Exp.No. 11 : The focal length of a convex lens by a graphical method
The aim of this experiment is to find the focal length of a convex lens by a graphical method

Apparatus:
An optical bench, aconvex lens with lens holder, an optical needle and a meter scale.

Ray diagram:

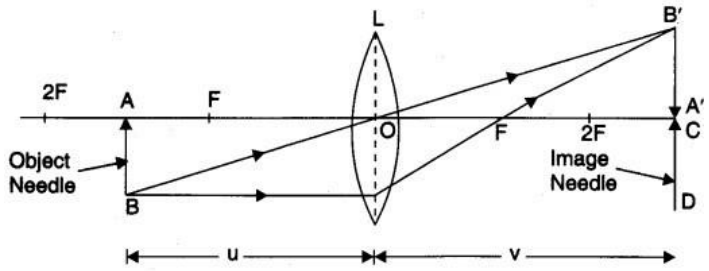

Fig. Focal length of convex lens.

Theory:
The relation between u, v and f for a convex lens is:

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \qquad (1)$$

Equation (1) is known as mirror formula.

Where, f = focal length of convex lens.

u = distance of object needle from lens

v = distance of image needle from lens.

Note: According to sign-convention, u has negative value and v has positive value for convex lens. Hence, f comes positive.

Procedure:

1. Mount object needle, lens and image needle uprights on the optical bench.
2. Place the object needle on left side of lens so as to get its inverted image of it.
3. Now place image needle on right side of lens .
4. Note down the position of object needle, lens and image needle in table.
5. For more reading move object needle slightly and keeping lens position fixed and note down the new positions of object needle, image needle and lens.
6. Take at least five readings.

Table(1)

Distance u, cm	Distance v, cm	1/u , cm^{-1}	1/v , cm^{-1}

Calculations:

Calculations of focal length by graphical methods.

Plot a graph between 1/u on y-axis and 1/v on x-axis .The graph will be a straight line. Calculate the point of intersection of the straight line with both 1/u axis and 1/v axis. Both values represent the value of the focal length of the convex lens as shown in the graph.

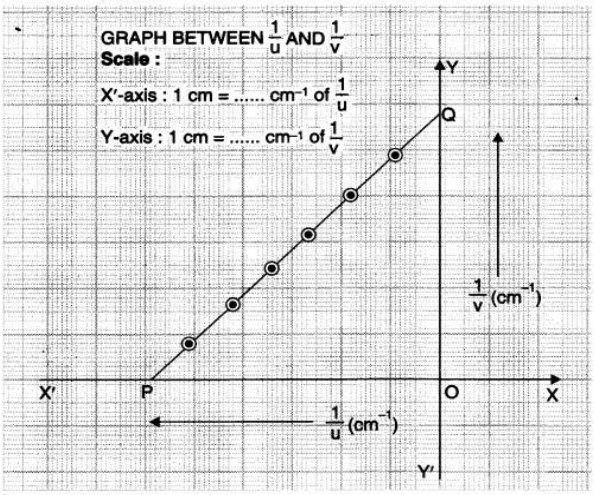

Fig. Graph between $\frac{1}{u}$ and $\frac{1}{v}$. It is a straight line.

The straight line cuts the two axes OX' and OY at an angle of 45^0 at points P and Q respectively and making equal intercepts on the axis. Measure the distance OP and OQ.

Then the focal length, f= 1/OP = 1/OQ = cm

From the mirror formula (equation 1),

a) If 1/u = 0 , then 1/v= 1/f
   Thus , intercept OQ = 1/v=1/f
b) If 1/v= 0 , then OP =1/u=1/f
   From a and b , we get f = cm