

6

Curved Mirrors

You would have observed and enjoyed watching yourself at magical mirrors where you would have found your images dispel, long, short, inverted or erect inside the magical mirrors. Such mirrors are curved mirrors.



Why do we observe our images long or short, inverted or erect, thick or thin in the curved mirrors?



Take a shining, big teaspoon and observe your face on the inner and outer sides of it. What do you see ?

What shape of your face is observed in the outer shining surface of a steel glass?



Let us prepare curved mirrors (knife).

What is required? a plastic ball, a cutter,

What to do?

- Take a plastic ball. Cut the portion of the ball as shown in figure 6.1. Collect the part as observed in fig. 6.2.

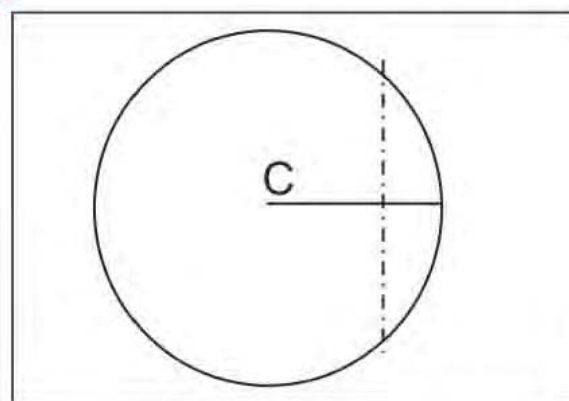


Figure 6.1

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- Just like the part cut from the plastic ball, similarly such parts are cut from hollow glass balls and curved mirrors.
- There are two types of curved mirrors
 - 1 Concave mirrors
 - 2 Convex mirrors

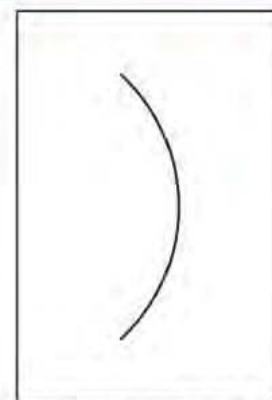


Figure 6.2

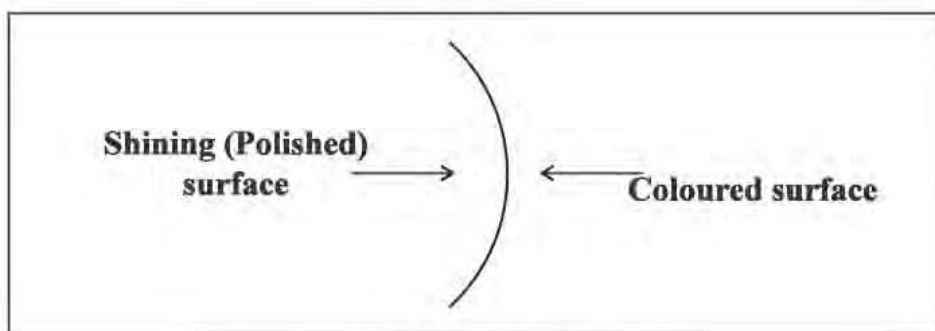


Figure 6.3 Concave mirrors

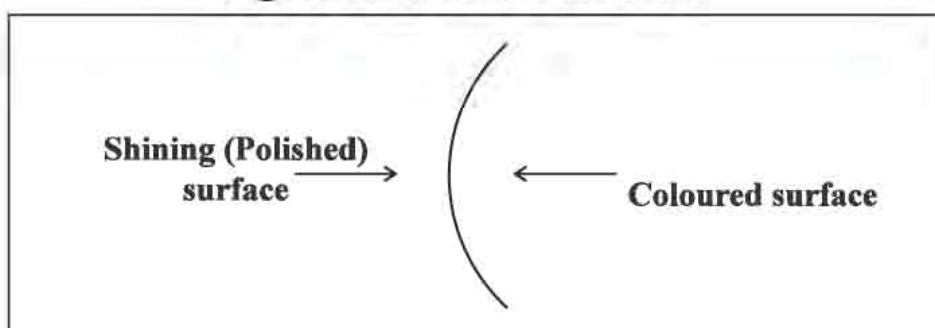


Figure 6.4 Convex mirrors

Some of the mirrors are polished internally and external curved surface are coloured. Such mirrors are called **concave mirrors**.

