Experiment (2)

Mirrors

Objective:-

1:-To find the focal length of a concave mirror by two methods:-

A:-Direct method.

B:-Graphical method.

Apparatus:-

Light source, concave mirror, object and screen.

Theory:-

The reflection can occur at an interface between two transparent materials or at a highly polished surface of an opaque material such as a metal, in which case the surface is usually called a mirror.

We have three types of mirrors:-

1. Concave mirror.
2. Convex mirror.
3. Plane mirror.

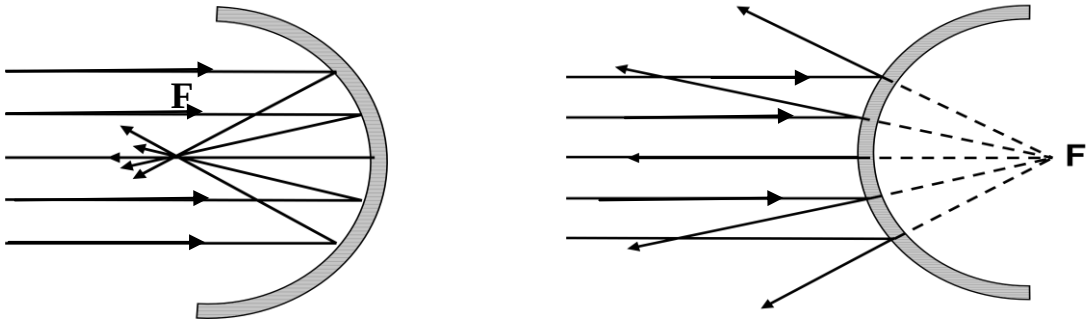
Concave and convex mirror also called spherical mirror.

Spherical mirror is a curved mirror which is a part of a hollow sphere.

1) Concave mirror :- is a spherical mirror whose reflecting surface is curved inwards. Rays of light parallel to the principal axis after reflection from a concave mirror meet at a point (converge) on the principal axis.

2) Convex mirror :- is a spherical mirror whose reflecting surface is curved outwards. Rays of light parallel to the principal axis after reflection

from a convex mirror get diverged and appear to come from a point behind the mirror.



Concave mirror ***Convex mirror***

Figure (1): Types of mirror

<u>Terms used in the study of spherical mirrors(very important)</u> :-

i) Center of curvature :- is the centre of the sphere of which the mirror is a part (C).

ii) Radius of curvature: - is the radius of the sphere of which the mirror is a part (CP).

iii) Pole :- is the centre of the spherical mirror (P).

iv) Principal axis :- is the straight line passing through the centre of curvature and the pole (X-Y).

v) Principal focus :- In a concave mirror, rays of light parallel to the principal axis after reflection meet at a point on the principal axis called principal focus(F).

In a convex mirror, rays of light parallel to the principal axis after reflection get diverged and appear to come from a point on the principal axis behind the mirror called principal focus (F).

vi) Focal length :- is the distance between the pole and principal focus (f). In a spherical mirror the radius of curvature is twice the focal length.

$$R=2f \quad \text{or} \quad f=\frac{R}{2}$$

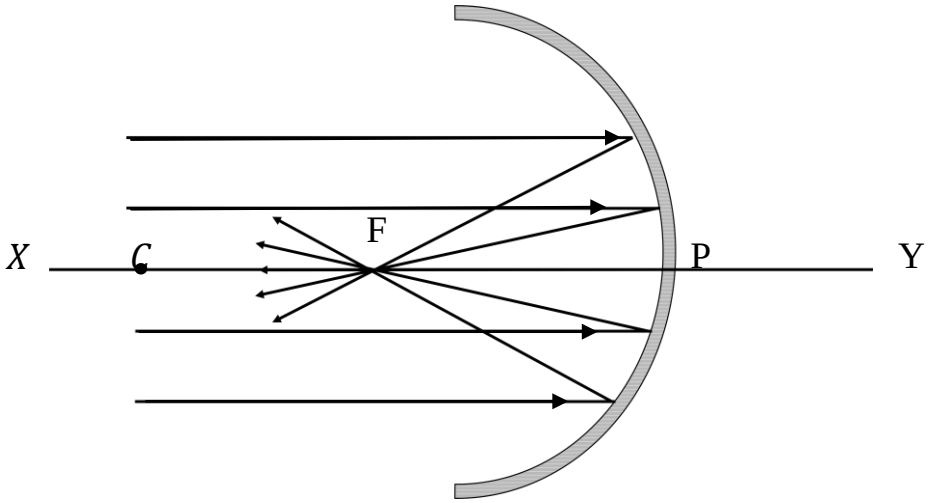


Figure (2)

C – centre of curvature ***CP – radius of curvature***

P – pole ***XY – principal axis***

F – principal focus ***PF – focal length***

A spherical reflection has image-forming properties similar to those of a thin lens, you can see a spherical mirror of radius of curvature (r) in Fig. (3).

In this case the focal length of spherical mirror can see in equation (1):

$$f=\frac{r}{2} \quad \ldots\ldots. (1)$$

Where:

f: focal length, r: is the radius of curvature of mirror.

But in graphical method one can find the focal length by using equation (2):

$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f} \quad \text{..... (2)}$$

Where:

u: Distance between object and mirror.

v: Distance between mirror and screen.

f: Focal length.

