



كلية المستقبل الجامعة
قسم الفيزياء الطبية
المرحلة الثانية

Medical Physics

Optics

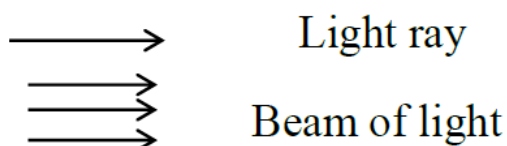
Lecture One

Lecturer: Mohammed Salih

Geometrical optics:

Optics : branch of physics concerning the Interaction of light with matter.

Geometrical Optics : branch of optics describes light propagation in terms of rays.



Light rays in the same medium travel in a straight line.

Light can travel through :

A: empty space B: medium like: air , glass , water

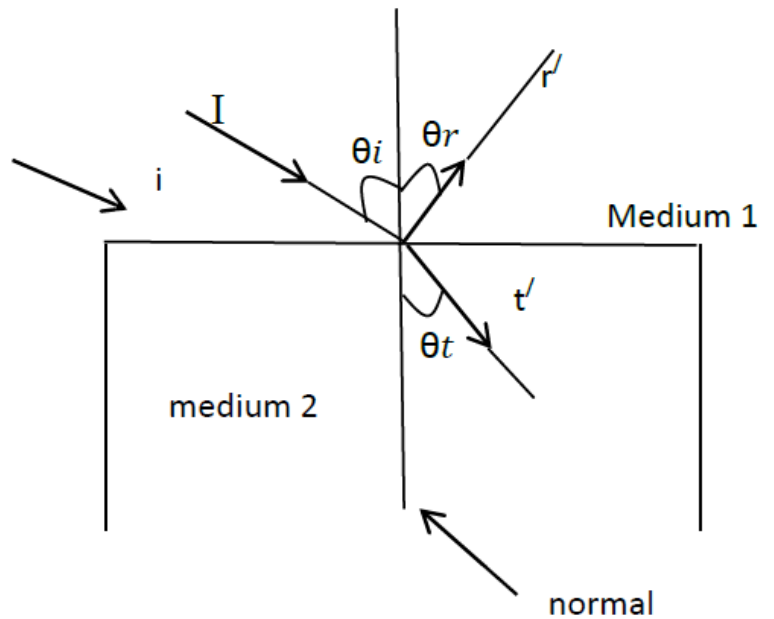
Laws of Reflection and Refraction:

When a ray of light approaches a smooth polished surface and the light ray bounces back, it is called the reflection of light. The incident light ray which lands upon the surface is said to be reflected off the surface. The ray that bounces back is called the reflected ray.

If a perpendicular were to be drawn on a reflecting surface, it would be called normal. The figure below shows the reflection of an incident beam on a plane mirror. The laws of reflection determine the reflection of incident light rays on reflecting surfaces, like mirrors, smooth metal surfaces and clear water.

Here, the angle of incidence and angle of reflection are with respect to normal and the reflective surface:

- I**: incidence ray
- R**: reflected ray
- T** : transmitted ray
- θ_i : incident angle
- θ_r : reflected angle
- θ_t : refracted angle



Sections of Reflection of Light:

Different sections of reflection of light are briefly discussed below :

- 1- Regular reflection is also known as specular reflection
- 2- Diffused reflection
- 3- Multiple reflection

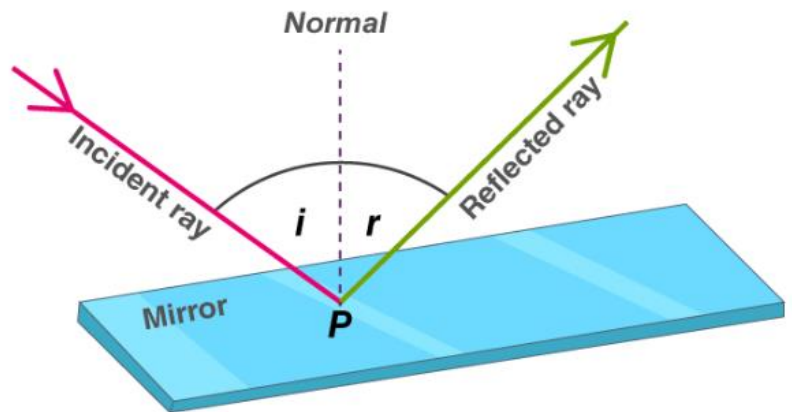
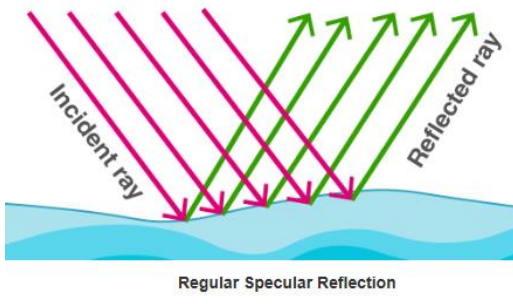
Specular Reflection :

