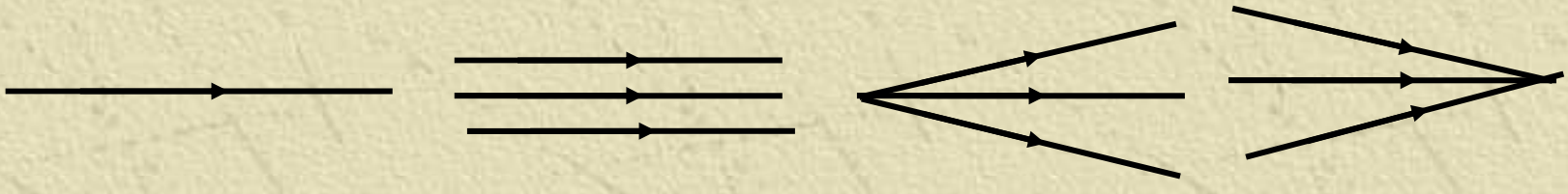
LIGHT

SECONDARY 3 PHYSICS

What is Light?

- Light is the part of the EM spectrum which we can see.
- Light travels in straight lines called **rays**.
- A bundle of rays is known as a beam of light.



A ray

A parallel beam

A divergent beam

A convergent beam

Luminous and Non-Luminous

- Luminous objects are those that give off light on its own.

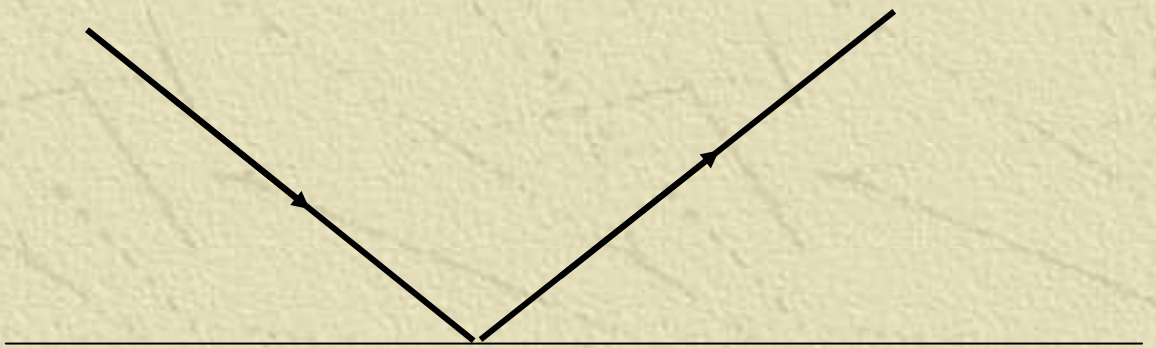
  Example: Light bulb, Sun

- Non-luminous objects are objects that do not give off light on its own.