Some of the mirrors are polished externally and internal curved surfaces are coloured. Such mirror is called **convex mirror**.



What is required? Watch glass, shining paper, water colour, gum, brush etc.

What to do?

- First of all take watch glass.
- Paste shining paper on the inner curved surface with gum

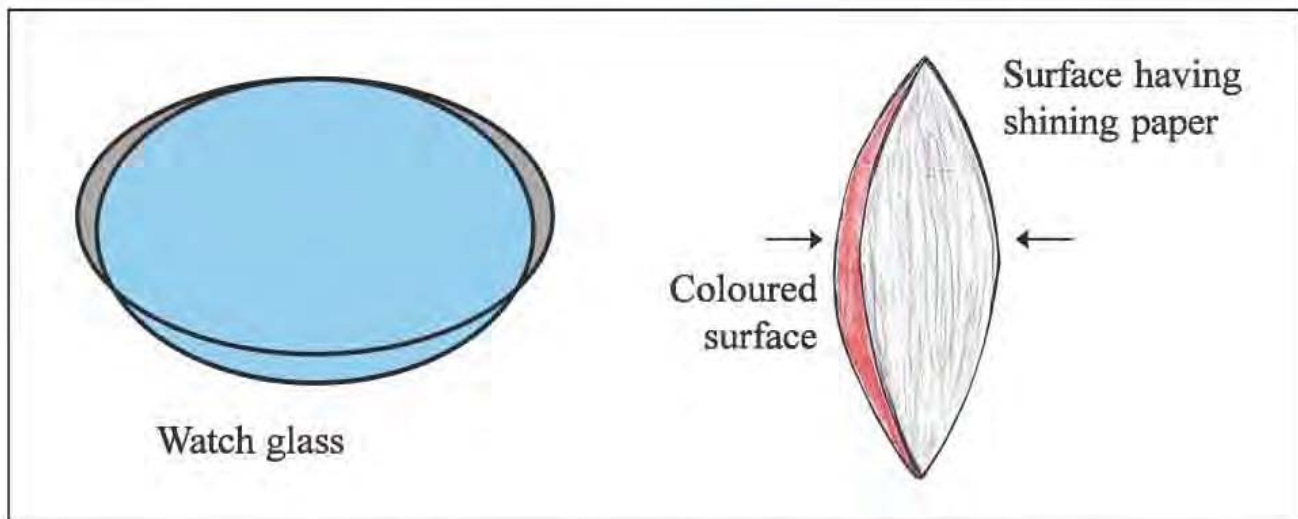


Fig. 6.5 Preparation of concave mirror

- Colour the external curved surface of the watch glass with brush.
- Which type of curved mirror will be when prepared this way?



What will you do to prepare convex mirror by above method?



