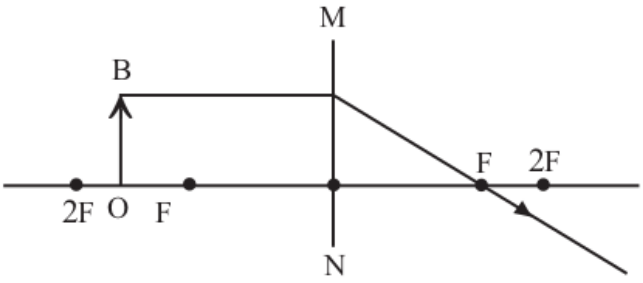
UNIT 5

Refraction of Light

03/01/2021 – Class 46

Assignment



(a) MN represents a lens. What type of lens is this?

(b) What are the characteristics of the image?

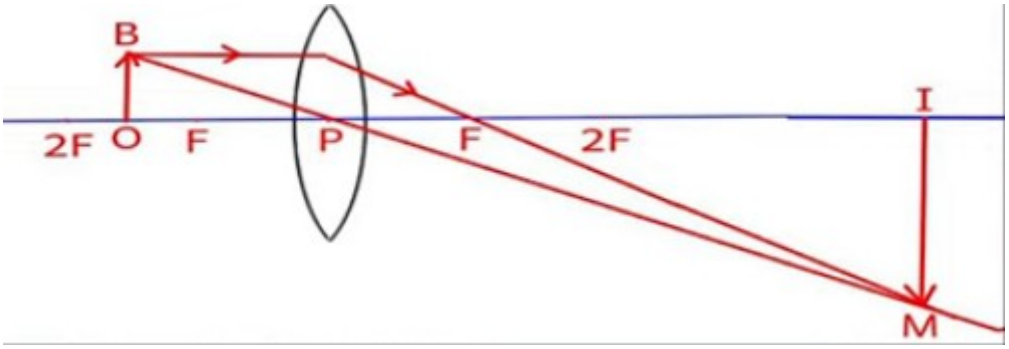
(c) Copy the ray diagrams in the science diary and complete it.

Answer

a) Convex lens

b) Real, inverted, enlarged.

c)



Activity 1

Distance related to lenses are also measured using ***New Cartesian Sign Conventions.***

New Cartesian Sign Conventions

- ➔ In experiments related to lens and mirror, distances are measured in the same manner **as in a graph.**
- ➔ In the case of lenses, distances are measured considering the **optic centre** as the **origin.**
- ➔ **All distances are to be measured from** the **optic centre.**
- ➔ **Light ray is assumed to travel** from **left to right.**
- ➔ Therefore all distances measured along the direction of incident light is **positive** and that in the opposite direction is **negative.**
- ➔ Distances measured **upwards from X-axis are positive** and those measured **downwards are negative**.
- ➔ **Focal length** of a **convex lens is positive** and that of a **concave lens, negative.**

Activity 2

Record the measurement shown in the figure as per the Cartesian System.

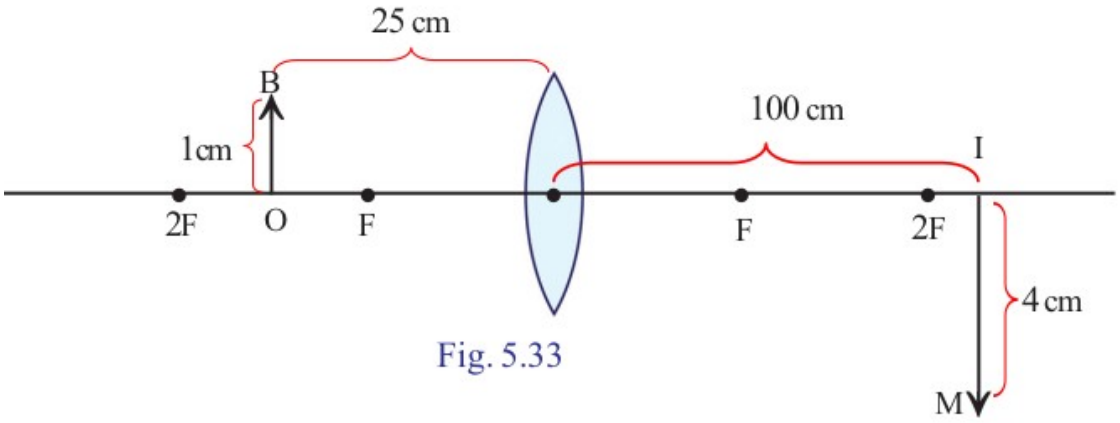


Fig. 5.33

Distance of the object from the lens **(u) = - 25 cm** (It is measured in the opposite direction of incident ray)

