Refraction through a spherical surface

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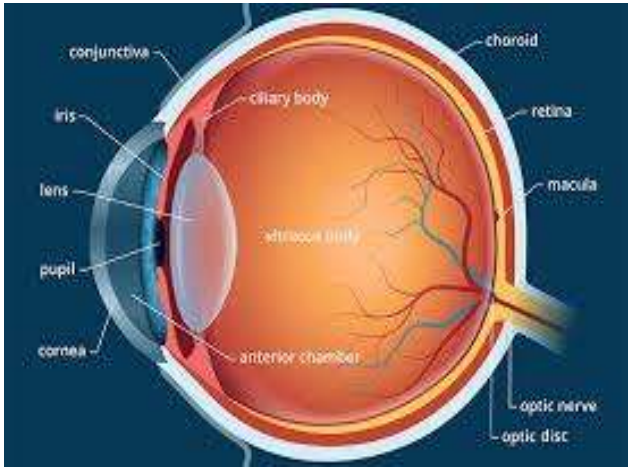
A spherical surface is part of a sphere. A lens is a spherical surface having two refracting surfaces.



There are two types of lenses

a. Convex lens
b. Concave lens

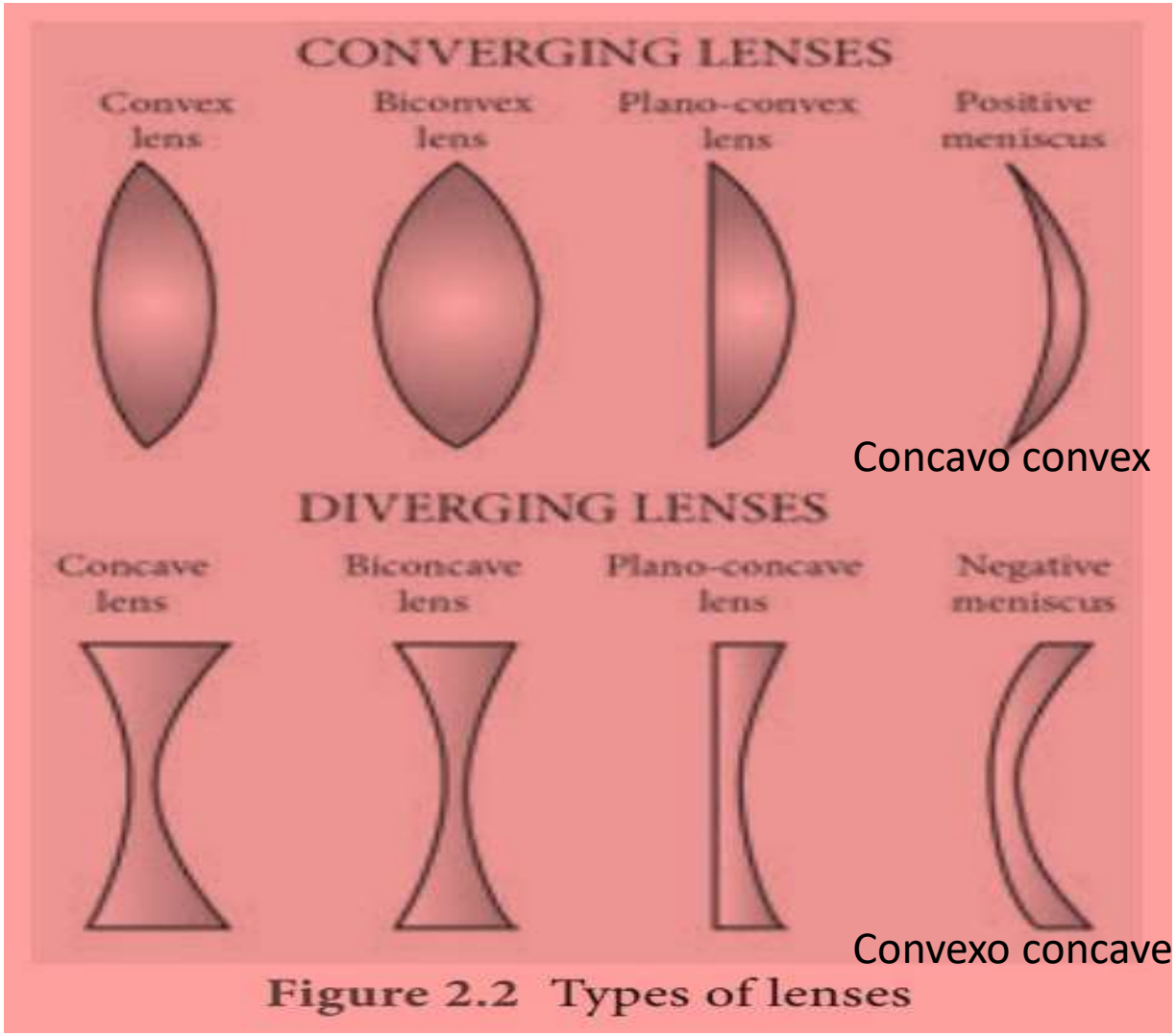


Figure 2.2 Types of lenses

Some definitions :