What is required? Concave mirror, Convex mirror,

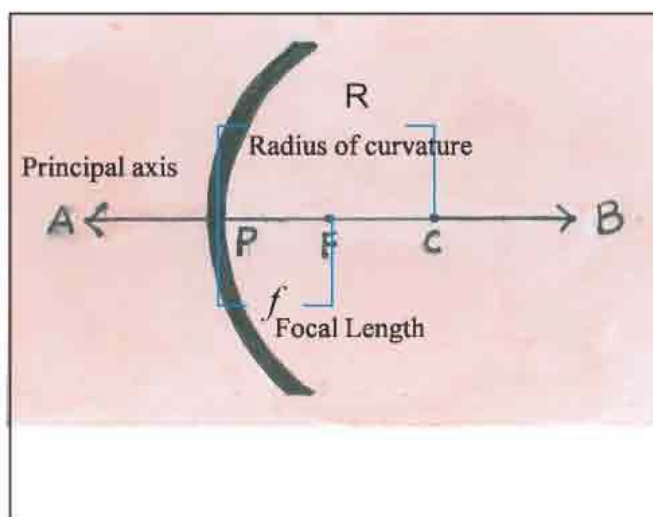


Figure 6.6
Concave mirror

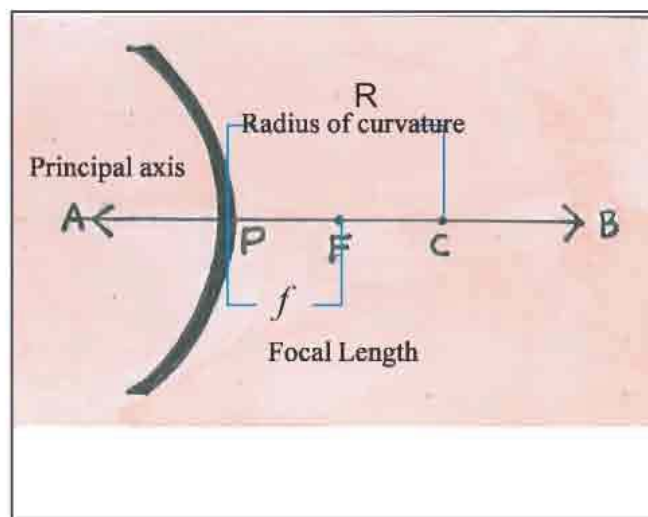


Figure 6.7
Convex mirror

What to do?

- Take one concave mirror and one convex mirror, Observe it and try to get acquainted with ITS terminology.
- **Pole :** the centre of the curved surface of the mirror is known as pole P is pole point.
- **Centre of curvature:** The centre of the hollow sphere from which curved mirror is cut is called centre of curvature is the centre of curvature in figure.
- **Radius of curvature:** The distance between pole point and centre of curvature (C) is called radius of curvature. The line segment CP in fig. is radius of curvature. It has a symbol R. Thus $CP = R$
- **Principal axis:** The virtual line passing through pole point and centre of curvature is known as principal axis. The line AB, is in figure represents principal axis.



What is required? a concave mirror, a torch, a paper, a stand.....

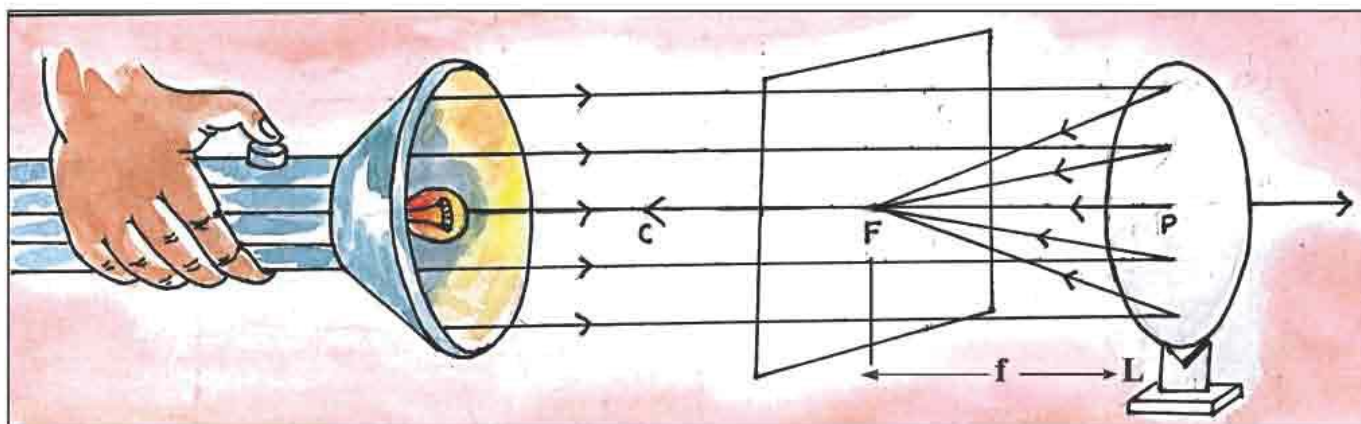


Figure 6.8

What to do?

- Take one concave mirror and adjust it on a stand as shown in the figure.
- Keep the torch at a distance larger than that of centre of curvature of mirror and allow the light to fall on it.
- Try to capture the point size image of rays of light reflected from concave mirror, on the paper and note your observation.
- Do you get point sized image of rays reflected from concave mirror? Yes/ No.
- **Principal focus :** The rays of light made incident parallel to the principal axis horizontally, gets, (converged) concentrated at a point on the principal axis after getting reflected from the concave mirror. A point on the principal axis is known as principal focus or principal focal point of concave mirror. As shown in fig., F is the principal focus (Principal focal point).
- Similarly, in case of concave mirror the reflected rays of light reflected from polished surface do not converge at a single point but they diverge, then those diverging rays of light can be virtually, imagined and extended backward at one point, such a point is focal point of convex mirror.
- **Focal length :** The distance between pole point and the principal focus of a curved mirror is known as focal length of that curved mirror, It is represented by symbol (f) as shown in the Fig.

