electric field then a seen and unseen radiation is produced which travels in all directions in the form of wave with a velocity $3 \times 10^8 ms^{-1}$. This is a transverse wave and no material medium is required for its propagation.

Quantum Theory:

In 1900. **Max kari Ernst Ludwing Planck** first put forward this theory later it was extended by **Albert Einstein.** According to this theory, ***the radiation of light or any energy from an object is not continuous. Radiation is discrete it means that it is emitted in the form of packets which is known as quanta.*** Light is composed of ***innumerable descrete quanta.*** These quanta are called **Photon**.

Please move this

Classical optics:

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Geometrical optics, or ray optics, describes light propagation in terms of rays. The ray in geometric optics is an abstraction useful for approximating the paths along which light propagates under certain circumstances.

The simplifying assumptions of geometrical optics include that light rays:

- propagate in straight-line paths as they travel in a homogeneous medium
- bend, and in particular circumstances may split in two, at the interface between two dissimilar media
- follow curved paths in a medium in which the refractive index changes
- May be absorbed or reflected.

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2. **Law of independence of light rays:**

   Light rays do not disturb one another when they intersect. If several rays are passing through a medium simultaneously in different directions, then the path of any ray is the same as it would be if all others were absent. The intersection of rays does not hinder the rays from propagating independently of each other. Rays of light always preserve their individuality.

3. **Law of reversibility of path:**

   If the path of a light ray is reserved, it will exactly retrace its path, irrespective of the number of reflections and refractions.

Reflection

the number of reflections and refractions.