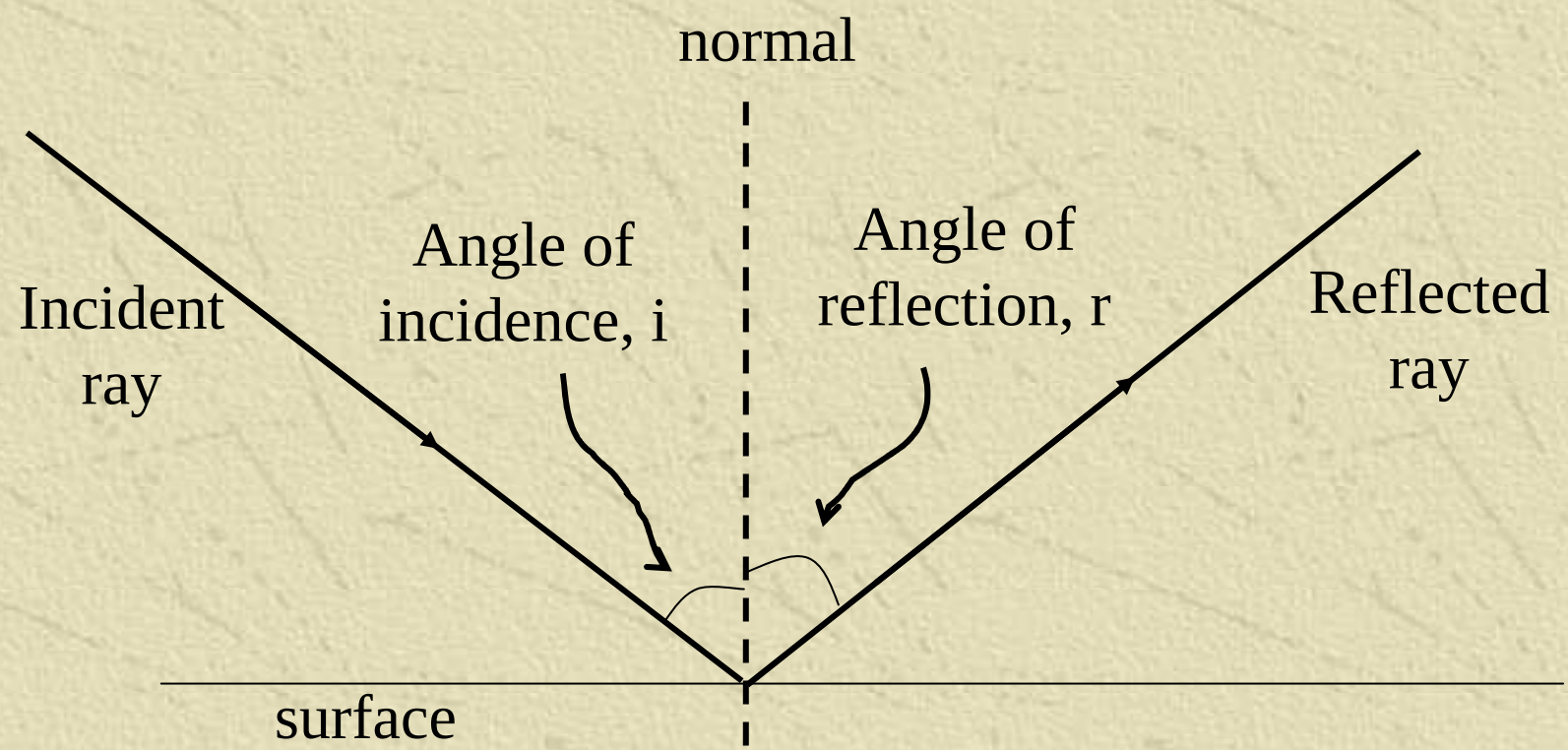
  Example: table, board, Moon

Reflection

- Reflection is the bouncing of light rays off a surface.
- We are able to see non-luminous objects as light is reflected off them.



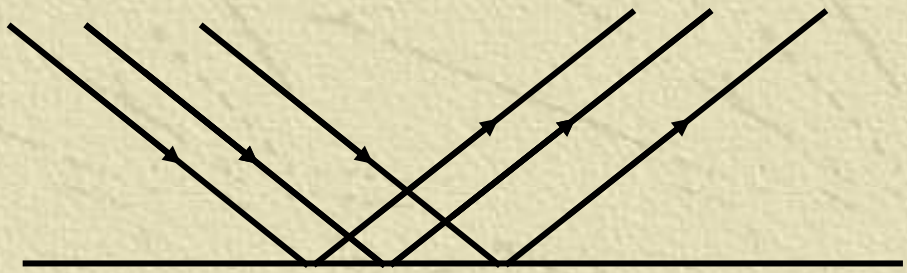
Reflection


normal
Incident ray
Angle of incidence, i
Angle of reflection, r
Reflected ray
surface

Laws of Reflection

- The incident ray, the reflected ray and the normal all lie on the same plane.
- The angle of incidence is equal to the angle of reflection.