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- **Relation between focal length and radius of curvature.**
- Radius of curvature of a curved mirror is always double than that of focal length F . thus, $R = 2f$ or $f = R/2$
- Calculate the following using the above formula.
- What will be the focal length of a curved mirror if it has 10 cm radius of curvature?

- If focal length of a curved mirror is 6 cm then what will be its radius of curvature?



Characteristics of image obtained by using concave mirror

What is required? a concave mirror, a candle, a match box, a drawing paper, a mirror stand, a candle stand

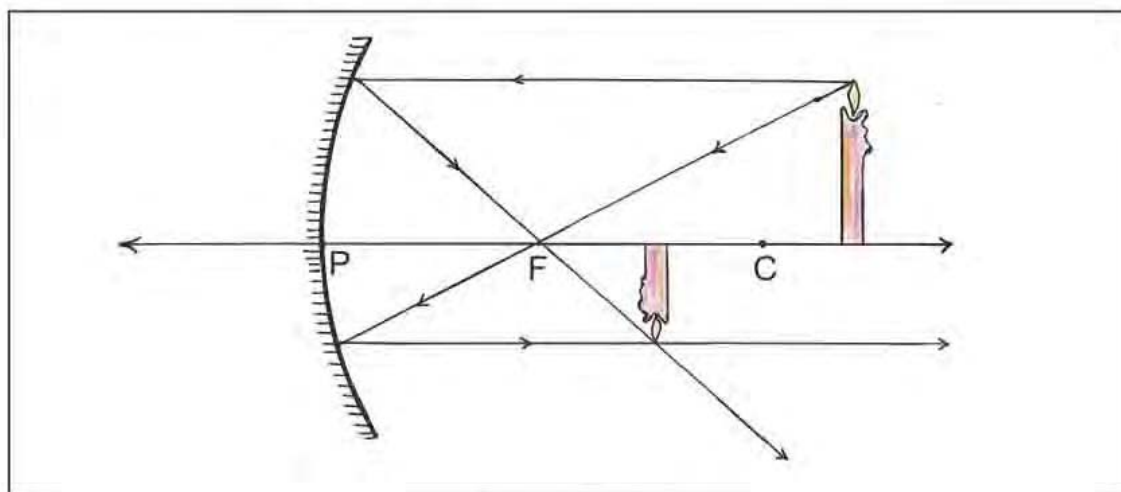


Figure 6.9

What to do?

- Adjust the drawing paper on a plain surface as shown in the figure.
- Adjust the concave mirror on stand on it.

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- Mark Principal focus F and centre of curvature C of concave mirror on it.
- Place a candle using candle stand on it at distance higher than radius of curvature in front of the concave mirror and light the candle.
- Capture the image of the flame of candle on a drawing paper and write your observations.
- Position of candle:
- Position of image:
- Which type of image is observed? Errect / inverted:
- How does the image appear ? Smaller / bigger than the flame of candle.

As in above activity, one of the rays of light coming from candle made incident on the concave mirror paralld to principal axis horizontally, passes through principal focus after reflection and the other which made incident on concave mirror after passing through principal focus get reflected paralld to the principal axis. All such rays converge at a point where the image of the object is obtained.