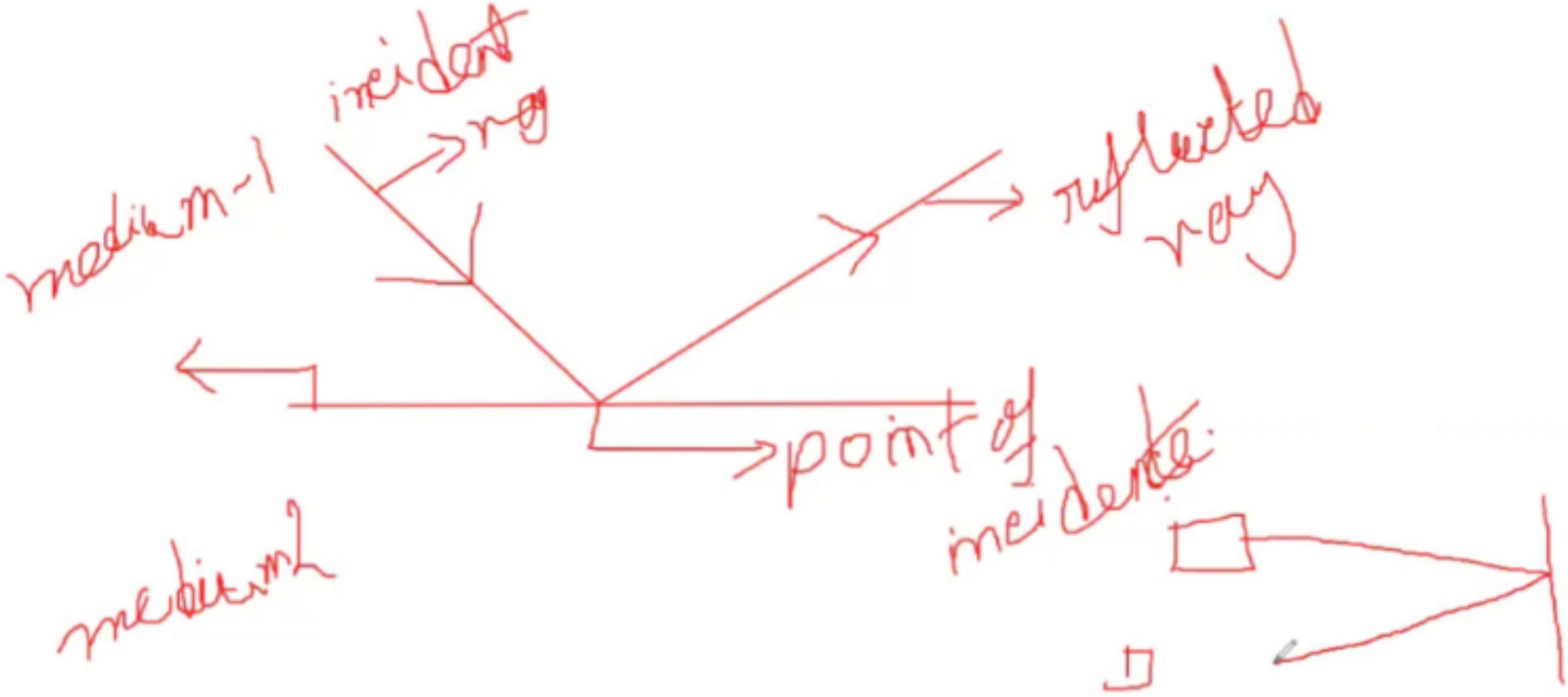
Reflection

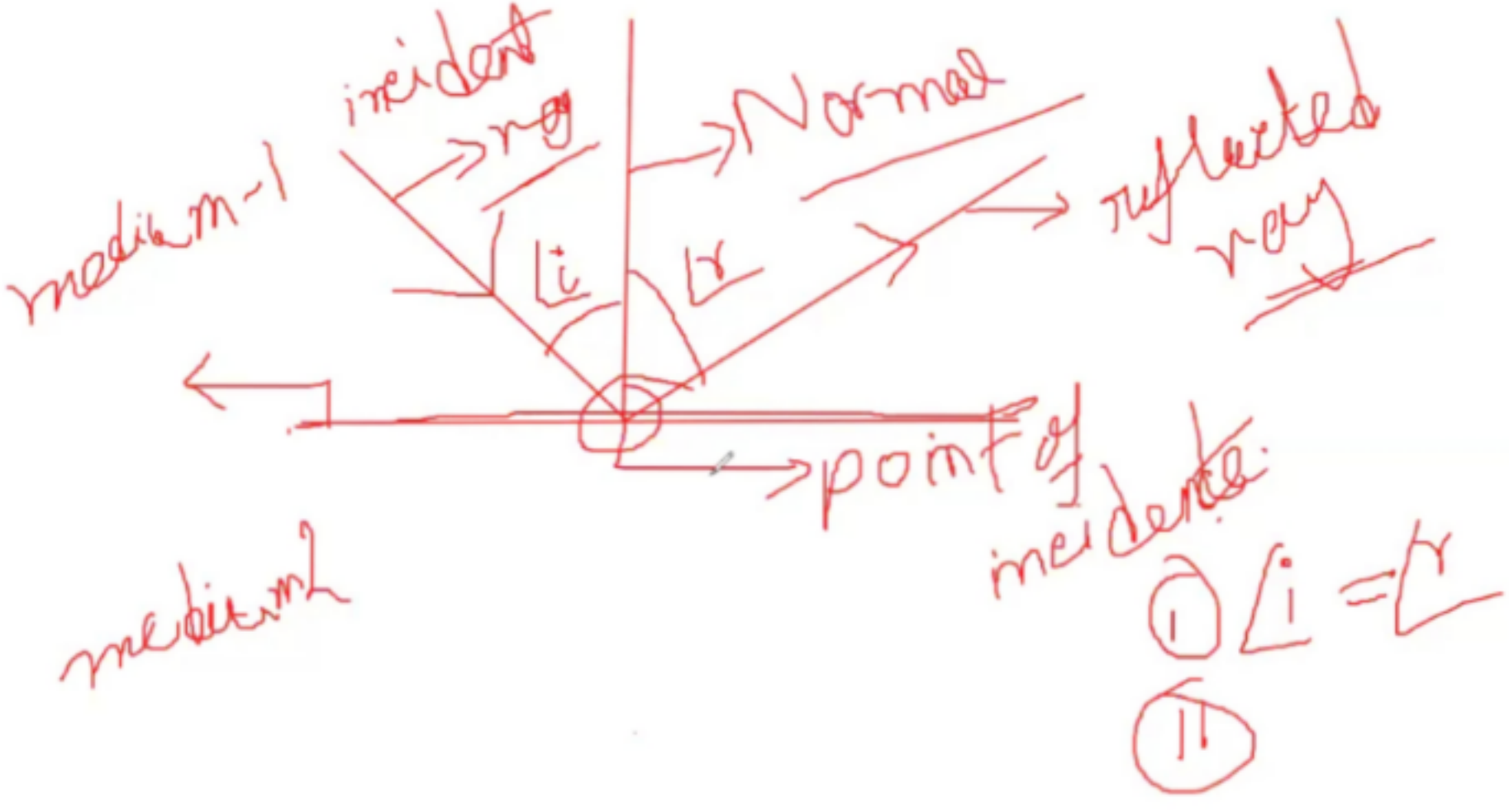
It is a phenomenon of light in which a ray of light form one medium strikes a smooth polished surface and returns back into the same medium.

