

PHYSICS

Live eBook

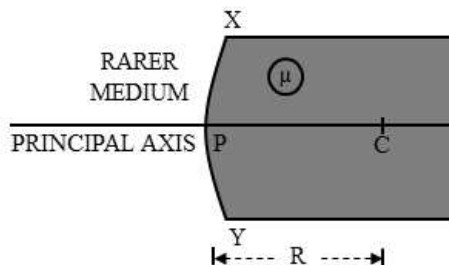


01. Spherical Refracting Surface

The portion of a refracting medium, whose curved surface forms the part of a sphere, is called spherical refracting surface.

Spherical refracting surfaces are of two types :

- (i) **Convex spherical refracting surface** :- Convex towards the rarer medium



- (ii) **Concave spherical refracting surface** :- Concave towards the rarer medium.

Terms related to the refraction from spherical refracting surfaces :

- (a) **Pole** – Centre of the spherical refracting surface
- (b) **Centre of curvature** – Centre of the sphere of which the curved surface forms a part
- (c) **Radius of curvature** – Radius of the sphere of which the curved surface forms a part
- (d) **Aperture** – Diameter of the spherical refracting surface
- (e) **Principal axis** – Line passing through the pole and the centre of curvature of the spherical refracting surface

02. Refraction at Convex Spherical Surface

- (i) **When object lies in the rarer medium and image formed is real**

$$\frac{\mu_1}{-u} + \frac{\mu_2}{+v} = \frac{\mu_2 - \mu_1}{+R}$$
$$-\frac{\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$$

where μ_1 is refractive index of rarer medium and μ_2 for denser medium

- (ii) **When object lies in the rarer medium and image formed is virtual**

$$-\frac{1}{u} + \frac{\mu}{v} = \frac{\mu - 1}{R}$$

- (iii) **When object lies in denser medium**

$$\frac{\mu_2}{-u} - \frac{\mu_1}{-v} = \frac{\mu_2 - \mu_1}{-R}$$
$$-\frac{\mu_2}{u} + \frac{\mu_1}{v} = \frac{\mu_1 - \mu_2}{R}$$

where μ_1 is refractive index of rarer medium and μ_2 for denser medium

03. Refraction at Concave Spherical Surface

$$-\frac{\mu_1}{-u} + \frac{\mu_2}{-v} = \frac{\mu_2 - \mu_1}{-R}$$

$$-\frac{\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$$

or

$$-\frac{1}{u} + \frac{\mu}{v} = \frac{\mu - 1}{R}$$

where μ_1 is reflective index of rarer medium and μ_2 for denser medium

04. Lens Maker's Formula

This formula is used to manufacture a lens of a particular focal length from the glass of given refractive index

Assumptions

- (i) The lens is thin
- (ii) The aperture of the lens is small.
- (iii) The object is a point object situated on the principal axis.
- (iv) The incident and refracted rays make small angles with the principal axis.

$$\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

05. Gaussian Form of Lens Equation (From Lens Maker's Formula)

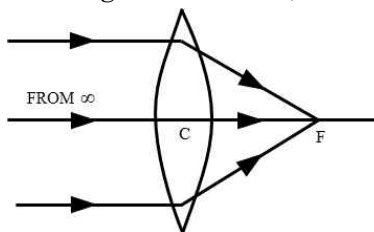
$$-\frac{1}{u} + \frac{1}{v} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

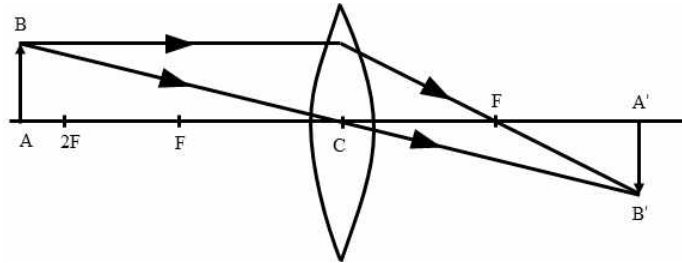
$$-\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