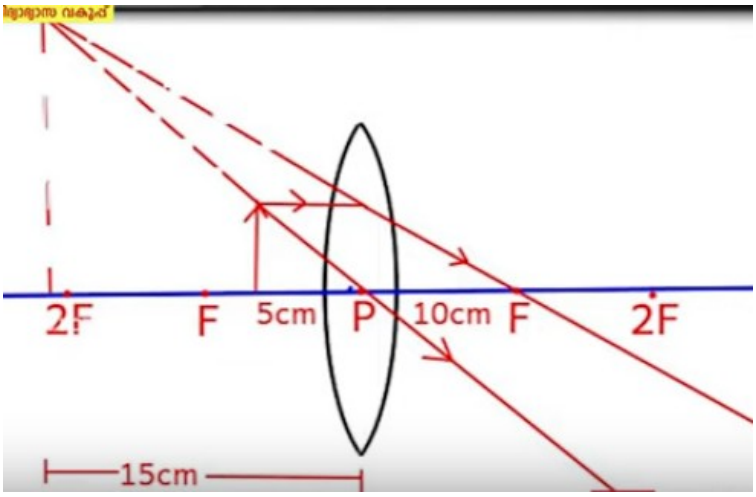
Distance of the image from the lens **(v) = +100 cm** (It is measured in the direction of incident ray)

Height of object (OB) = **+1 cm** (It is measured upwards from X-axis)

Height of image (IM) = **- 4 cm** (It is measured downwards from X-axis)

Activity 3

Observe the diagram and find the values using New Cartesian Sign Conventions.



Discussion

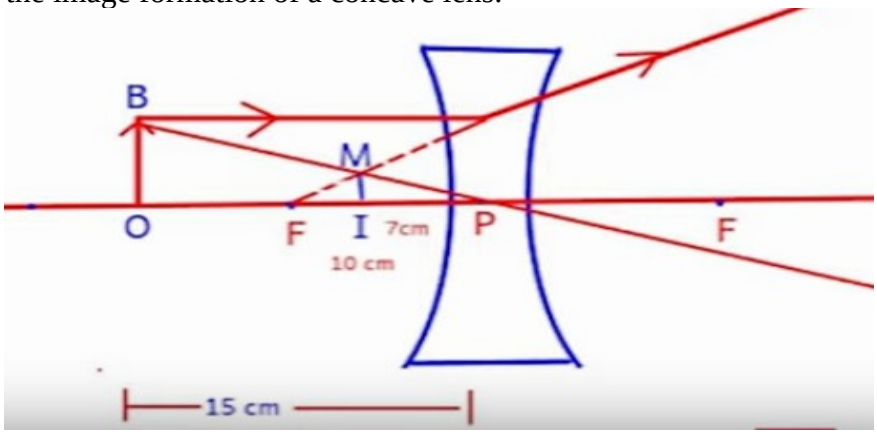
- Where is the position of the object? **Between F and lens.**
- Image formed is real or virtual? **Virtual.**
- What is the distance of the object, from the lens(u)? **- 5 cm.**
- What is the distance of the image, from the lens(v)? **- 15 cm.**
- What is the value of focal length (f)? **+10 cm**

Inference

When the object is in between the focus (F) and lens of a convex lens, **the distance of the image from the lens (v) is negative.**

Activity 4

Observe the image formation of a concave lens.



Discussion

- What is the distance of the object, from the lens(u)? **- 15 cm.**
- What is the distance of the image, from the lens(v)? **- 7 cm.**
- What is the value of focal length (f)? **-10 cm**

Inference

According to New Cartesian Sign Convention, in a concave lens, the value of distance of the object from the lens(**u**), distance of the image from the lens(**v**) and the focal length (**f**) are all **negative.**

Activity 5

Let's examine how distances of object and image are related to the focal length of the lens.