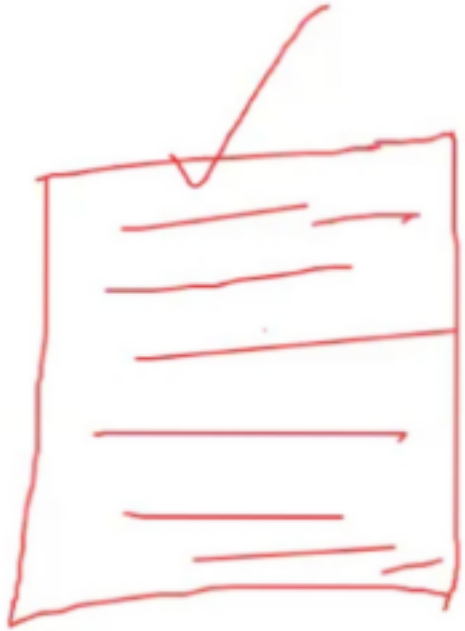
Laws of reflection

The two laws of reflection of light are:-

1. ***The incident ray, the normal and the reflected ray lie in the same plane.***


incident ray
medium-1
reflected ray
point of incidence
medium-2


incident ray
Normal
medium-1
reflected ray
$\angle i$
$\angle r$
point of incidence
medium 2
① $\angle i = \angle r$
②

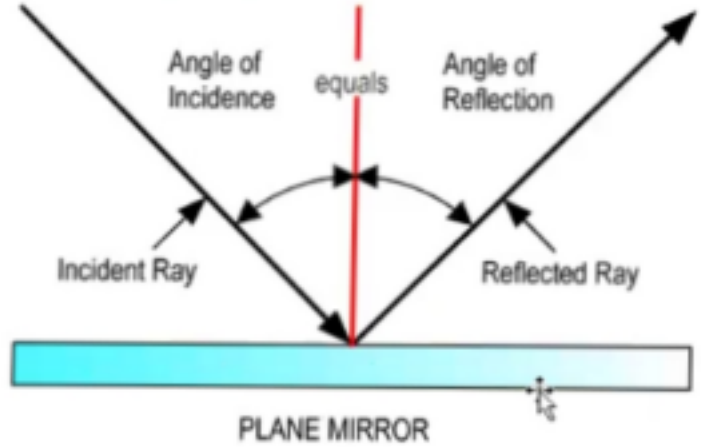


Laws of reflection

The two laws of reflection of light are:-

1. ***The incident ray, the normal and the reflected ray lie in the same plane.***

2. ***The angle of incidence is equal to the angle of reflection of a ray of light striking a smooth polished surface i.e., $i = r$.***



Mirror

Mirror

The smooth surface from which regular reflection of light occurs is called a mirror.

