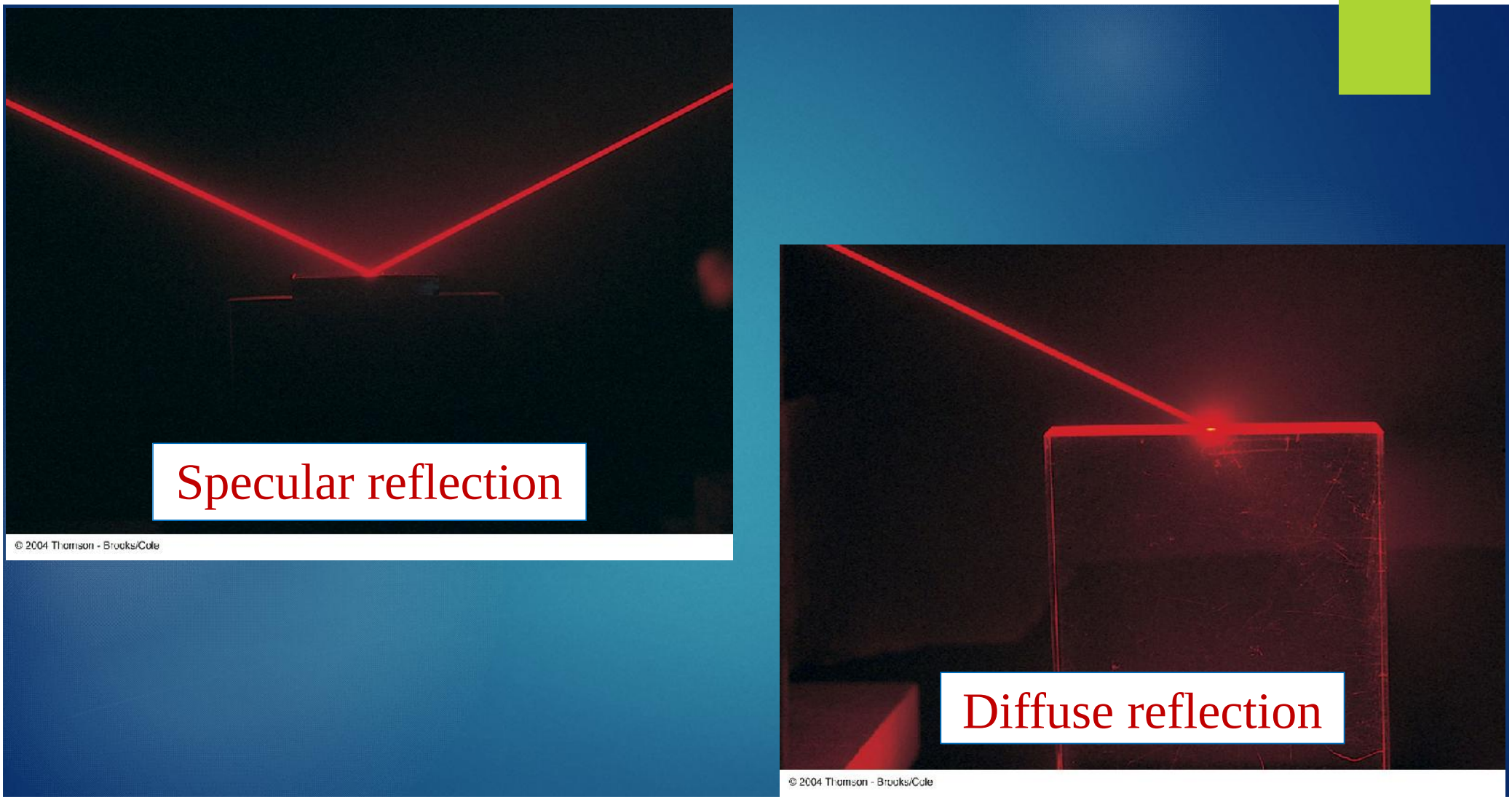
(*b*) Diffuse reflection

Rough surfaces,
e.g. paper, wood, unpolished metal, surface of a pond on a windy day

