Optics Refrection-1

LIGHT

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- Light is a form of energy, which is propagated as an **electromagnetic wave**.
- It is the radiation which makes our eyes able to 'see the object. Its speed is **3 x 10^8 m/s**. It is the form of energy. It is a **transverse wave**.
- It takes **8 min 19s** to reach on the earth from the sun.
- When light falls on the surface of an object it can either be
    1. **Absorbed -** If an object absorbs all the light falling on it, then it will appear perfectly black for example a blackboard
    2. **Transmitted -** An object is said to transmit light if it allows light to pass through itself and such objects are transparent.
    3. **Reflected -** If an object sends back light rays falling on its surface then it is said to have reflected the light

Reflection of Light

- When a ray of light falls on a boundary separating two media comes back into the same media, then this phenomenon is called the reflection of light.

Laws of Reflection of light

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

Reflection from Plane Mirror

- If an object moves towards a plane mirror **with speed v**, relative to the object the moves towards it with **a speed 2v**.
- To see his full image in a plane mirror, a person required a mirror of at least half of his height.

Refraction of Light

- The phenomenon of deviation of light rays from its path when it travels from one transparent medium to another medium is called refraction of light.
- The cause of refraction is due to the different speed of light in a different medium.

- When a ray of light enters from one medium to another medium, its frequency and phase do not change, but wavelength and velocity change.
- Due to refraction from Earth's atmosphere, the stars appear to twinkle.

Laws of Refraction:

- The incident ray, the refracted ray and the normal at the point of incidence all three lie in the **same plane.**
- The ratio of sine angle of incidence to the sine angle of refraction remains constant for a pair of media i.e.
  Sin i/Sin r = constant = $\mu 2/\mu 1$, this law is known as Snell's law

Application of Refraction:

- When light travels through a denser medium towards a rarer medium it deviates away from the normal, therefore a pond appears shallower.
- A coin appears at **lesser depth** in water.
- Writing on a paper appears **lifted** when a glass slab is placed over the paper.

Critical Angle:

- The angle of incidence in a denser medium for which the angle of refraction in the rarer medium becomes 90°, is called the critical angle.

Total Internal Reflection:

- When a light ray travelling from a denser medium to the rarer medium, in this incident at the interface at an angle of incidence greater than the critical angle, then light rays reflected back into the denser medium, this phenomenon is known as **total internal reflection**
- Sparkling of diamond, mirage and looming, shinning of the air bubble in water and optical Fibre are examples of total internal reflection.

Spherical Mirror:

Type of Spherical Mirrors-

1. Concave mirror

- The image formed by a concave mirror is generally real and inverted.

2. Convex mirror

- The image formed by a convex mirror is always virtual, erect and diminished.

Uses of Concave Mirror

- As a shaving mirror
- As a reflector for the headlights of a vehicle, searchlight.
- In ophthalmoscope to examine the eye, ear, nose by doctors.
- In solar cookers.

Uses of Convex Mirror

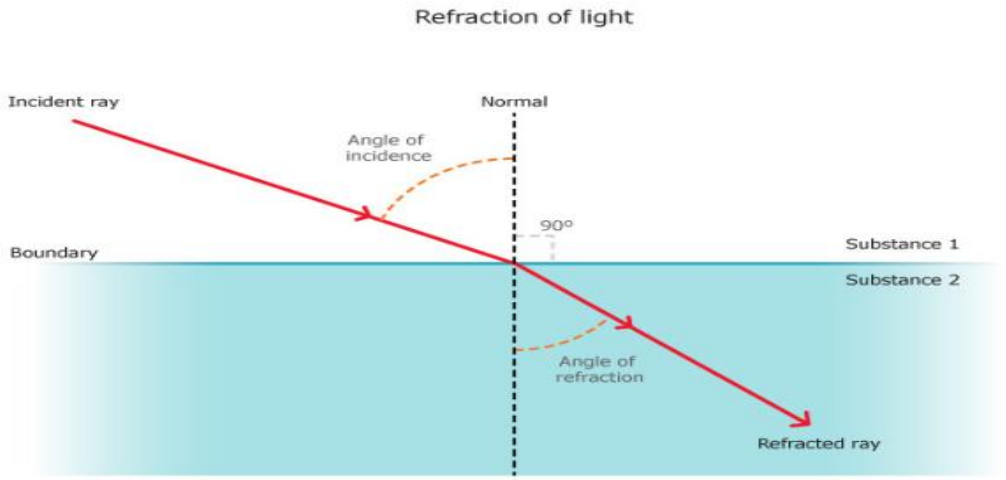
- As a rear view mirror in the vehicle because it provides the maximum rear field of view and image formed is always erect.
- In sodium reflector lamp.