Procedure:-

A:-Direct method:

1. To find the focal length place the concave mirror facing the object and screen with object in the same level as shown in Fig.(1):

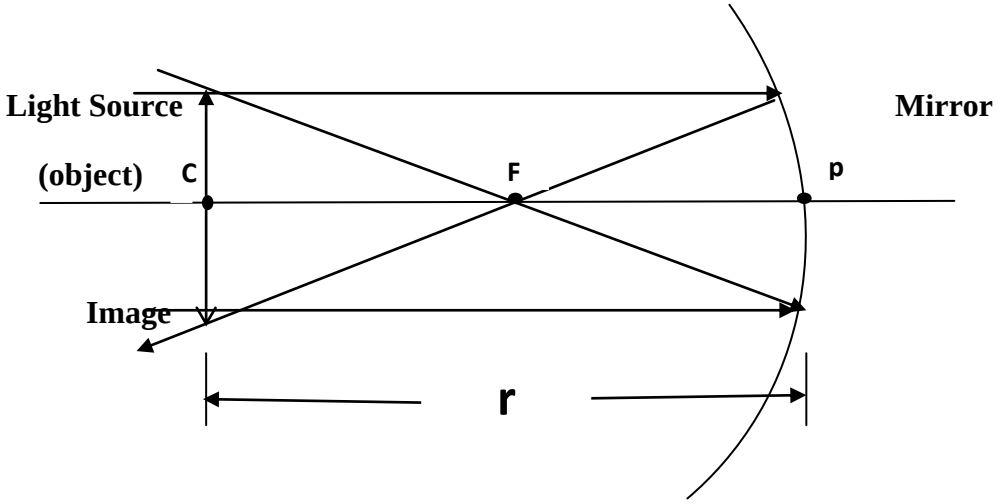


Figure (3): ***The setup of Direct Method.***

2. Adjust the position of mirror until a sharp and screen image coincides with the object.
3. Measure the distance between the bottom of the mirror and the object.
4. Find the focal length (f) of the mirror by applying equation (1).
5. Find the percentage error (p.e) of the focal length.

$$\mathbf{p.e= ((f_{th}-f_{exp})/f_{th}) \times 100\%}$$

B:-Graphical method:

1. Place the object at a distance u from the concave mirror.
2. Fix the concave mirror and move the screen as shown in Fig. (4).

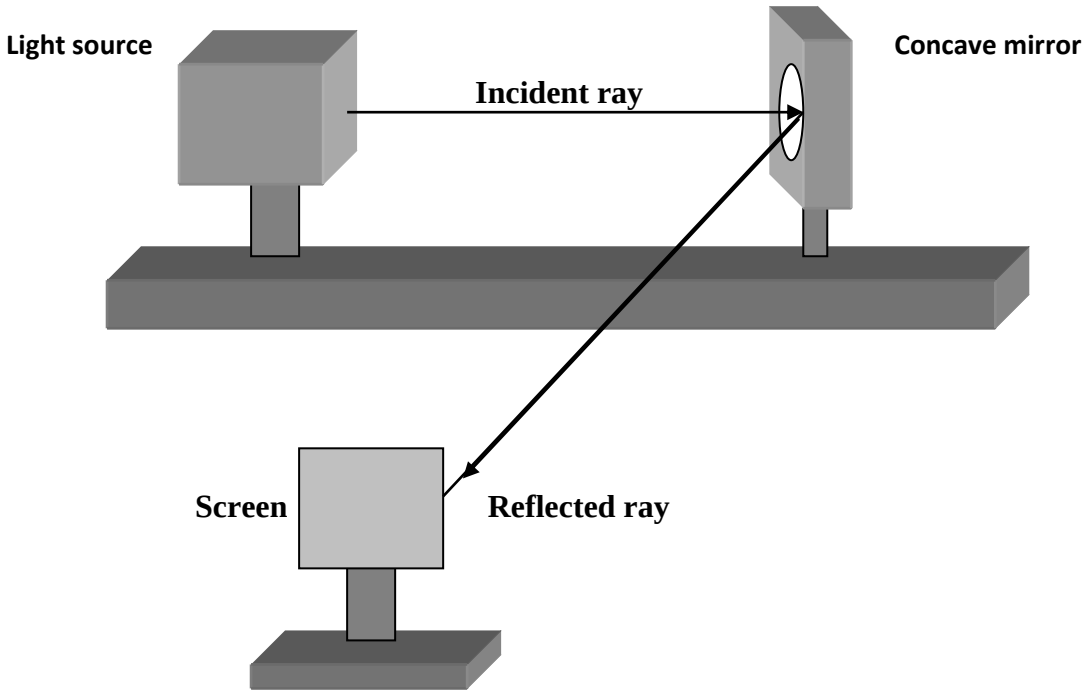


Figure (4): ***The setup of Graphical Method.***

3. Take six reading for u and the corresponding v.

u	v	1/u	1/v	1/f=1/u + 1/v	f	Image properties for each case

u: Distance between object and mirror.

v: Distance between mirror and screen.

f: Focal length.

4. Plot a graph of 1/u in x-axis and 1/v in y-axis to find focal length (f).

5. Find the percentage error (p.e) of the focal length.

$$\mathbf{p.e= ((f_{th}-f_{exp})/f_{th}) \times 100\%}$$

Discussion:-

Q1:-Which method you prefer to find the focal length? And why?

Q2:-Explain the six cases for producing image formed by concave mirror.

Q3:-Prove that f=r/2 when u=v=r .