06. Image Formed by a Convex Lens

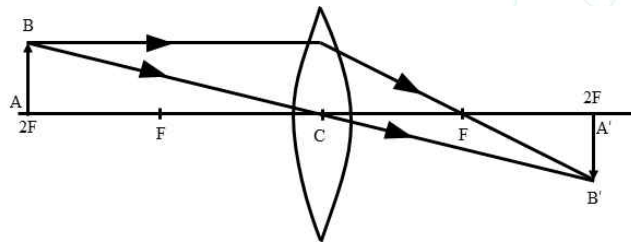
- (i) When object lies at infinity :- Image will be *real, inverted and point in size.*



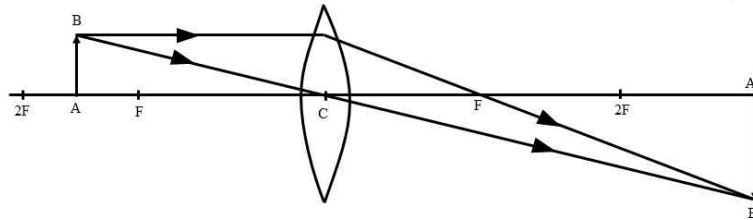
- (ii) **When object lies beyond $2F$:-** Image will be formed *between F and $2F$* and will be *real, inverted and smaller in size.*



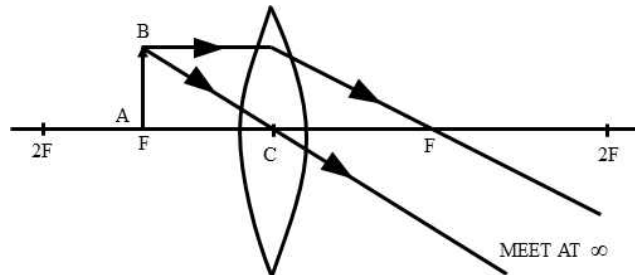
- (iii) **When object lies at $2F$ -** Image will be formed *at $2F$* and will be *real, inverted and equal in size.*



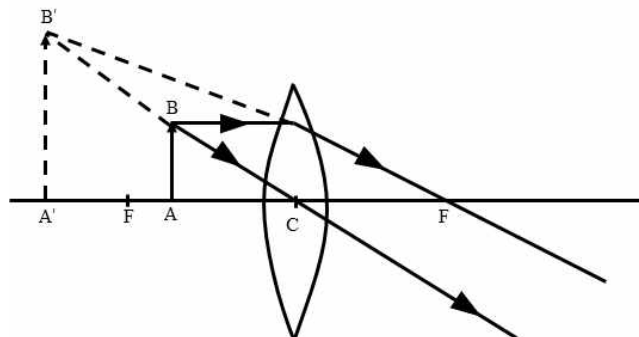
- (iv) **When object lies between F and $2F$ -** Image will be formed *beyond $2F$* and will be *real, inverted and larger in size.*



- (v) **When object lies at F -** Image will be formed *at infinity* and will be *real, inverted and highly magnified.*

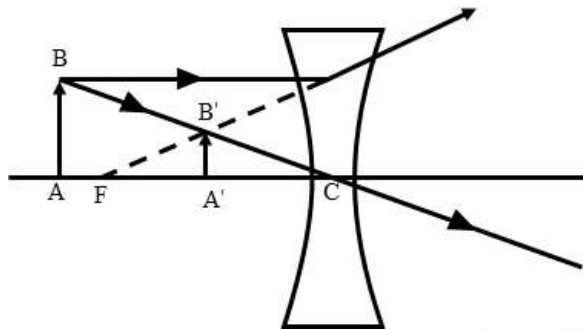


- (vi) **When object lies between F and C -** Image will be formed beyond F on the same side of the lens. Further, the image will be *virtual, erect and magnified.*



07. Image Formed by a Concave Lens

$$v = \frac{uf}{u+f}$$



08. Power of Lens

The ability of a lens, to converge or diverge the rays of light incident on it, is called the power of the lens.

$$P = \frac{1}{f(\text{metre})}$$

$$F = \frac{1}{1\text{m}} = 1\text{m}^{-1} = 1\text{ dioptre (D)}$$

The power of a lens is said to be one dioptre, if its focal length is one metre.

The power of *converging lens* is *positive* and that of a *diverging lens* is *negative*.