Experiment

Take a convex lens of focal length 10 cm. Keep a lighted candle at a certain distance from the lens and adjust the lens to get a clear image on the screen. Then measure the values of u and v and tabulate the values on the basis of the New Cartesian Sign Conventions. Repeat the experiment by changing the position of the object.

Si No	u	v	f = uv/(u-v) cm
1	***-25 cm***	***+17 cm***	**+10.11**
2	***-30 cm***	***+16 cm***	**+10.43**
3	***-35 cm***	***+15 cm***	**+10.5**
Average (f)			**10.34 cm**

- Compare the focal length of the lens, with the values in the table? **They are approximately equal.**

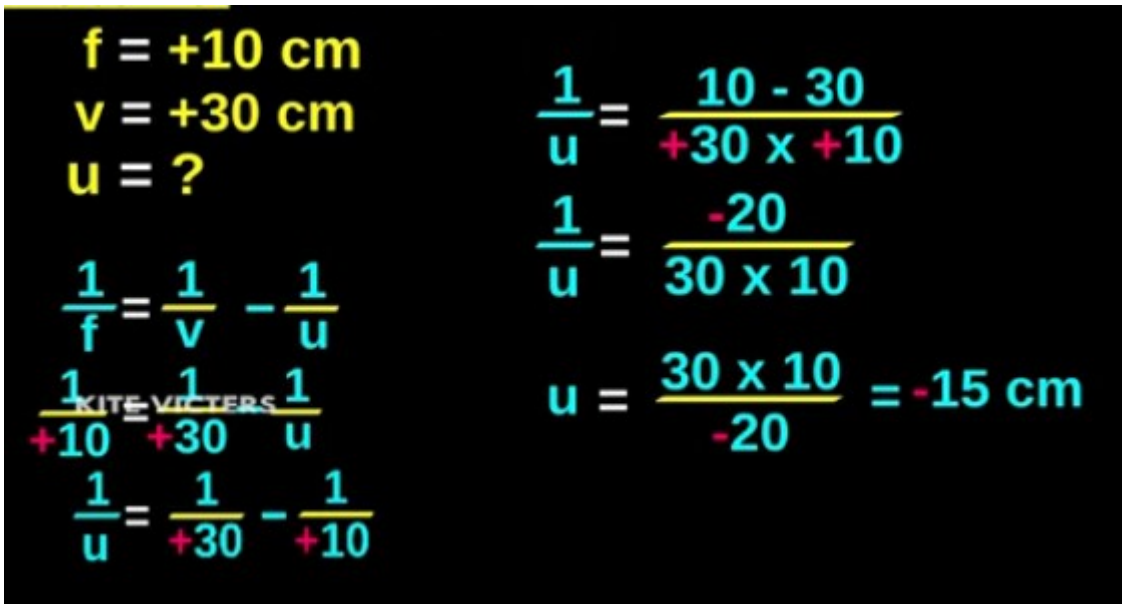
Inference
Focal length of a lens **(f) = uv / (u-v)**

Lens equation
1/f = 1/v – 1/u

From the lens equation,
f = uv / (u – v)
v = uf / (u+f)
u = fv / (f-v)

Activity 6

The focal length of a convex lens is 10 cm. When an object is placed at a particular distance from the lens an image is formed at a distance of 30 cm. Calculate the distance of object from the lens?



Activity 7

The focal length of a concave lens is 40 cm. If an object is kept at a distance of 30 cm from the lens, find out the distance to the image formed?

Focal length of a concave lens **(f) = - 40 cm**
Distance to the object from the lens **(u) = - 30 cm**
We have,

1/f = 1/ v – 1/ u
1/v = 1/f + 1/u
1/v = (u +f) / fu
v = fu / (u+f)
Distance to the image from the lens (v) = (-30 X – 40) / (-30 + - 40)
= 1200 / -70 = **- 17. 1 cm**

Assignment

When an object is placed at a distance of 30 cm from a convex lens, a real image is formed at a distance of 60 cm. What is the focal length of lens?