Optics Refrection-2

Refraction is the phenomenon that takes place due to the bending of light when it travels from medium to another. The bending is caused due to the differences in density between the two substances.

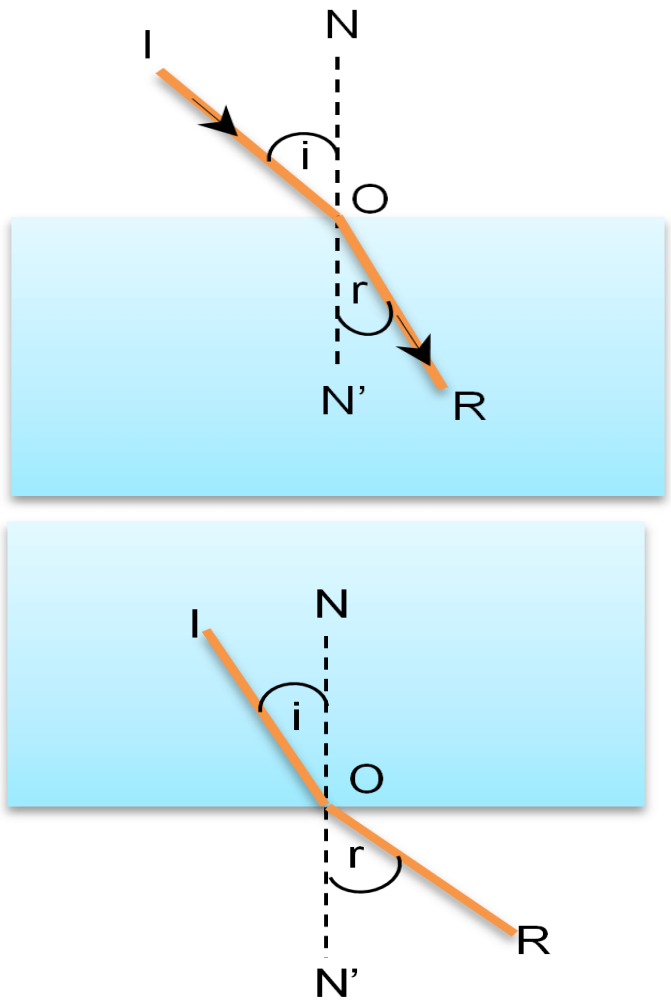
Change of Speed Results in Change in Direction

A light ray refracts whenever it travels at an angle into a medium of different refractive index. This change in speed results in a change in direction. As an example, consider air travelling into water. The speed of light decreases as it continues to travel at a different angle.



Rules of refraction of light

- When a ray of light goes from an optically rarer medium to an optically denser medium, it bends towards the normal. In this case the angle of refraction will be smaller than the angle of incidence.
- When a ray of light goes from an optically denser medium to an optically rarer medium, it bends away from the normal. In this case the angle of refraction will be greater than the angle of incidence.



Laws of Refraction of Light

- The incident ray refracted ray, and the normal to the interface of two media at the point of incidence all lie on the same plane.
- The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant. This is also known as Snell's law of refraction.