Mirror are two types; such as –

1. **Plane mirror:** if the surface is plane and smooth and regular reflection of light takes place from that surface then it is called plane mirror.

2. **Spherical mirror:** Spherical mirror is that mirror whose reflecting surface is a portion of a hallow sphere of glass. It is of two main types, concave mirror and convex mirror.
   (a) **Concave Mirror:** - A concave mirror is that spherical mirror in which the process of reflection takes place at the concave or curved surface as shown under:

2. **Spherical mirror:** Spherical mirror is that mirror whose reflecting surface is a portion of a hallow sphere of glass. It is of two main types, concave mirror and convex mirror.

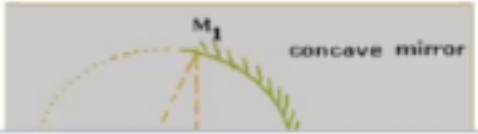
(a) **Concave Mirror:** - A concave mirror is that spherical mirror in which the process of reflection takes place at the concave or curved surface as shown under:

Concave mirror

(b) **Convex Mirror:** - A convex mirror is that M' mirror in which the process of reflection takes place at the convex or bulging out surface as shown under:

Convex mirror

Terms associated with spherical mirrors



The various terms associated with spherical mirrors are:

1) Center of curvature:- The center of curvature of a spherical mirror is the central point of the hallow sphere of which the mirror is a part.

2).Radius of curvature:- The radius of curvature of a spherical mirror is the radius of the hallow sphere of which the mirror is a part, in other words, it is the distance between the center of curvature and pole of a mirror. It is represented by letter R.

3).Pole:- The pole of spherical mirror is the center or middle point of a spherical mirror. It is represented by letter P.

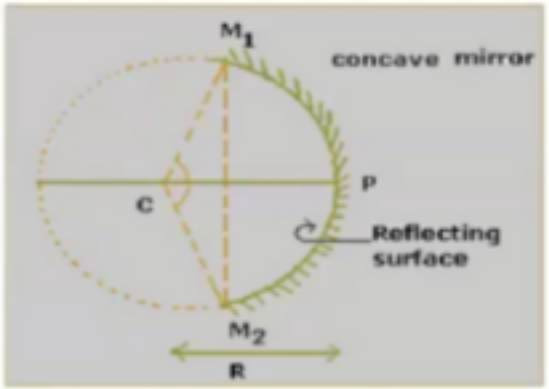
4).Principle axis:- Principle axis of a spherical mirror is the line passing through the center of curvature and its pole. In other words, it is the line joining the pole and center of curvature of a mirror.

5).Secondary axis:- Any straight line other than the principal axis passing through the center of a spherical mirror is referred to as secondary axis. It is usually represented by letters SS'.

6).Aperture of a mirror:- Aperture of a mirror is the portion of a mirror from which reflection of light takes place. In other words it is the maximum size of a mirror. It is usually

Convex mirror

Terms associated with spherical mirrors



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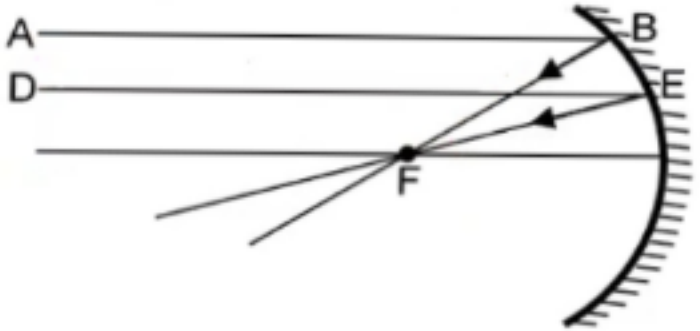