Specular reflection-Diffuse reflection






Specular reflection
© 2004 Thomson - Brooks/Cole
Diffuse reflection
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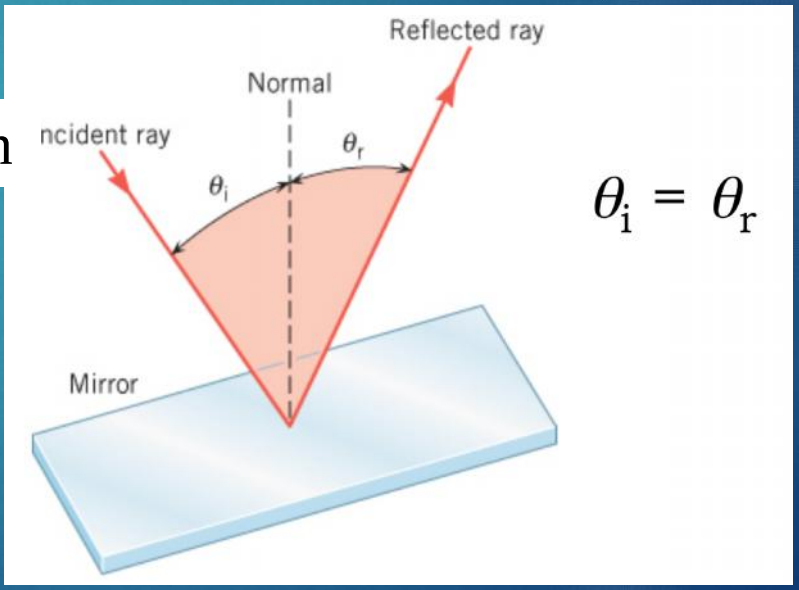
Law of reflection from flat mirrors

The incident ray, the reflected ray, and the normal to the surface all lie in the same plane, and the angle of incidence, θ_i , equals the angle of reflection, θ_r

Angle of incidence = Angle of reflection

The angle of incidence is formed between the incident ray and the normal.

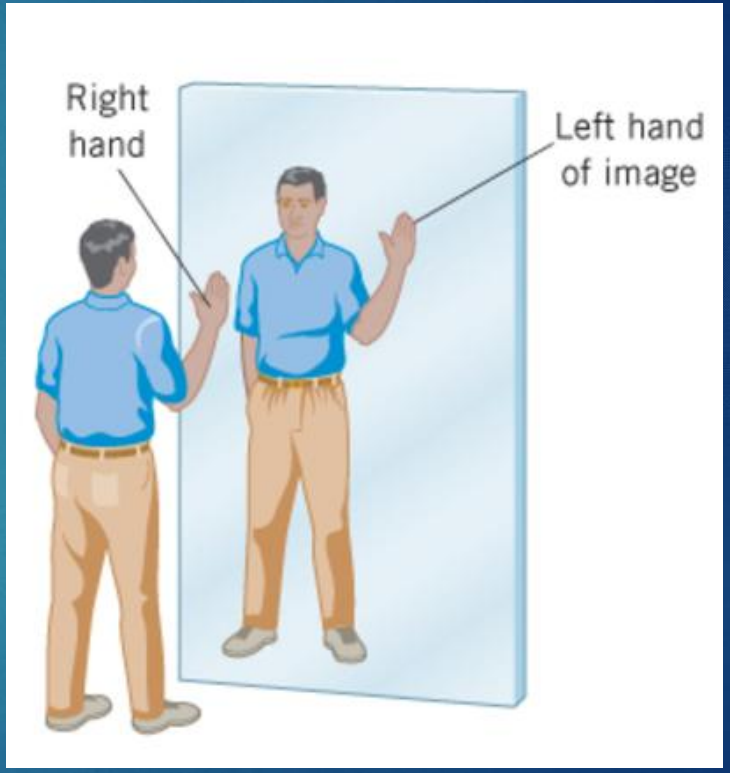
The angle of reflection is formed between the reflected ray and the normal



The Formation of Images by a Plane Mirror

Your image in a flat mirror has four properties:

1. It is upright.
2. It is the same size as you are.
3. The image is as far behind the mirror as you are in front of it.
4. It is reversed, left <--> right



The persons right hand becomes the images left hand.