Reflection for Different Surfaces



Regular reflection

- **On smooth surfaces**

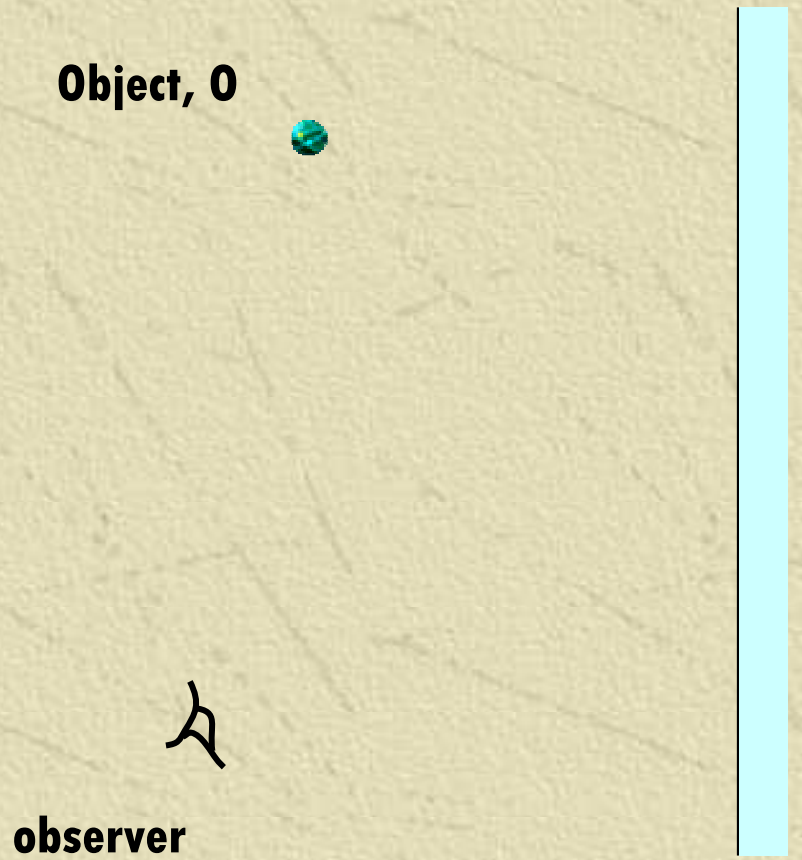
Diffused reflection

- **On rough surfaces**

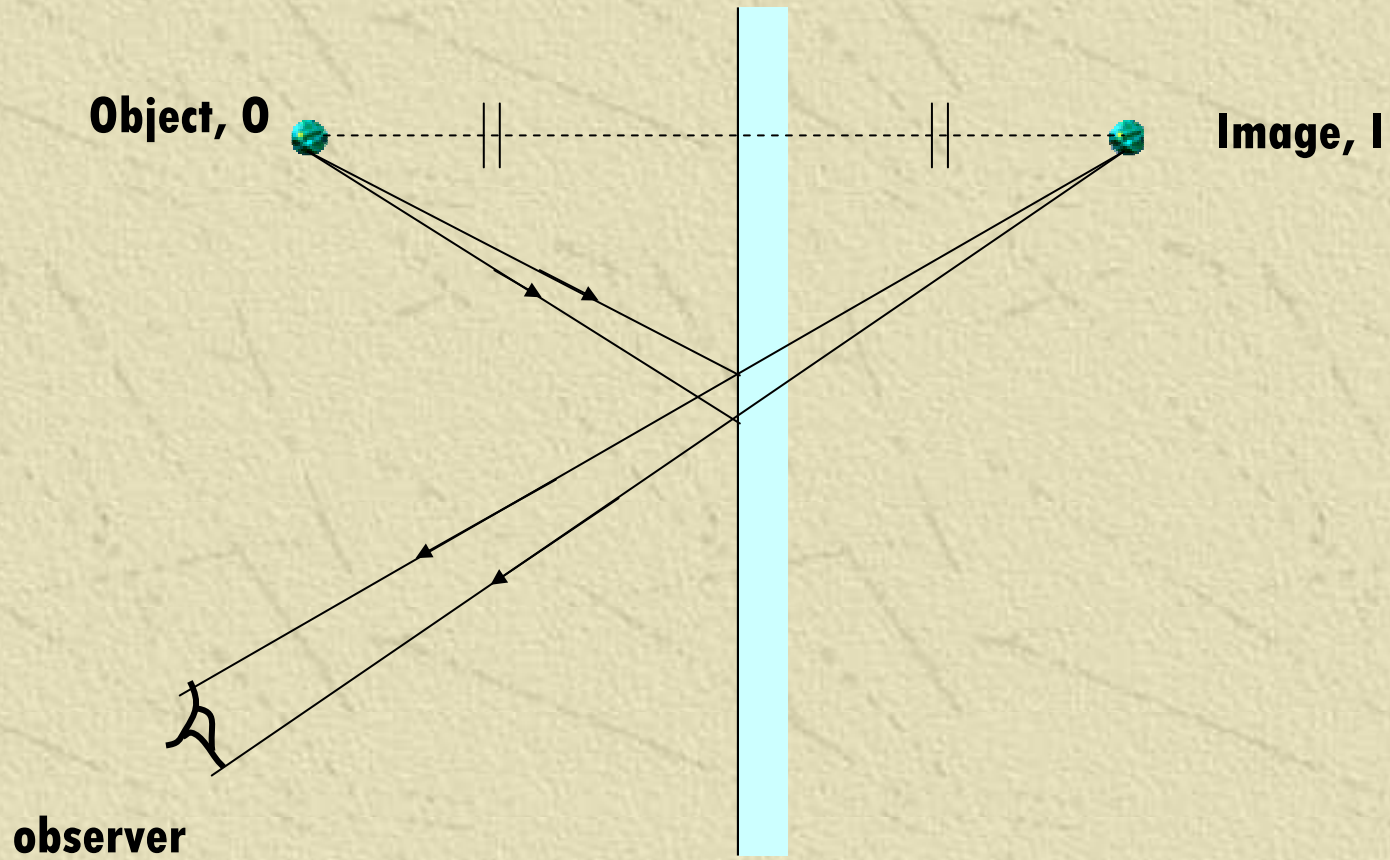
Properties of Image Formed by Plane Mirror