Position: at the focal plane

Nature: Real and inverted

Size: Extremely diminished

2. When the object is placed beyond the center of curvature

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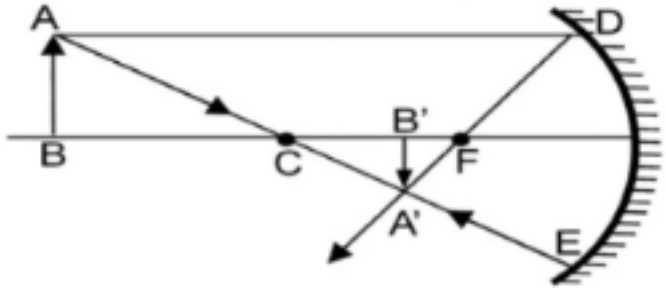
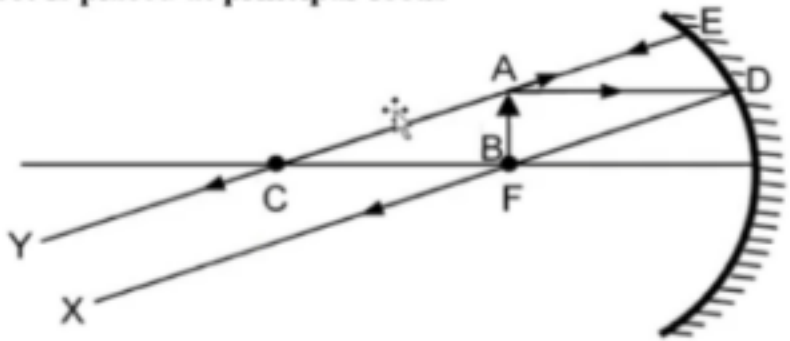


Position: in between the center of curvature and the principle focus
Nature: Real and inverted
Size: diminished

3. When the object is placed at the center of curvature

Size: Magnified.

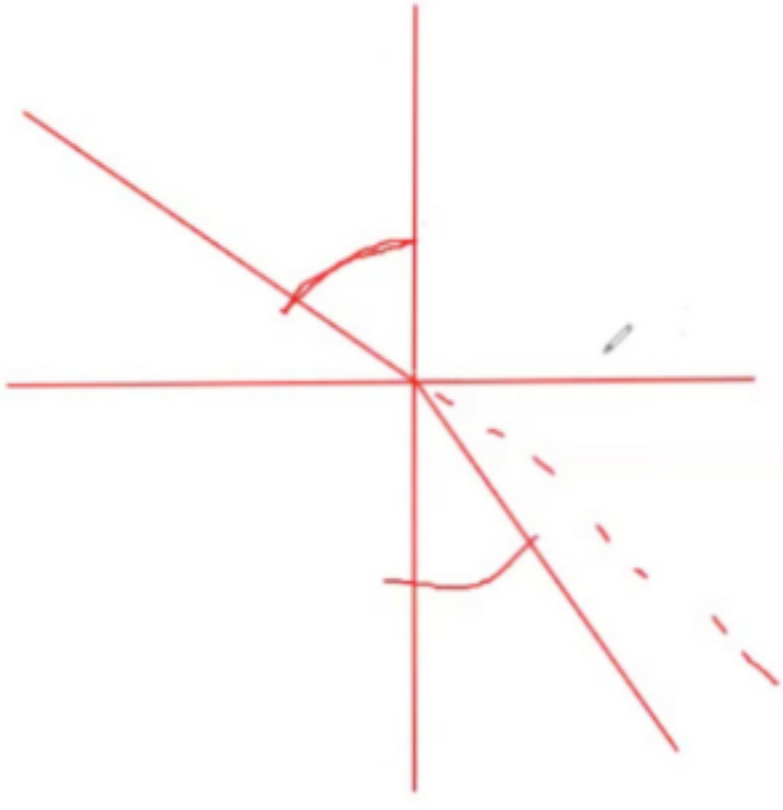
5. **When the object is placed at principal focus**



Position: at infinity
Nature: Real and inverted or virtual and erect
Size: Extremely Magnified.