i. Principal axis

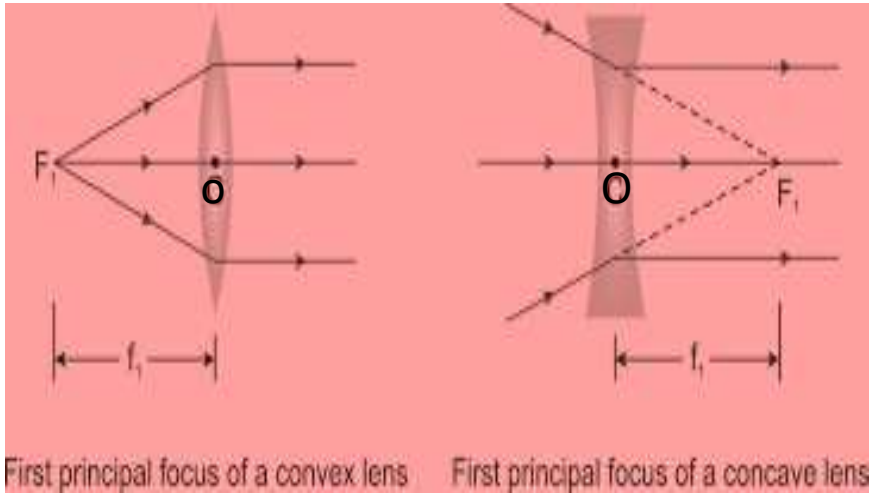
ii. Centre of curvature

iii. Focus of a lens

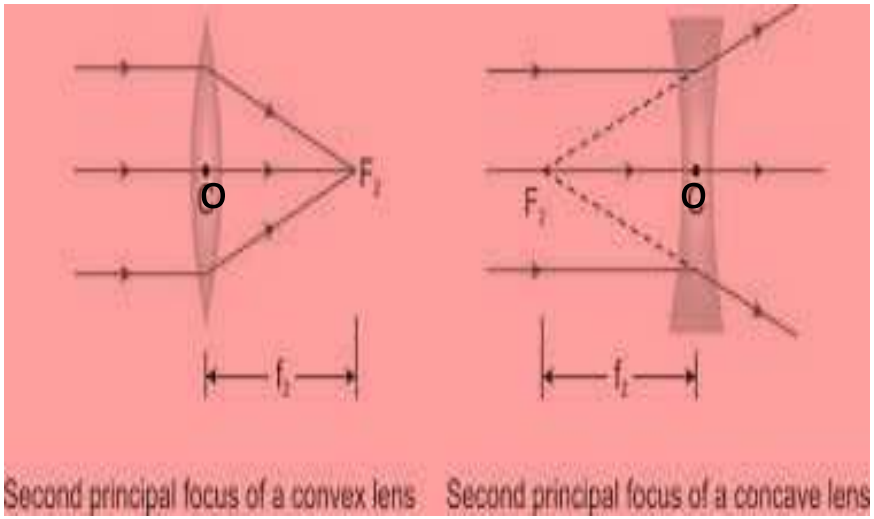
iv. Focal length

v. Aperture of a lens

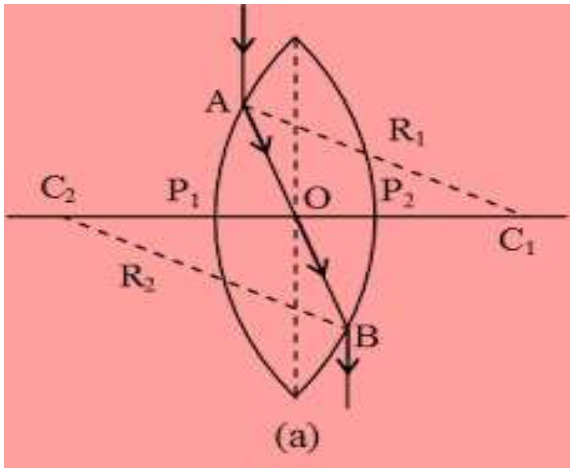
vi. Optical centre of a lens



First principal focus of a convex lens First principal focus of a concave lens

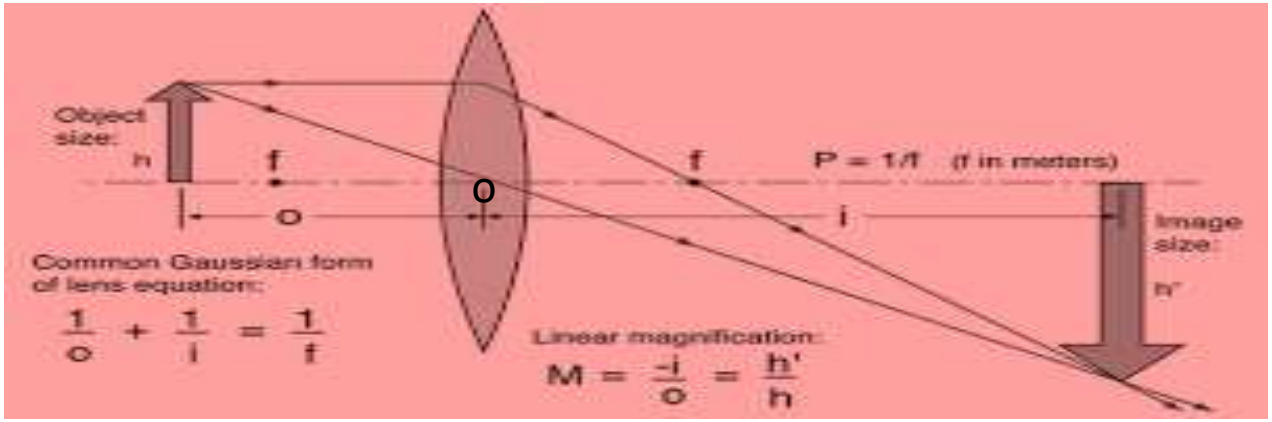


Second principal focus of a convex lens Second principal focus of a concave lens

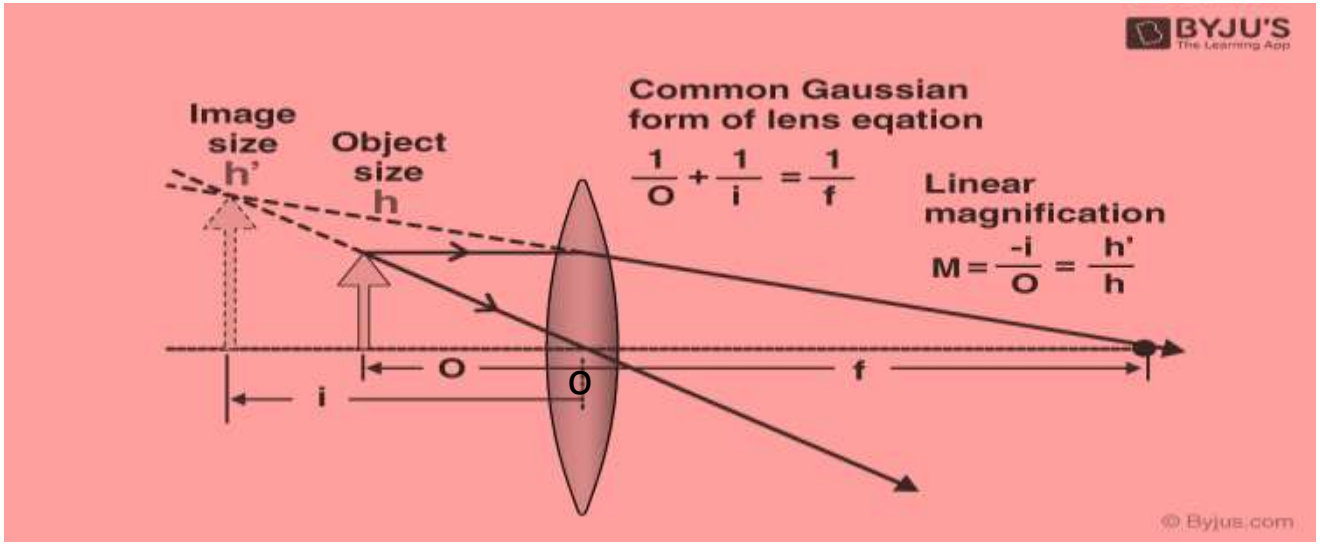


O -is optical centre of lens

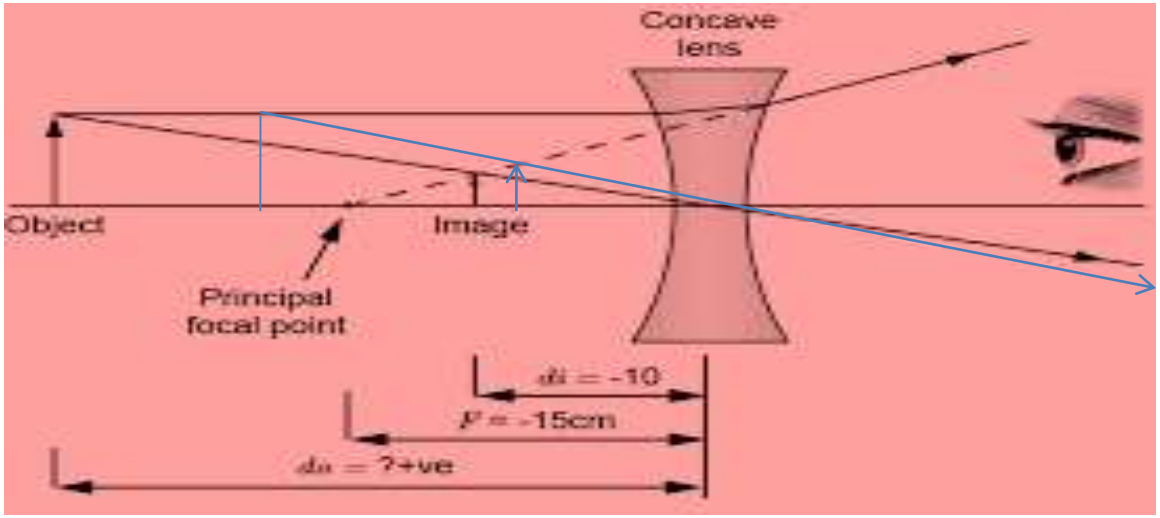
1. Real image produced by a convex lens:



2. Virtual image produced by a convex lens:



3.Virtual image produced by a concave lens:



New Cartesian Sign convention:

1. All distances are measured from the optical centre of the lens
2. Distances measured along the direction of the incident beam is taken as positive.
3. Distances measured in the direction opposite to the incident beam is taken as negative.
4. The height measured upward and perpendicular to the principal axis is positive .
5. The height measured downward and perpendicular to the principal axis is negative .

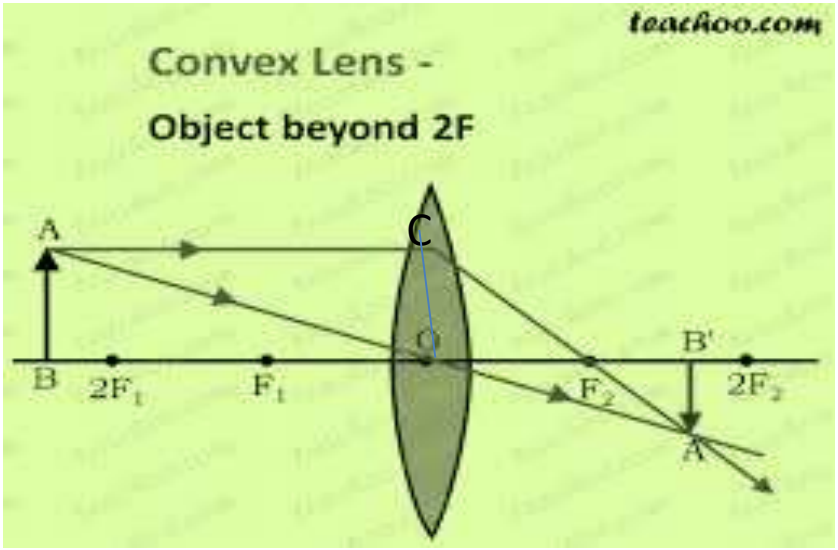
Relation among object distance, image distance and focal length of a lens:

Here

OB- object distance= -u

OB′- image distance =+v

OF_2 -focal length = +f



Now from the similar triangle ABO and Δ AB′O we have

$$\frac{AB}{A'B'} = \frac{OB}{OB'} \quad \text{.....(1)}$$

Again from the ΔCOF_2 and $\Delta A'B'F_2$ we have

$$\frac{CO}{A'B'} = \frac{OF_2}{F_2B'} \quad \text{.....(2)}$$

Since AB=CO from equations (1) & (2) we can write

$$\frac{OB}{OB'} = \frac{OF_2}{F^2B'}$$

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

-uv+uf= vf

uv= uf-vf

Dividing both sides by buff we get

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

The equation (3) is called as lens formula.

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