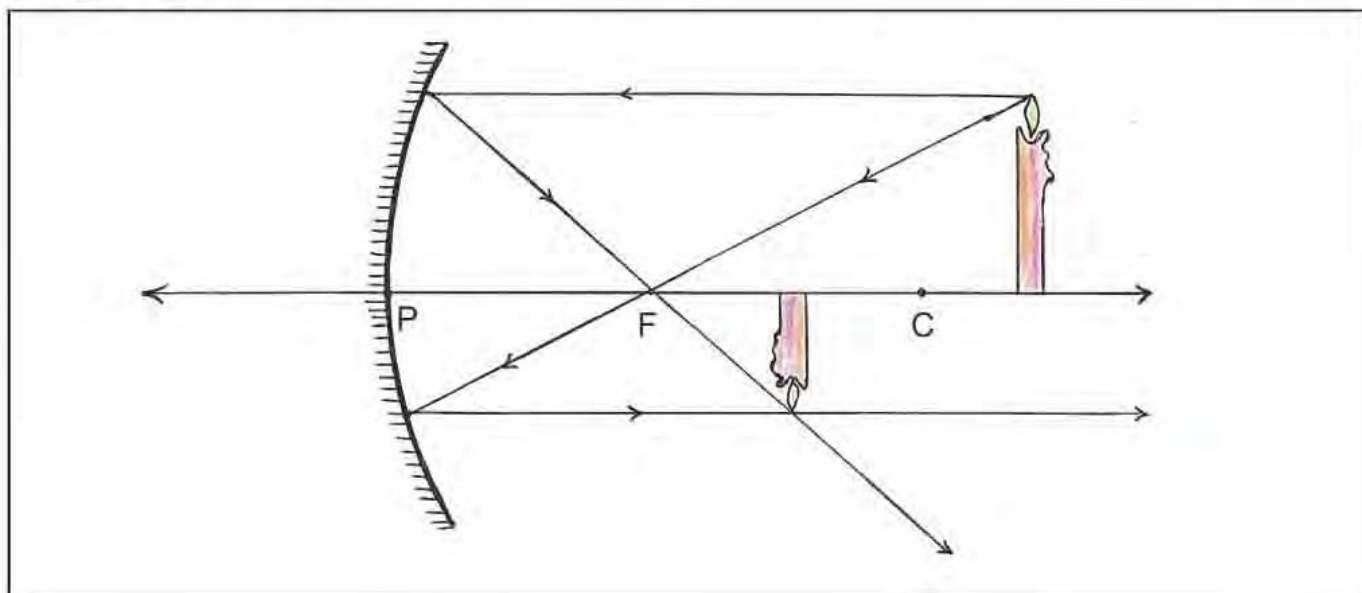


Figure 6.10

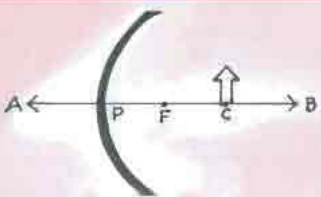
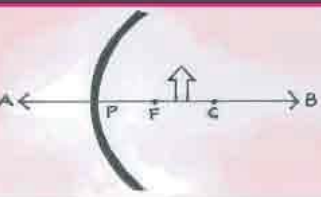


Repeat the above activity, keeping the candle at different positions as shown in the following table and note the position of image, type of images and other characteristic.

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Discuss in each case, in which you get which type of images, and why you get it like that with your teacher.

Position of candle	Position of image	Type of image of candle			Position of rays
		erect or inverted	bigger or smaller than flame of candle	Real / virtual	
At radius of curvature					 <p>Figure 6.11</p>
Between radius of curvature and principal focus					 <p>Figure 6.12</p>



Observe the following figure 6.13

As in above activity, when the candle is placed between point P and Point F of a concave mirror, the rays coming out of object (candle) gets, incident on the mirror and after reflection passes through principal focus C. while some of them travelling in the direction of radius of curvature get reflected in the same direction and passes through centre of curvature C.