- Same size as the object
- Laterally inverted (left-to-right inversion)
- Upright
- Virtual (image cannot be caught on a screen)
- Object distance is equal to image distance

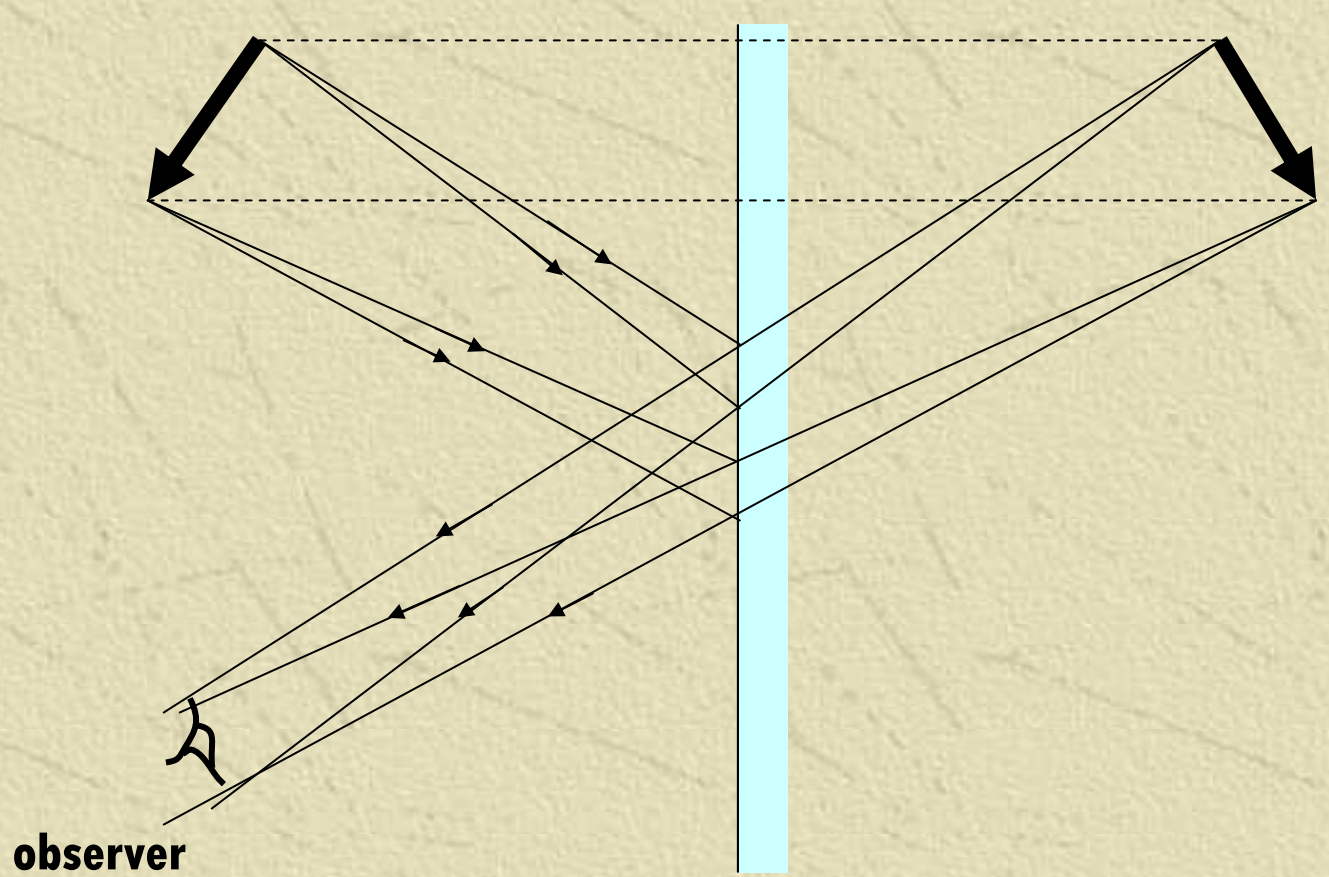
Ray Diagram for Reflection

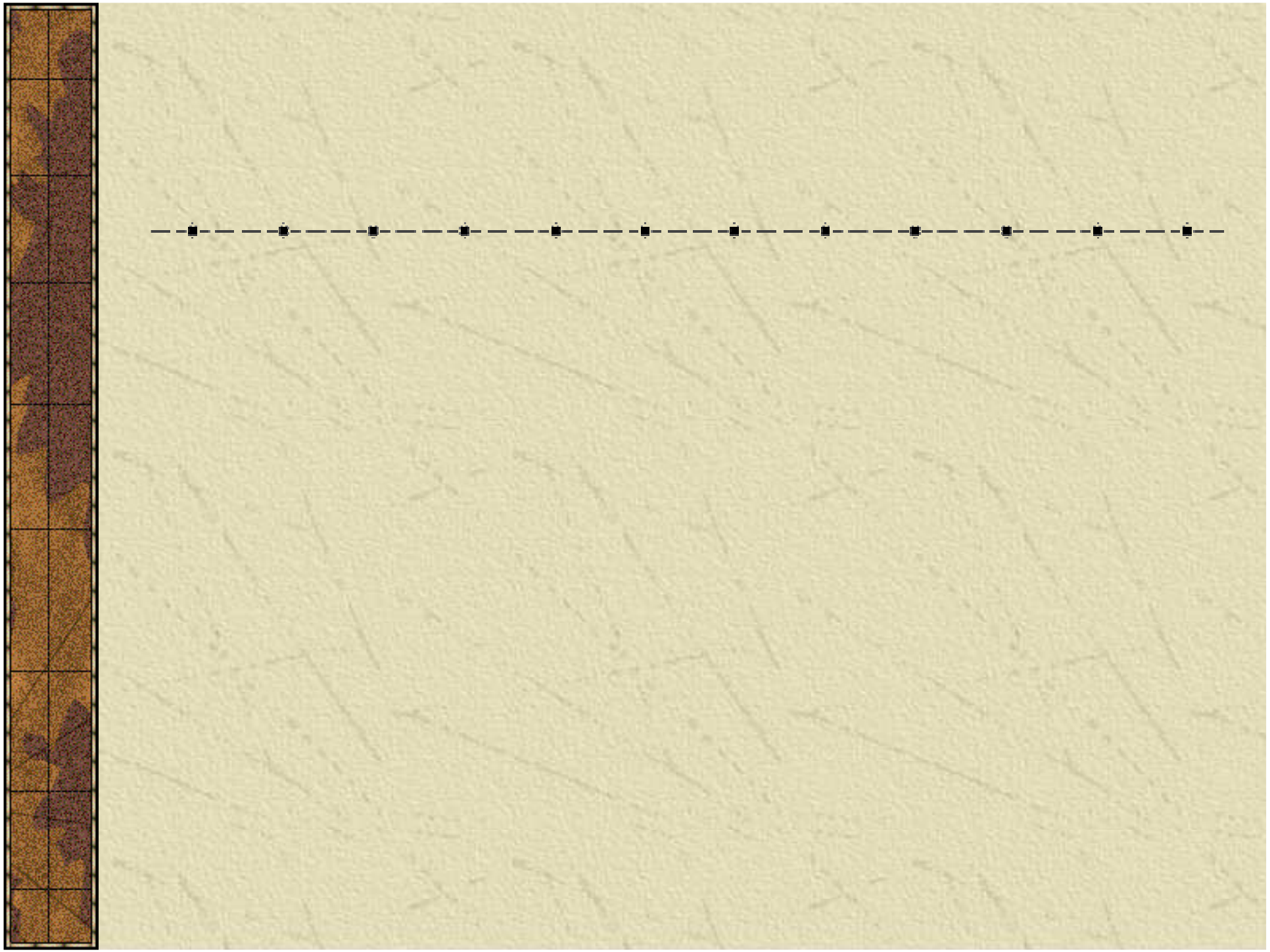


Ray Diagram for Reflection



Ray Diagram (Extended object)

