BAL BHARATI PUBLIC SCHOOL, PITAMPURA, DELHI – 110034

SUBJECT:-PHYSICS

CHAPTER:- LIGHT – REFLECTION & REFRACTION

GUIDELINES:

Dear Students,

- There is only **1 Assignment**.
  Assignment 8: Based on sub topics given below.
  Complete the Assignment in Physics Notebook.
- **Video links** have been provided for better understanding of the concept through visuals. Watch the videos carefully as these will help you in doing the assignment.
- Read the lesson from **NCERT textbook** also.
- Link for lesson :- http://ncert.nic.in/textbook/pdf/jesc110.pdf (page no 178 to 184.).

SUB TOPICS:

1. Image formation by Convex Lens
2. Sign convention for Spherical lenses
3. Lens formula & Magnification
4. Power of a Lens

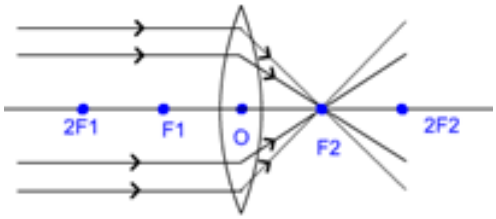
Let's begin the journey of learning:

1. IMAGE FORMATION BY CONVEX LENS

In case of a convex lens, if we bring the object close to the lens, the size of the image keeps on increasing. As you bring the object more close to the lens, we get the image all the more enlarged. So here we can say that the images formed can be of a variety of types. We can have diminished inverted image, small sizes inverted image, enlarged inverted image, enlarged erect image. So in a convex lens, there is a possibility of getting erect as well as an inverted image.

- **Object at infinity:**

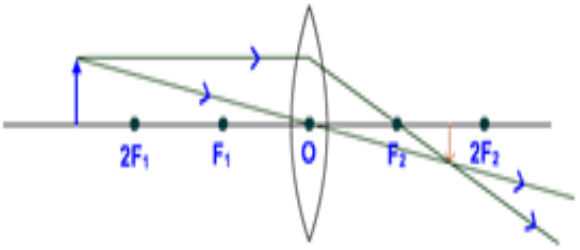
Convex lens converge parallel rays coming from object at infinity and a highly diminished - point sized, real and inverted image is formed at principal focus F2.



***Properties of Image*:** Image is highly diminished, real and inverted.

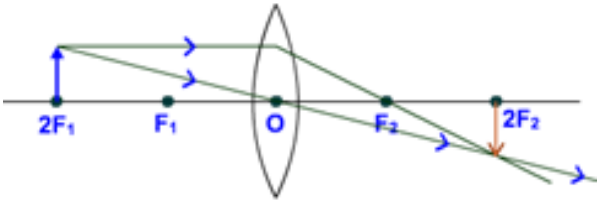
- **Object beyond 2F1:**

A diminished, real and inverted image is formed between principal focus, F2 and 2F2 at the opposite side when an object is placed beyond 2F1 of a convex lens.



***Properties of Image*:** Image is diminished, real and inverted.

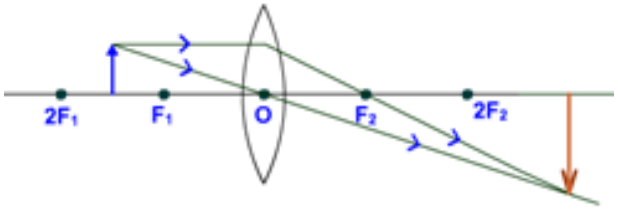
- **Object at 2F1:**



A same sized, real and inverted image is formed at 2F2 when object is placed at 2F1 of a convex lens.

***Properties of Image*:** Image is same size as object, real and inverted.

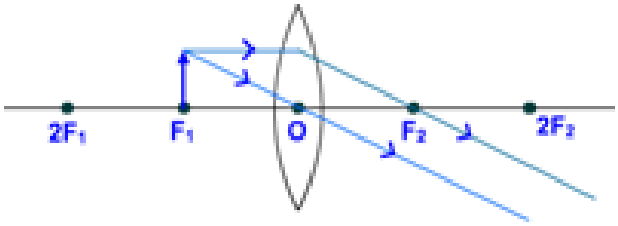
- **Object between 2F1 and F1:**



An enlarged, real and inverted image is formed beyond 2F2 when an object is placed between 2F1 & F1 of a convex lens.

***Properties of Image*:** Image is enlarged, real and inverted.

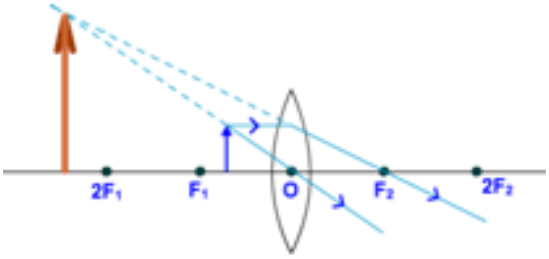
- **Object at principal focus, F1:**



An infinitely large, real and inverted image is formed at infinity when object is placed at principal focus, F1 of a convex lens.

Properties of Image: Image is highly enlarged, real and inverted.