Type of Image

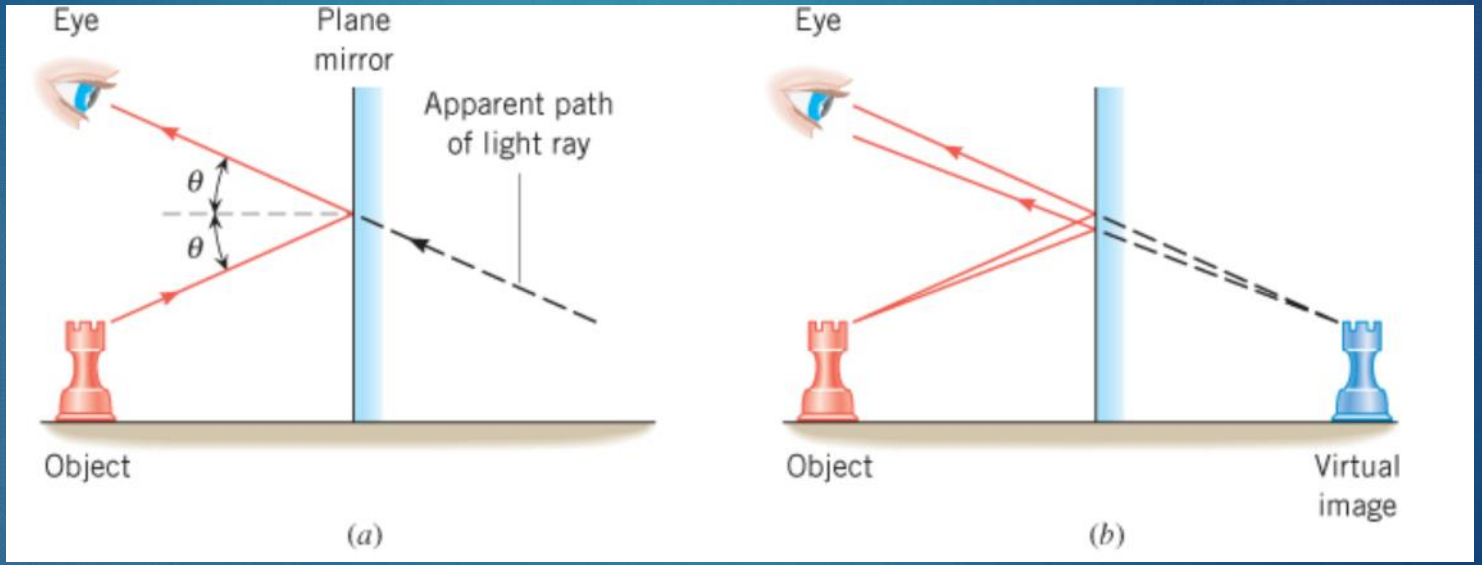
Real or Virtual

Enlarged or Reduced

Direct or inverted

The Formation of Images by a Plane Mirror

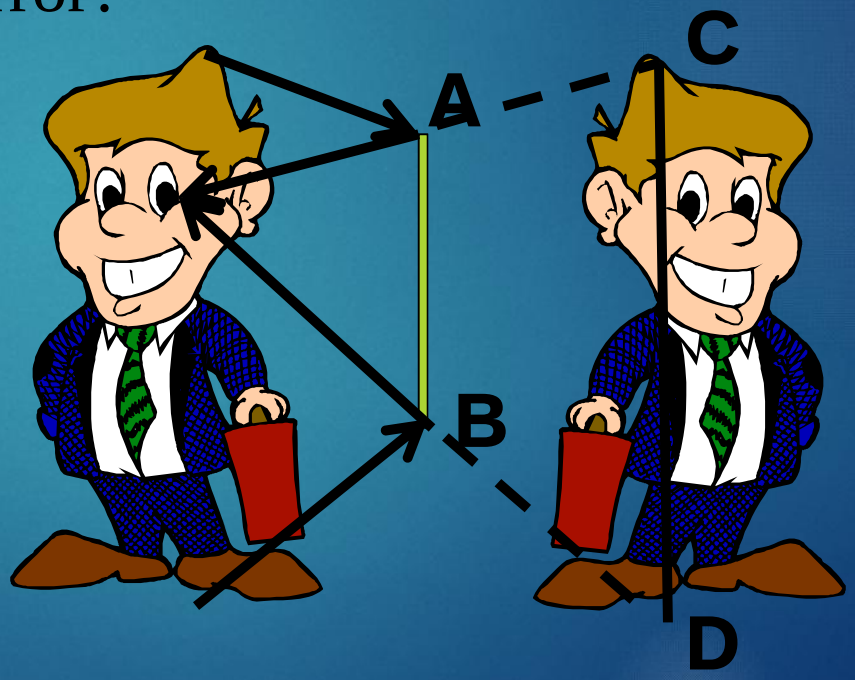
A ray of light from the top of the chess piece reflects from the mirror.