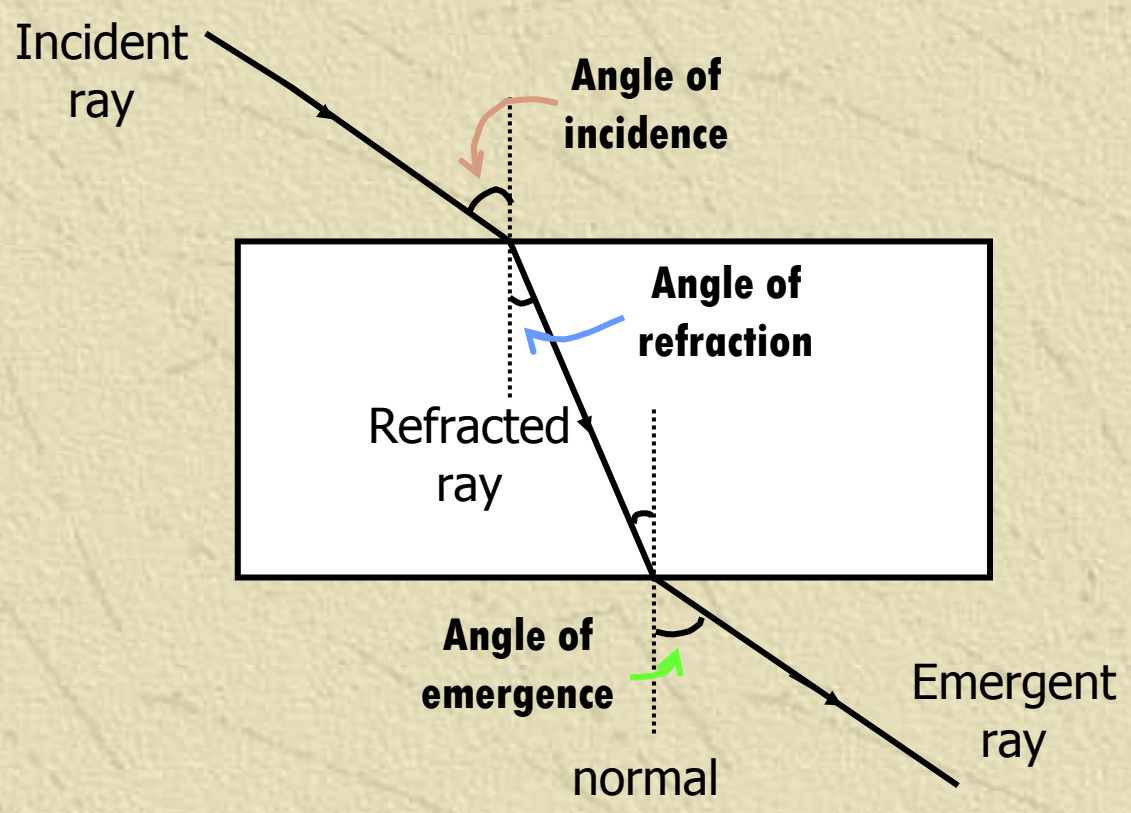




Refraction

- Refraction is the bending of light when it enters from one transparent medium into another.
- It is caused by the different speeds of light in different media.
- The greater the optical density of the medium, the slower the speed of light.

Refraction


Incident ray
Angle of incidence
Angle of refraction
Refracted ray
Angle of emergence
Emergent ray
normal

Laws of Refraction

- The incident ray, the refracted ray and the normal all lie in the same plane.
- For two particular media, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant.

$$n = \frac{\sin i}{\sin r} \qquad \text{(Snell's Law)}$$

Refractive Index

- When light passes from vacuum (or air) into a given medium (eg. water), the constant ratio of $\frac{\sin i}{\sin r}$ is known as the refractive index, n, for that medium.

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

Angle of incidence

Angle of refraction