Specular Reflection refers to a clear and sharp reflection, like the ones you get in a mirror. A mirror is made of glass which is coated with a uniform layer of a highly reflective material such as powder.

This reflective surface reflects almost all the light incident on it uniformly. There is not much variation in the angles of reflections between various points. This means that the haziness and the blurring are almost entirely eliminated. in specular reflection:

1-The angle of incidence = Angle of reflection : $\theta_i = \theta_r$

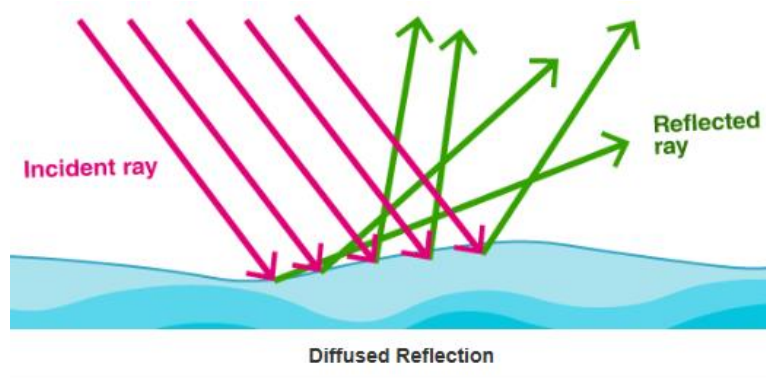
2- incident ray and reflection ray and normal are all in same plane .



Diffused Reflection:

Reflective surface other than mirrors, in general, has a very rough finish. This may be due to wear and tear such as scratches and dents or dirt on the surface. Sometimes even the material of which the surface is made of matters. All this leads to a loss of both the brightness and the quality of the reflection.

In the case of such rough surfaces, the angle of reflection when compared between points is completely haphazard. For rough surfaces, the rays incident at slightly different points on the surface is reflected in completely different directions. This type of reflection is called diffused reflection and is what enables us to see non-shiny objects.



Refractive index (n) :

It is the ratio between speed of light in vacuum to velocity in medium :

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

n: refractive index of medium .

c: velocity of light in vacuum .

v: velocity of light in medium .

Speed of light in vacuum : $C = 3 * 10^8 \text{m/sec}$

H.W : Refractive index of any medium ($n= 1$ or $n > 1$) Why??

Example 1 : If the velocity of light in medium ($V= 2 * 10^8$) m / sec.

Determine the refractive index of medium?

Sol:

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

$$n = \frac{3 * 10^8}{2 * 10^8} \longrightarrow n = 1.5$$

Example 2 : If the velocity of light in medium ($v = \frac{c}{4}$) m / sec . find the refractive index of medium?

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

$$v = \frac{c}{4}$$

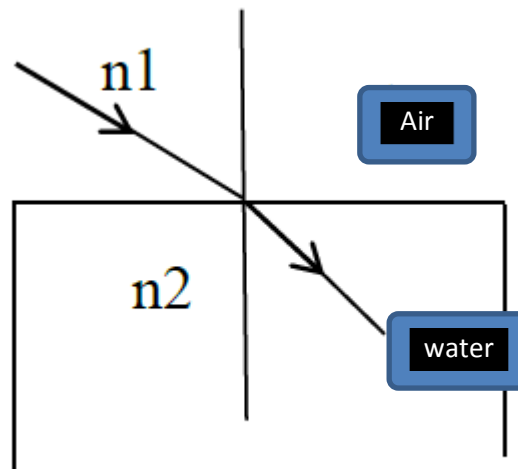
$$n = \frac{c}{c/4} \longrightarrow n = 4$$