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

Refractive Index

The refractive index, also called the index of refraction, describes how fast light travels through the material. The refractive Index is dimensionless. For a given material, the refractive index is the ratio between the speed of light in a

vacuum (c) and the speed of light in the medium (v). If the refractive index for a medium is represented by n, then it is given by the following formula:

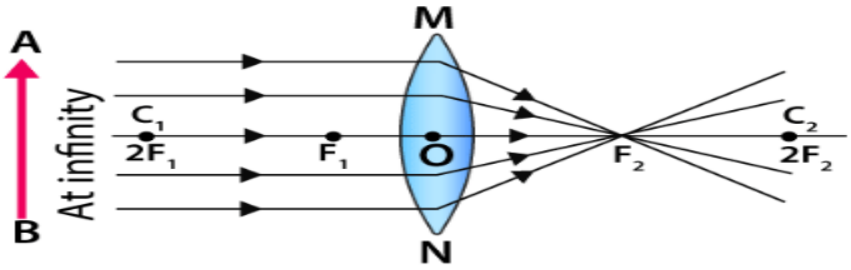
$$n = \frac{c}{v}$$

S No.	Name of the material medium	Refractive index value
1.	Diamond	2.42
2.	Rock salt	1.54
3.	Glass	1.52
4.	Water	1.33
5.	Ice	1.31
6.	Air	1.00

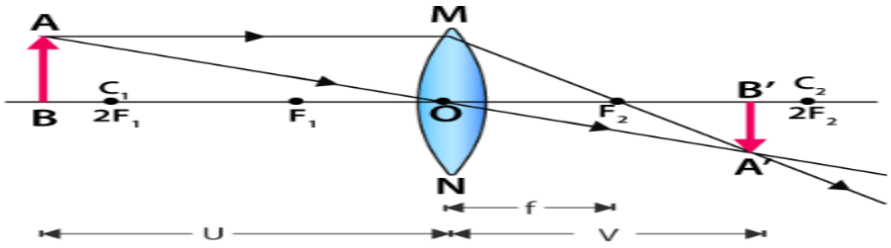
Image Formation by Concave and Convex Lenses:

Convex Lenses

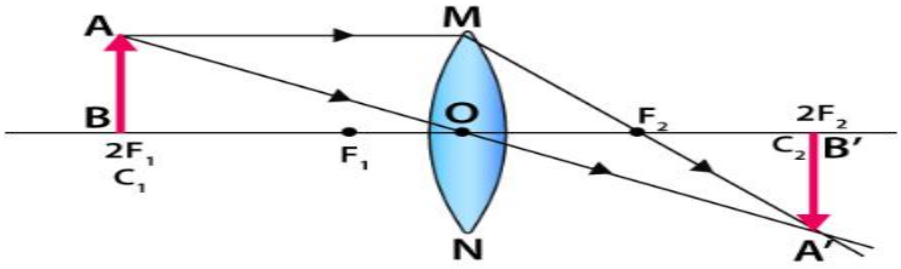
- When an object is placed at infinity, the real image is formed at the focus. The size of the image is much smaller than that of the object.



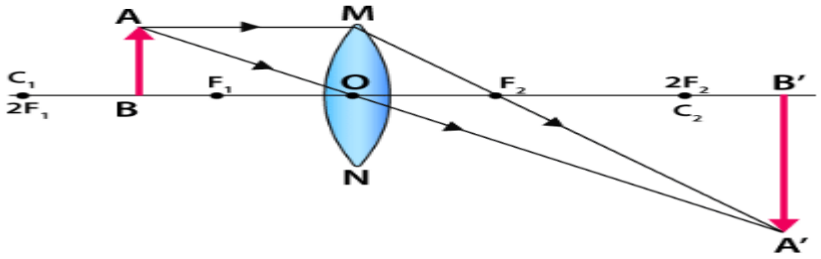
- When an object is placed behind the center of curvature, the real image is formed between the center of curvature and focus. The size of the image is the same as compared to that of the object.



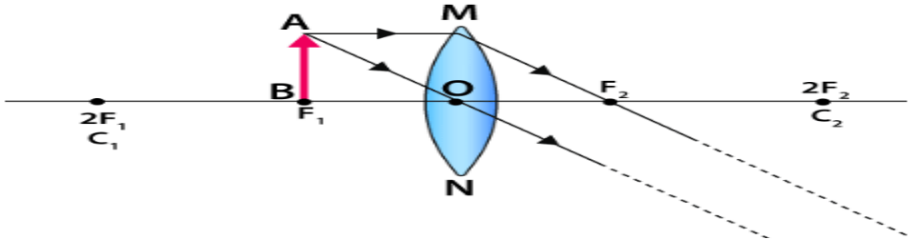
- When an object is at the center of curvature, the real image is formed at the other center of curvature. The size of the image is the same as compared to that of the object.