6. **When the object is placed between the principal focus and the pole**

medium-1



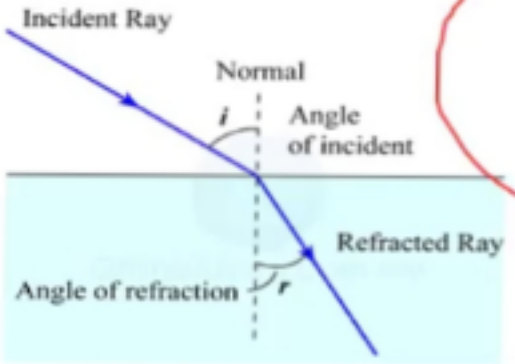
μ

medium

Laws of refraction

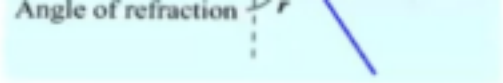
The incident ray, the refracted ray and the normal to the refracting surface at the point of incidence all lies in the same plane. The ratio of sine of angle of incidence of the sine of the angle of refraction is a constant for a given pair media i.e.

$$\text{Sin } i / \text{Sin } r = \text{constant} = \mu$$



Refractive index

Refractive index, also called index of refraction, measure of the bending of a ray of light



Refractive index

Refractive index, also called index of refraction, measure of the bending of a ray of light when passing from one medium into another. If i is the angle of incidence of a ray in vacuum (angle between the incoming ray and the perpendicular to the surface of a medium, called the normal) and **r** is the angle of refraction (angle between the ray in the medium and the normal), the refractive index **μ** is defined as the ratio of the sine of the angle of incidence to the site of the angle of refraction; i.e.,

$$\mu = \sin i / \sin r.$$

Refractive index is also equal to the velocity of light c of a given wavelength in empty space divided by its velocity v in a substance, or

$$\mu = c / v.$$

Snell's law

Snell's law is defined as *"The ratio of the sine of the angle of incidence to the sin of the angle of refraction is a constant, for the light of a given color and for the given pair of*

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Snell's law is defined as ***"The ratio of the sine of the angle of incidence to the sin of the angle of refraction is a constant, for the light of a given color and for the given pair of media"***. Snell's law formula is expressed as:

Sin i / Sin r = constant= μ

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

$$\mu$$

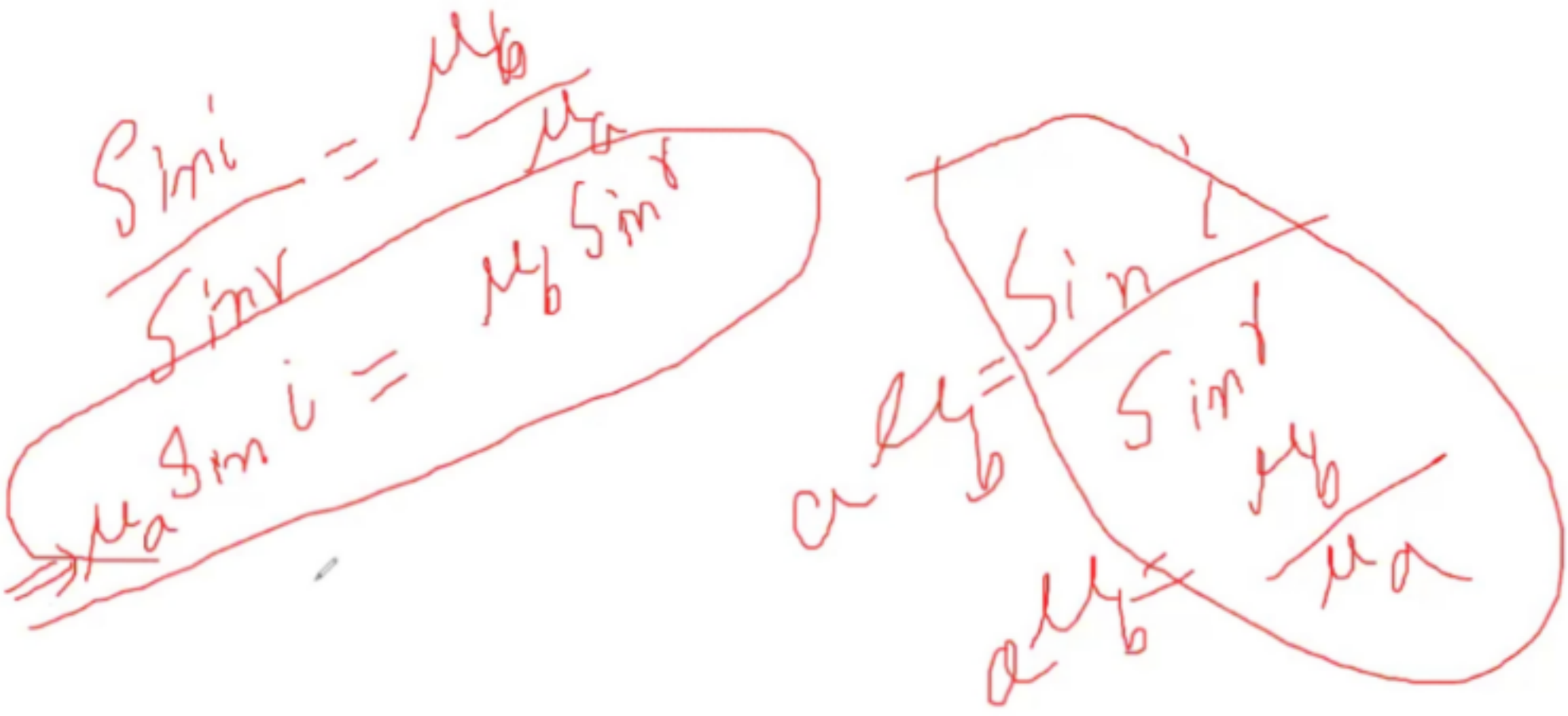
$${}_a\mu_b = \frac{\mu_b}{\mu_a}$$

$${}_a\mu_b = \frac{c_a}{c_b}$$

$$a\mu_b = \frac{1}{b\mu_a}$$

$$a\mu_b = \frac{\sin i}{\sin r}$$

$$a\mu_b = \frac{\mu_b}{\mu_a}$$


$\frac{\sin i}{\sin r} = \frac{\mu_b}{\mu_a}$
$\mu_a \sin i = \mu_b \sin r$
$\sin i = \frac{\mu_b}{\mu_a}$
$\sin r = 1$
$\mu_a \sin i_c = \mu_b$
$\sin i_c = \frac{\mu_b}{\mu_a}$

medium is called the critical angle between those two media. It is denoted by θ_c.

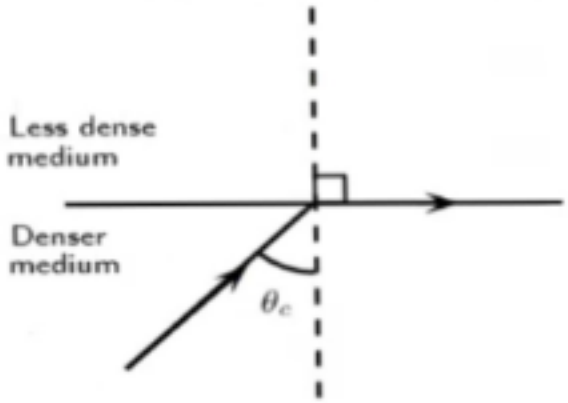


Fig: Critical Angle

Suppose a ray of light from a denser medium 'a' is refracted in a rarer medium 'b'. If the ray of light is incident between the boundary surface of the pair of media at an angle equals the critical angle, i.e., $i = \theta_c$, the ray will be refracted along the boundary surface and the angle of refraction is $r = 90^0$.So, the refractive index of the medium 'b' with respect to the medium 'a' is,

$$a^{\mu}b = \frac{\sin i}{\sin r} = \frac{\sin \theta_c}{\sin 90^0} = \frac{\sin \theta_c}{1}$$

$$or, a^{\mu}b = \sin \theta_c$$