Image Formation by Spherical Lenses

Project : **OSCAR**

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Various terms Associated with Spherical Lens

Spherical Lens : It is the segment of a sphere, and it refracts rays of light equally in all meridians..

Concave Lens: A concave lens causes light to spread out or diverge in which the reflecting surface curves inward.

Convex Lens : A convex lens is a lens that is curved outward. The ends are narrow and the middle is wide. Often it is referred to as a converging lens. Light passing through a convex lens is converged to a point. This point is also called a focal point. A Convex Lens can produce either a real or virtual image.

Optical Centre : The optical centre is defined as the geometric centre of the curved lens .

Principal Axis :The principal axis of a curved lens is defined as the imaginary line passing through its centre and focus..

Focus :The principal focus is defined as the point on the principal axis where the light rays traveling parallel to the principal axis after refraction actually meet (for a convex lens) or appear to meet (for a concave lens).

Rules of Refraction for Spherical Lenses

- 1. A ray from the object parallel to the principal axis after refraction passes through the second principal focus F2 (in a convex lens) or appears to diverge (in a concave lens) from the first principal focus F1.
- 2. Any light ray that passes through F1 (for a convex lens) or appears to meet at it (for a concave lens) emerges parallel l to the principal axis after refraction.
- 3.A ray of light passing through the optical centre of the lens, emerges without any deviation after refraction.

Lens Equations

$1/f = i/u + 1/v$

Magnification (M) = v/u

f – Focal length of the mirror.

u – Distance of the object from the Optical Centre .

v - Distance of the image from the Optical Centre.

*f is -ve in the case of concave lens.

*f is +ve in the case of a convex lens.

*v is +ve if the image is a real image and formed on the right side of the optical centre of the lens.

* v is -ve if the image is a virtual image and formed on the side of the object.

Characteristics of the Image Formed by a Concave Lens According to the Position of the Object

When the object is at infinity in the case of a concave lens, the image formed has the following properties.

1. The image is virtual.
2. The image is Erected.
3. The image is Highly diminished .
4. The image is formed at the principal focus (F1) in front of the concave lens.

When the object is between infinity and the Optical Centre of the Lens,the image formed has the following properties.

1. The image is virtual.
2. The image is erect.
3. The image is diminished.
4. The image is formed between the principal focus (F1) and the optical center of the lens.

Characteristics of the Image Formed by a Convex Lens According to the Position of the Object

When the object is placed at the principal focus (F1)in front of a convex lens, the image formed has the following properties.

1. The image is real.
2. The image is inverted.
3. The image is highly enlarged.
4. The image is formed at infinity on the right side of the lens.

When the object is placed between the centre and the principal focus (F1) in front of a convex lens , the image formed has the following properties.

1. The image is virtual.
2. The image is erect.
3. The image is enlarged.
4. The image is formed in front of the lens.

When the object is placed between the principal focus (F1) and 2F1 in front of a convex lens, the image formed has the following properties.

1. The image is real.
2. The image is inverted.
3. The image is enlarged.
4. The image is formed beyond the 2F2 on the right side of the lens.

When the object is placed at the 2F1 in front of a convex lens,the image formed has the following properties.

1. The image is real.
2. The image is inverted.
3. The image is of the same size as the object.
4. The image is formed at the 2F2 on the right side of the lens.

When the object is placed at Infinity , the Image formed in the case of a convex lens has the following properties.

1. The image is real.
2. The image is inverted.
3. Highly diminished.
4. The image is formed at F2 on the right side of the lens.