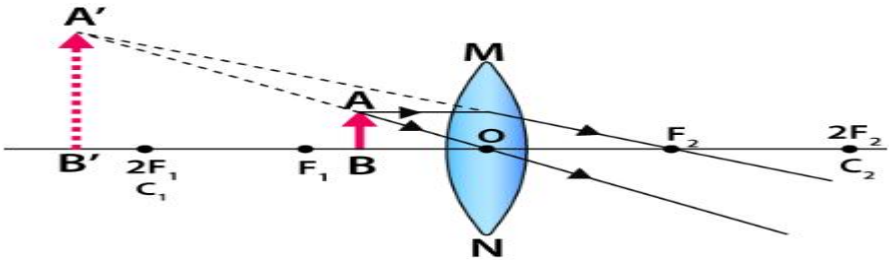
- When an object is placed in between the center of curvature and focus, the real image is formed behind the center of curvature. The size of the image is larger than that of the object.



- When an object is placed at the focus, a real image is formed at infinity. The size of the image is much larger than that of the object.

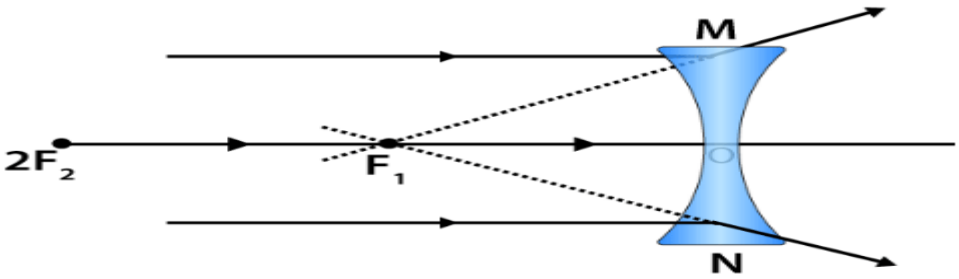


- When an object is placed in between focus and pole, a virtual image is formed. The size of the image is larger than that of the object.

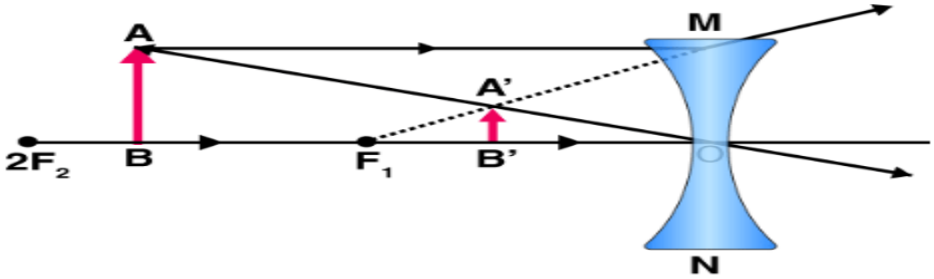


Concave Lenses

- When an object is placed at infinity, a virtual image is formed at the focus. The size of the image is much smaller than that of the object.



- When an object is placed at a finite distance from the lens, a virtual image is formed between the pole and the focus of the convex lens. The size of the image is larger than that of the object.



Summary of Image Formation by Concave and Convex Lens

Image formation by Concave Lens			
Object Location	**Image Location**	**Image Nature**	**Image Size**
Infinity	At F2	Virtual and Erect	Highly Diminished
Beyond Infinity and Zero	Between F1 and Optical center	Virtual and Erect	Diminished

Image formation by Convex Lens			
Object location	**Image location**	**Image nature**	**Image size**
Infinity	At F2	Real and Inverted	Diminished
Beyond 2 F1	Between 2F2 and F2	Real and Inverted	Diminished
Between 2F1 and F1	Beyond 2F2	Real and Inverted	Enlarged
At F1	At infinity	Real and Inverted	Enlarged
At 2 F1	At 2F2	Real and Inverted	Same size
Between F1 and 0	On the same side as the object	Virtual and Erect	Enlarged