EXPERIMENT

AIM

To find the focal length of a convex mirror, using a convex lens.

MATERIAL REQUIRED

Optical bench, four upright stands (two fixed and two with lateral movement) the convex lens of known focal length (say 30 cm), two optical needles, one knitting needle, mirror holder, convex mirror, lens holder, half-meter scale.

DIAGRAM

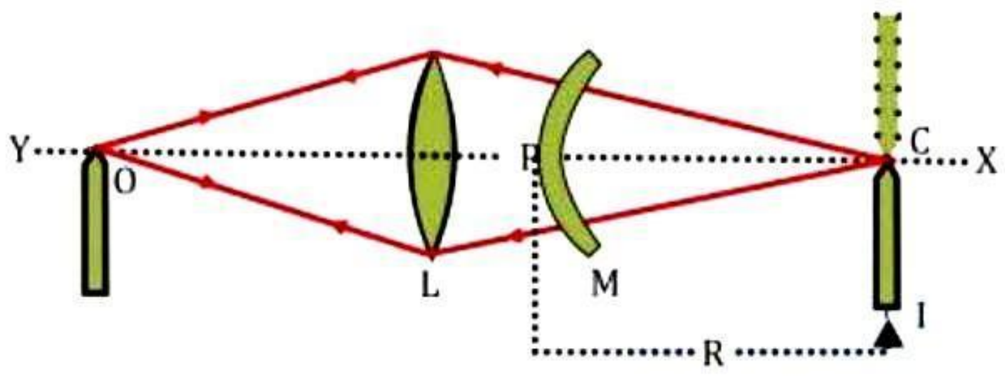

Fig. Experimental arrangement for finding the focal length of convex mirror a convex lens.

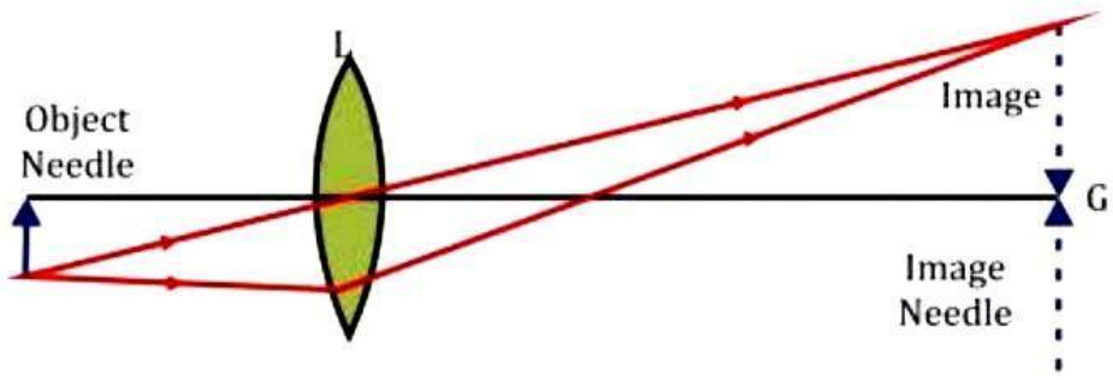

Fig. Experimental arrangement for finding the focal length of convex mirror a convex lens.

THEORY

In the figure given, rays originating from an object O undergo refraction as they pass through the convex lens L. Subsequently, they strike the convex mirror M perpendicularly, retracing their path and resulting in the formation of an inverted image. The distance PC is then equivalent to the radius of curvature of the convex mirror. Expressing the focal length f of the mirror, it is given by half of the radius of curvature, denoted as:

$$f = \frac{r}{2}$$

PROCEDURE

1. Mount the given convex mirror and lens and object needle on the optical bench. Form the inverted image of an object using the combination of mirror and lens. Parallax if any, should be removed by fine adjustment on the optical bench.
2. Note the positions of all three (i.e., mirror, lens, and object).
3. Now without disturbing the lens and object, remove the mirror.
4. Take the second needle and place it on the opposite side of the lens. Adjust its position so that there is no parallax between this needle and the inverted image of the object needle.
5. Find the index correction for the convex mirror and image needle.
6. Take at least five-six of the observations by repeating Steps 1 to 4.

OBSERVATION AND CALCULATION

The focal length of the convex lens = _____ cm.

Index correction = _____ cm.

Mean observed distance = _____cm.

Corrected mean observed distance = _____ cm.

Focal length = $\frac{R}{2}$ = _____ cm.

For radius of curvature of the convex mirror

No. of observations	Position of			Image pin, I (cm)	Observed r = MI	Corrected, r(cm)
	Object pin, O (cm)	Convex lens, L(cm)	Convex mir-ror, M(cm)			
1.						
2.						
3.						
4.						
5.						

RESULT

The focal length of a given convex mirror is..... cm.

PRECAUTIONS

1. Index correction should be carefully recorded and applied.
2. Parallax should be carefully removed from tip to tip.
3. The focal length of the convex lens used should be large.
4. The optical bench should be horizontal.
5. The principal axis of the mirror when mounted on the upright stand should be parallel to the bed of the optical bench.
6. The needles should be so mounted that their tips reach the same horizontal level.

SOURCE OF ERROR

1. The stands may not be perfectly vertical.
2. Index error may not be obtained correctly.
3. Parallax may not be removed satisfactorily.

VIVA- VOCE

Q 1. Why is a spherical mirror called so?

Ans. A spherical mirror is called so because it is a part of a hollow sphere whose one surface reflects light.

Q 2. Distinguish between images formed by concave and convex mirrors.

Ans. A convex mirror always forms erect and diminished images of the object while a concave mirror can form real and inverted images too, of different sizes.

Q 3. What is the focal length of the plane mirror?

Ans. Infinity.

Q 4. Is the mirror formula true for plane mirrors also?

Ans. Yes, it is true.

Q 5. Relate the radius of curvature of a spherical mirror with its focal length.

Ans. The radius of curvature = 2 × focal length.

Q 6. What is the angle of reflection if a ray strikes a mirror parallel to its surface?

Ans. 0°

Q 7. In what situation does a concave mirror form a vertical by erect image?

Ans. When the object is kept very close to the mirror, i.e., at a distance less than the focal length mirror.

Q 8. What is parallax and how is it removed?

Ans. Refer to the 'Introduction' part of this chapter.

Q 9. Why is parallax removed tip to tip?

Ans. The tip of the needle is sharp, so parallax is accurately removed.

Q 10. Give two uses of the concave mirror.?

Ans. A concave mirror is used as a shaving mirror, as an eye surgeon's mirror, and as the reflector in searchlights.

Q 11. What is the use of a convex lens in the experiment?

Ans. It helps to locate images formed by a convex mirror.

Q 12. Why can't you obtain the focal length of the convex mirror using a meter scale and a distant object?

Ans. The convex mirror never forms a real image. So, it can't obtain any image on a screen.

Q 13. Give a few uses of the convex mirror.

Ans. The convex mirror is used as a rear-view mirror in vehicles and as a showroom mirror to keep a vigil over the whole shop.

Q 14. Define spherical aberration. How can it be controlled?

Ans. The paraxial and marginal rays coming from the point object do not meet at a single point after reflection from the mirror surface. This is called spherical aberration. It can be controlled by using paraboloid mirrors, only controlling the aperture of the mirror with the help of suitable stops.

Q 15. Define conjugate foci.

Ans. The pair of points on the principal axis of the concave mirror such that when the object is placed at one of these, an image is formed at the other point, are called conjugate foci.