Interactive Session

There will be a window having two radio buttons named ' Concave Lens' and 'Convex Lens' . User can click any of them. While clicking on the 'Concave Lens' button, a concave lens, object and its image will be displayed in the window. (This is shown in slide 25)

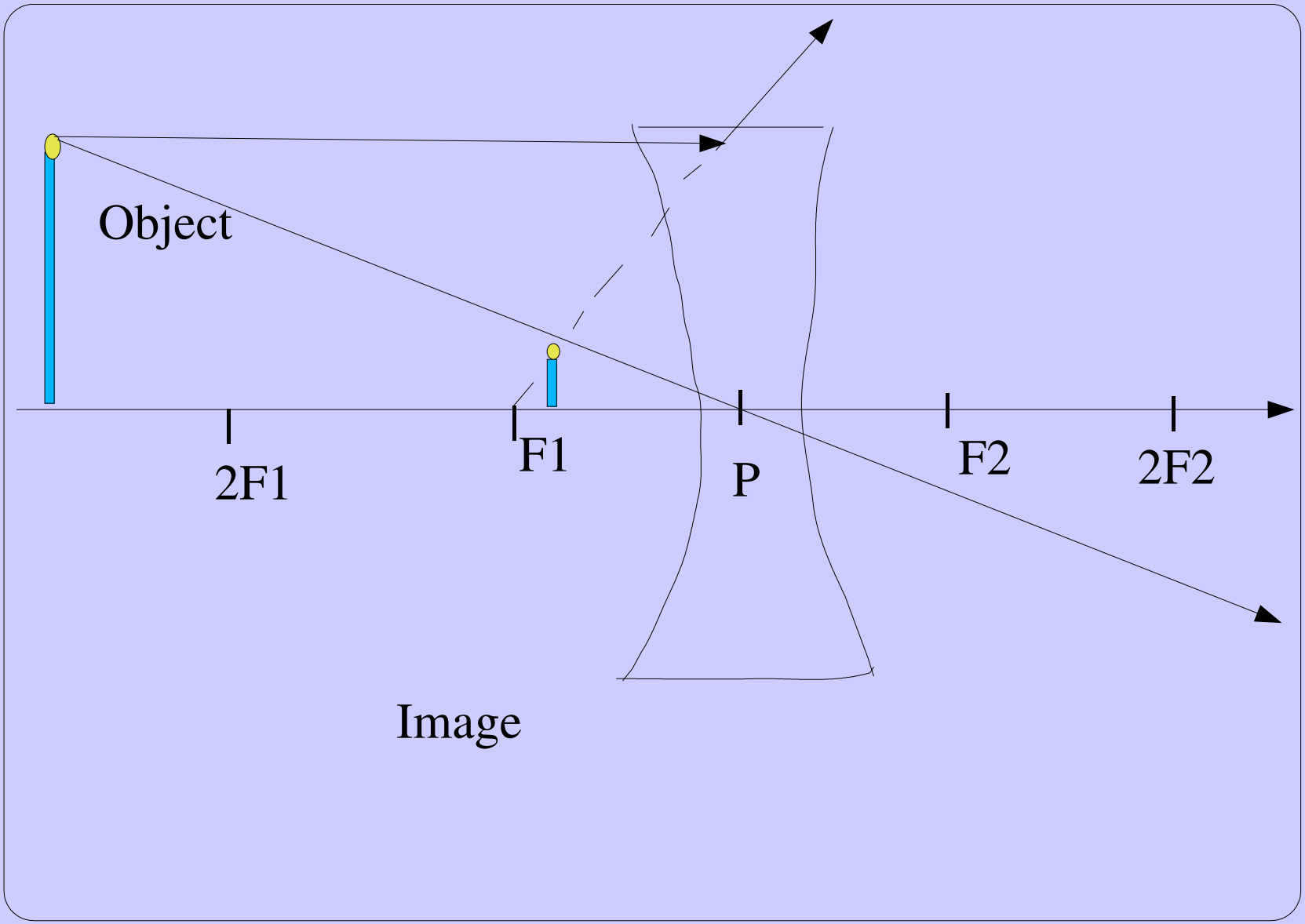
User can change the position of the object along the principal axis of the lens by clicking the bottom of the object and dragging the mouse along the principal axis. and can see how the image is formed accordingly. The conditions that one can distinguish in the case of a convex mirror are

1. Object between infinity and 2F1
2. Object at 2F1
3. Object between 2F1 and F1
4. Object at F1
5. Object between F1 and O