To the eye, the ray seems to come from behind the mirror.
Because none of the rays actually emanate from the image, it is called a ***virtual image*.**



Each point of an illuminated object emits a continuum of light rays in a range of directions. Two of these rays are shown here.

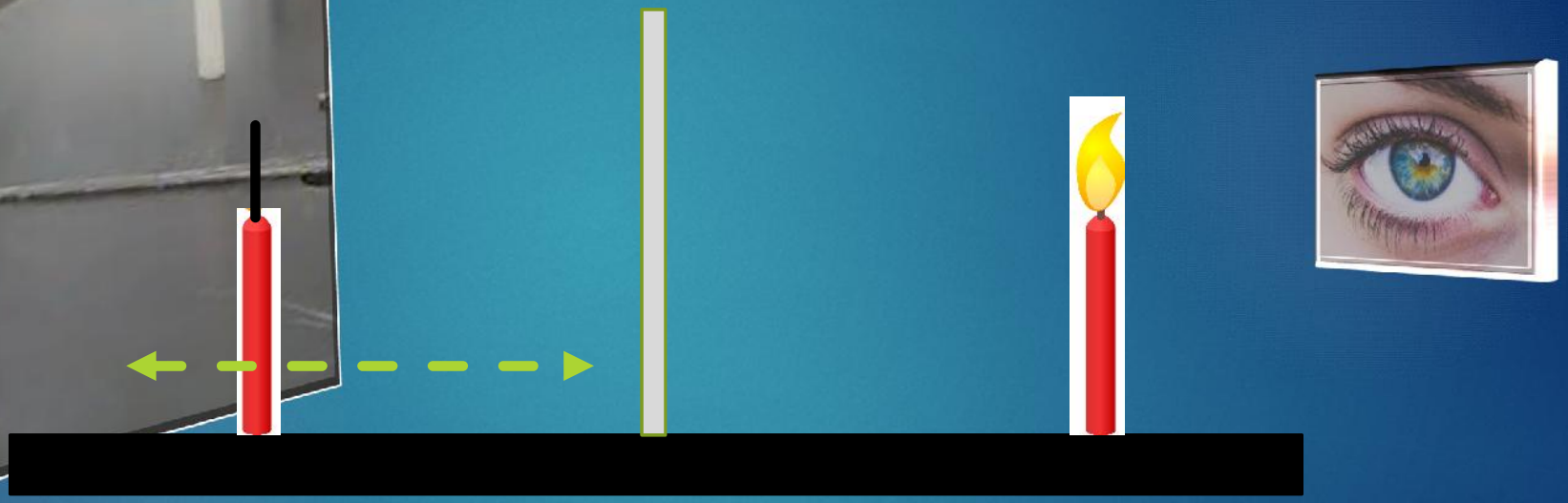
?