Speed and Refractive Index

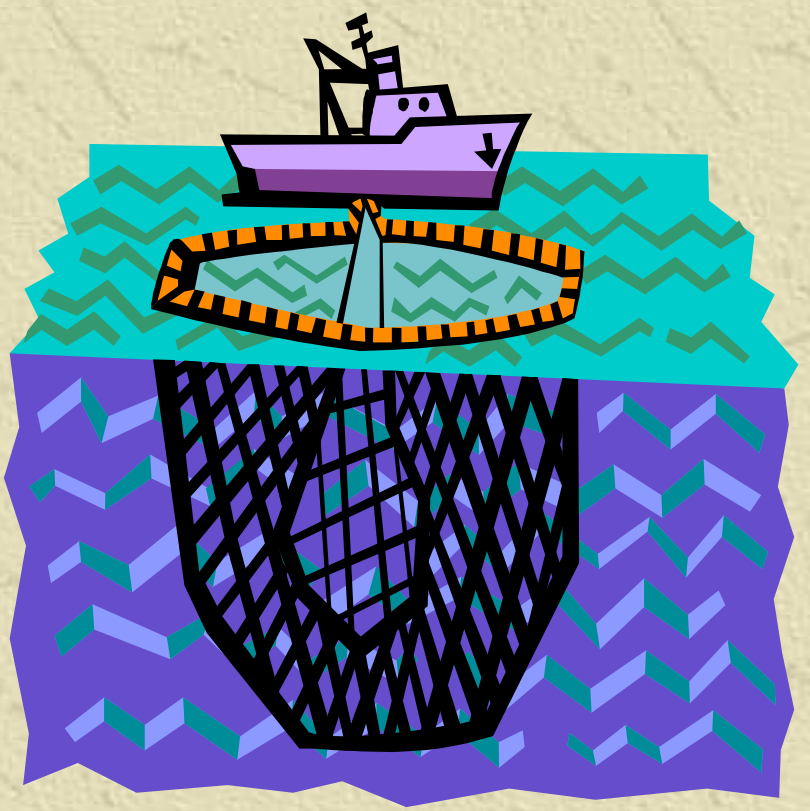
- Speed of light in vacuum = 3×10^8 ms^{-1}
- Light is found to move slower in optically denser mediums. (eg. glass and water)

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

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

Daily Phenomena of Refraction

- Swimming pool and ponds appear shallower than it really is.
- Object is at a deeper depth than where it appears to be.
- Bent objects in liquids



Total Internal Reflection

- Light ray is unable to exit a medium.
- Occurs when
  - Ray of light passes from a denser to a less dense medium
  - Angle of incidence in the denser medium is greater than the critical angle.

http://www.lightlink.com/sergey/java/java/totintrefl/index.html

Critical Angle

- The angle of incidence in the optically denser medium for which the angle of refraction in the less dense medium is 90°.

$$\sin c = \frac{1}{n}$$

Critical angle

Refractive index