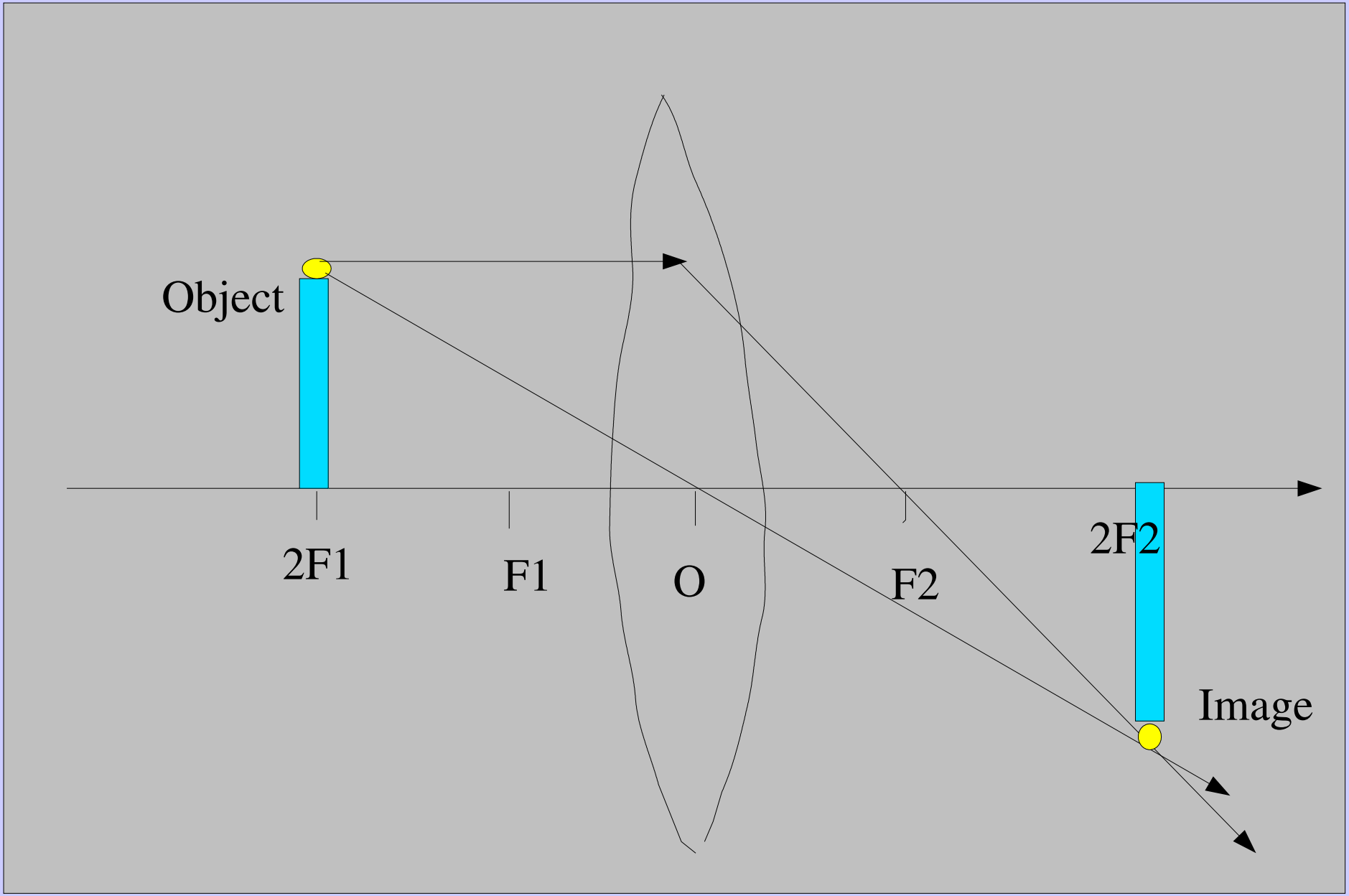
If the user clicks on the 'Concave Lens' button,
then a concave lens, and object and its image will be shown.

The image is formed between F1 and O when the object is placed anywhere between infinity and 2F1 in the case of a concave lens .

(Clicked) Concave Lens Convex Lens



When Convex Lens is selected



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