Medical Physics

Focal length of a convex lens

Experiment Seven

Asst. Lect. Leal Abdullah Hamza

leal.abdullah@mustaqbal-college.edu.iq

2020-2021

Focal length of a convex lens by a graphical method

The Aim:

1. To find the power of magnification of the lens.
2. To find focal length of a convex lens.

The Apparatus:

1. Light source with holder.
2. Object with holder.
3. Screen with holder.
4. Convex lens with holder.
5. Metric scale or ruler.

Theory:

$$P = \frac{1}{F} = \frac{1}{u} + \frac{1}{v}$$

P: is the power of magnification (Diopter).

F: is the focal length of the lens (cm, m).

u: is the distance of the object from the lens (cm).

v: is the distance of the image from lens (cm).

1. To find the power of magnification of the lens:

Place a convex lens at a distance from your eye and see any word written on a paper as shown in the diagram, adjust the position of the lens until you get the best amplification of the lens on these letters and measure the distance between the lens and the letters.

This distance is equal to the length of the lens (F).

According to this equation, find the power of magnification:

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

2. To find the focal length of a convex lens:

Connect the instrument as shown in the diagram.

Place an object pin at a distance from the lens and locate the position of its real image on the other side of the lens, with an image pin. Measure the distance of the object pin u and of the image pin v from the lens.

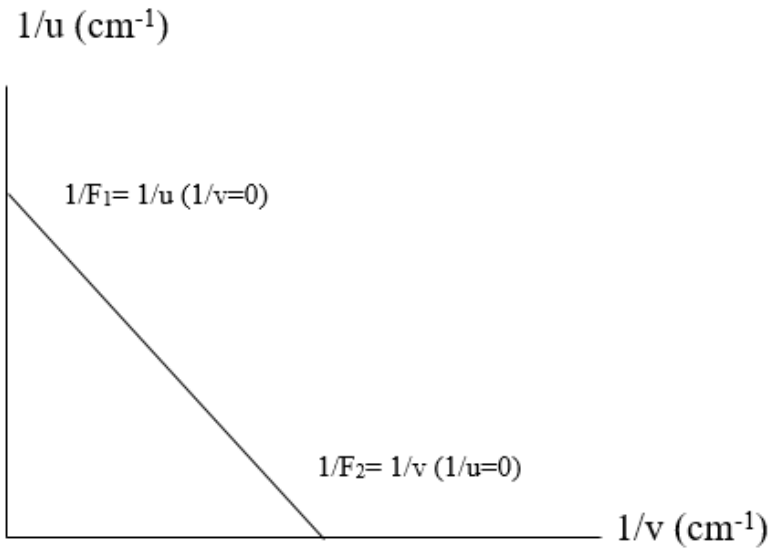
Now move the object pin 5 cm and locate the new position of the image.

Take many such pairs of readings to enable you to draw a graph of 1/u against 1/v, not forgetting that the two readings of each pair are interchangeable (conjugate foci for a lens).

Tabulate the readings:

Distance of object from lens u (cm)	1/u cm^{-1}	Distance of image from lens v (cm)	1/v cm^{-1}
45			
40			
35			
30			
25			

Plot a graph of 1/u cm-1 against 1/v cm-1. Draw the best straight line through the points and produce it to intersect both axes.



The calculation:

In the usual notation:

$$\frac{1}{F} = \frac{1}{u} + \frac{1}{v}$$

Hence, if values of $1/u$ cm^{-1} are plotted against values of $1/v$ cm^{-1} a straight line included at 45° to each axis is obtained. The intercept on each axis is a value of $\frac{1}{F}$. Take the mean of the two intercepts. The reciprocal of this the magnitude of the focal length of the lens.

$$F_{average} = \frac{F_1 + F_2}{2}$$

According to this equation, find the power of magnification:

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

The Medical Applications of Lens

1. To determine the focal length of the eye and distance between the object and the lens.

2. for the treatment of the eye defects like far sight vision, near sight vision, old age vision, and astigmatism.

3. It is used in many medical and biological devices like microscope, otoscope, endoscope, ophthalmoscope, etc.

4. In dentistry it is used in many devices and instruments, like dental chairs, mouth mirror, etc.