Types of Reflection:

1- External Reflection:

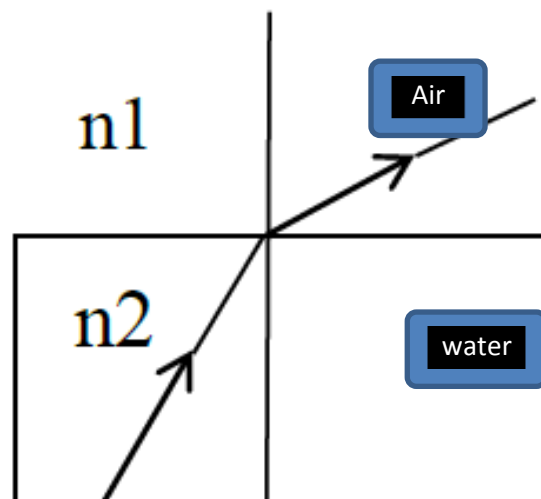
When the beam passes from a medium of low refractive index such as air to a medium of high refractive index such as water . that is means (n_2) greater than (n_1) .

$$\text{If } n_2 > n_1$$



2- Internal Reflection:

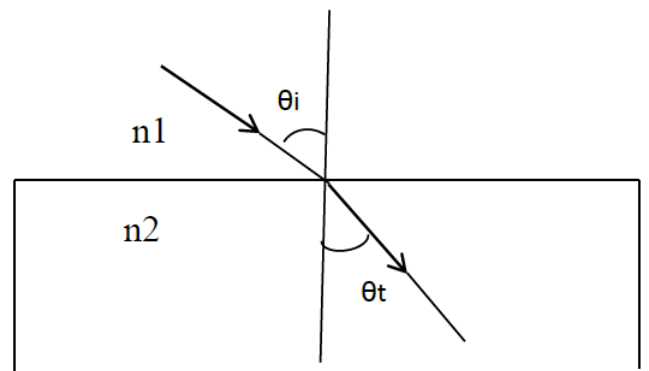
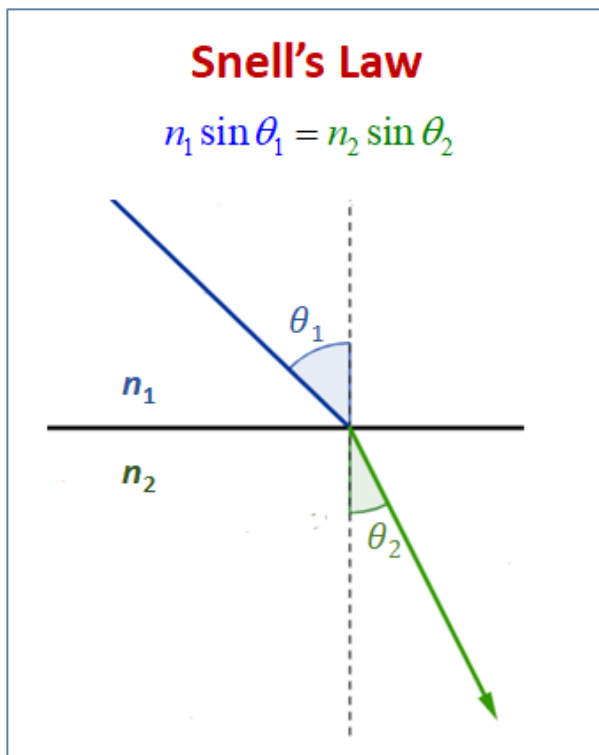
When the beam passes from a medium of high refractive index such as water to the medium of low refractive index such as air .



Snells Law :

Snell's law (also known as Snell–Descartes law and the law of refraction) is a formula used to describe the relationship between the angles of incidence and refraction, when referring to light or other waves passing through a boundary between two different isotropic media, such as water, glass, or air.

Snells law gives a relationship between the angles of incidence and refraction when a ray of light travels from a rarer medium of refractive index to a denser medium of refractive index.



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

or $\frac{v_2}{v_1} = \frac{\sin \theta_2}{\sin \theta_1}$

Note: Refractive index

n of air = 1

n of water = 1.33

n of glass = 1.53