- **Between principal focus, F1 and optical centre, O:**



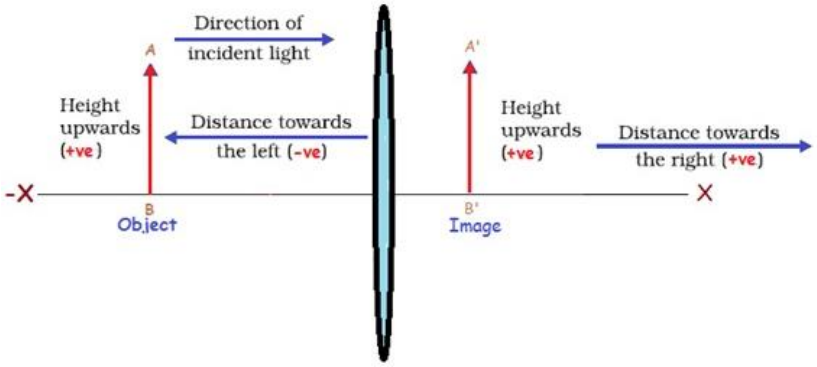
A virtual, erect and enlarged image is formed at the same side of lens, when an object is placed between principal focus, F1 and optical centre, O of a convex lens.

Properties of Image: Image is enlarged, virtual and erect.

Position of object	Position of image	Size of image	Nature of image
at infinity	at F2	point-sized	real & inverted
beyond 2F1	between F2 & 2F2	diminished	real & inverted
at 2F1	at 2F2	same size	real & inverted
between F1 & 2F1	beyond 2F2	enlarged	real & inverted
at F1	at infinity	highly enlarged	real & inverted
between F1 & O	on the same side of the lens as the object	enlarged	virtual & erect

2. SIGN CONVENTION FOR SPHERICAL LENSES

We follow sign conventions, similar to the one used for spherical mirrors. We apply the rules for signs of distances, except that all measurements are taken from the optical centre of the lens.



3. LENS FORMULA & MAGNIFICATION

Lens formula is given by:

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

where :

- u – image distance
- v – object distance
- f – focal length

Magnification: The ratio of the height of the image and the height of the object. It is represented by the letter m.

$$m = \frac{\text{height of image (h')}}{\text{height of object (h)}} \qquad m = \frac{h'}{h} = \frac{v}{u}$$

- The positive sign shows that the image is erect and virtual.
- The negative sign shows that the image is inverted and real.

4. POWER OF A LENS

The capacity of a lens to bend the rays of light depends upon the focal length. The smaller the focal length, the greater is the bending of a ray of light and vice- versa. Thus the power of a lens to bend the rays of light is inversely proportional to the focal length of the lens.

- The power of a lens is defined as the reciprocal of its focal length.
- It is represented by the letter P.

$$P = \frac{1}{f}$$

- The SI unit of power of a lens is 'dioptre'. It is denoted by the letter D.
- Power of a convex lens is positive and that of a concave lens is negative.

Power of combination of lenses : The focal length of the combination of two lenses placed in contact is given by the relation.

$$1/F = 1/f1 + 1/f2$$

If p1 is the power of lens of focal length f1, p2 the power of the focal length f2 and P the power of the combination of focal length, F then,

$$P = p1 + p2$$

Thus the power of combination of lenses is the algebraic sum of the powers of individual lenses.

SOME SOLVED EXAMPLES

Q.1 A lens is formed by combining two thin lenses of powers + 12 D and – 8 D in contact with each other. What will be the focal length of combination ?

Solution:

$P1 = +12$ D, $P2 = -8$ D

Power of combination (P) = P1 + P2

$= 12 - 8 = 4$ D

Focal length of combination (f) = 1/P = 1/+4

$= 0.25$ m $= 25$ cm.

Q.2 A convex lens of power +4 D and a concave lens of power 3 D are placed in contact. What is equivalent power of the combination ?

Solution:

$P1 = 4$ D, $P2 = -3$ D,

P = P1 + P2

$= 4D - 3D = 1D$

For Better understanding kindly go through the video link given below:

https://youtu.be/J2Y33Keypqs : For image formation by Convex lens

ASSIGNMENT 8

1. The focal length of convex lens is 50 cm. What is its power?
   (a) +2 D (b) – 2D (c) –50 D (d) +50 D

2. Two converging lenses of equal focal lengths f are placed in contact. The focal length of the combination is
   (a) f (b) 2f (c) f/2 (d) 3f

3. Two lenses one convex and other concave of focal length 0·5 m and 1·0 m respectively recombined, the power of combination will be
   (a) –1·0 D (b) +1·0 D (c) 0·5 D (d) –0·5 D

4. A convex lens has focal length of 20 cm. find its power in Dioptres.

5. A convex lens of power +6 D is placed in contact with a concave lens of power –4D. What will be the nature and focal length of this combination?

6. A 5 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 30 cm. Find the:
   (i) position (ii) nature (iii) size of the image formed.

7. A 6 cm object is placed perpendicular to the principal axis of a convex lens of focal length 15 cm. The distance of the object from the lens is 10 cm. Find the position, size and nature of the image formed, using the lens formula.

8. Draw ray diagrams to show the formation of image by an object by a concave lens when the object is placed
   (i)at infinity
   (ii)between infinity and optical centre of the lens.