What is the minimum mirror height required for a person to see their full self in the mirror?

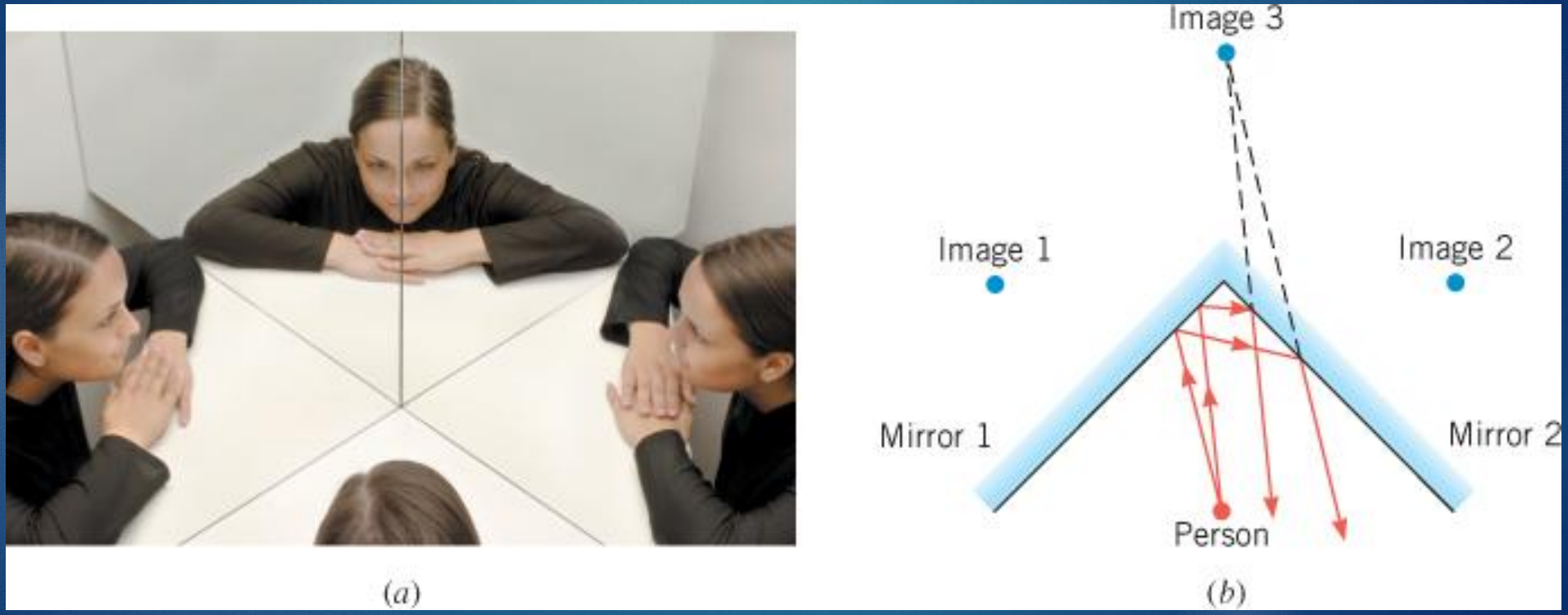


Hint: Compare AB to CD

Experiment



The Formation of Images by a Crossed Plane Mirror
Multiple Reflections



1- Reflection in plane mirror
2- Images properties
3- Multiple reflection
4- Laws of reflection
5- Double rotation of reflection angle