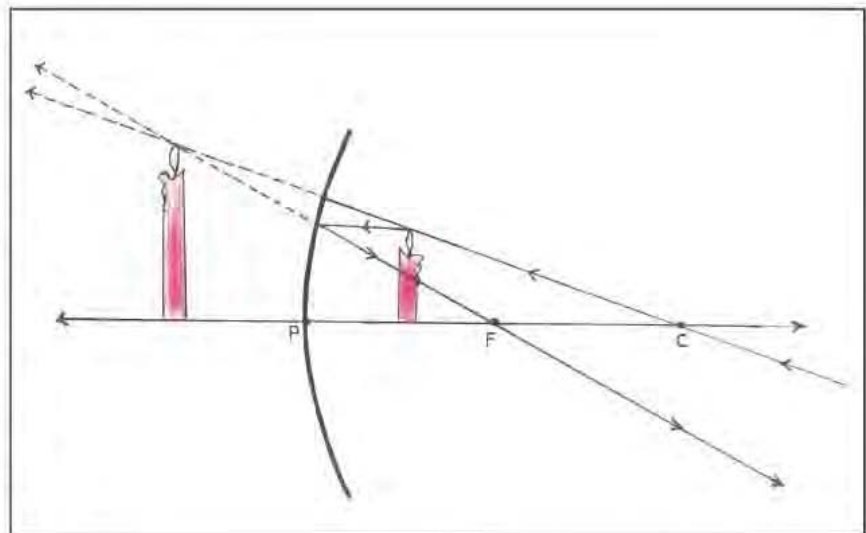


Figure 6.13

Thus, drawing of the path of rays indicate these rays do not intersect on one side of the mirror but we need to extend them virtually to understand the point of intersection of these rays. Which we get at a position behind the concave mirror. Thus, these rays appear to intersect behind the mirror at some point where we get the image of the object (candle), which is big in size, erect and virtual image.

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These characteristics of images obtained by curved mirrors are useful in daily life.

Some of the pictures of objects in which we use curved mirrors are shown. Observe them carefully and write the characteristics used in the table.

Pictures showing use	For which characteristic it is used?
 	
 	
	
	



Write the other uses of curved mirror you have observed :



Let us prepare a parabolic solar cooker

What is required?

An earthen pot, a curved metal sheet, polished aluminum foil, gum, a wooden stand, a nut bolt etc.

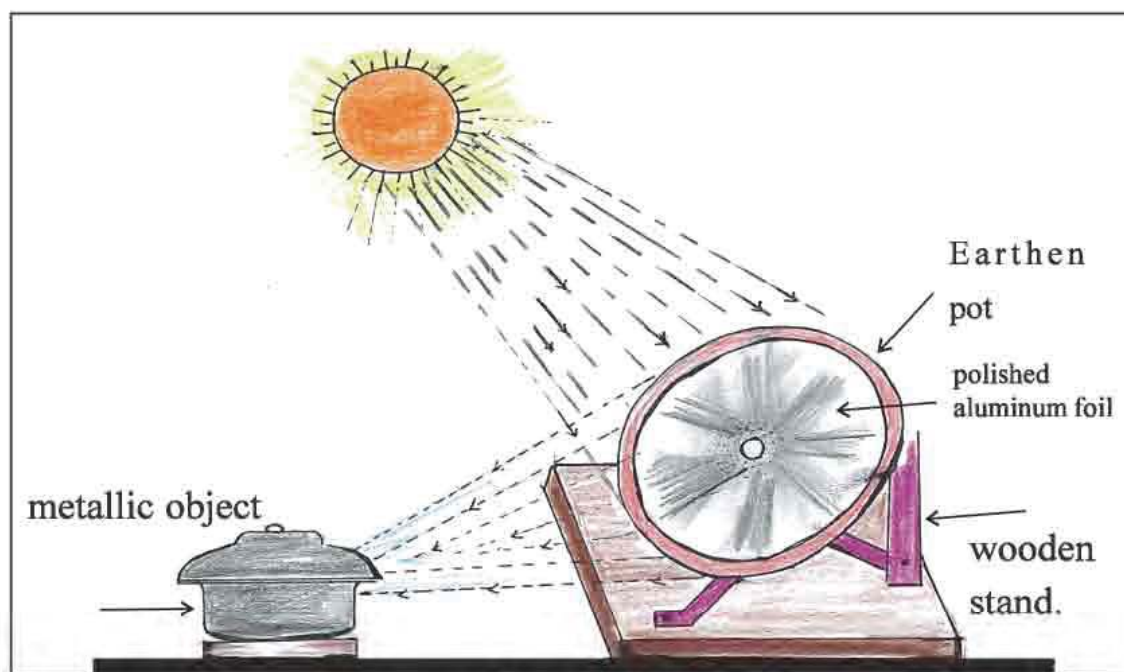


Figure 6.14

What to do?

- Take the curved earthen pot, paste the polished aluminum foil inside it.
- Prepare a hole at the centre of sheet and using nut bolts get it fitted on the wooden stand.
- Adjust this arrangement in front of sun light in such a way that the reflected sun light gets focussed at a single point.
- Place a metallic object at that place and observe it after some time.
- Note your observations.



Characteristic of images observed in convex mirrors.

What is required? a convex mirror, a mirror stand, a candle, a candle stand, a match box, a drawing paper

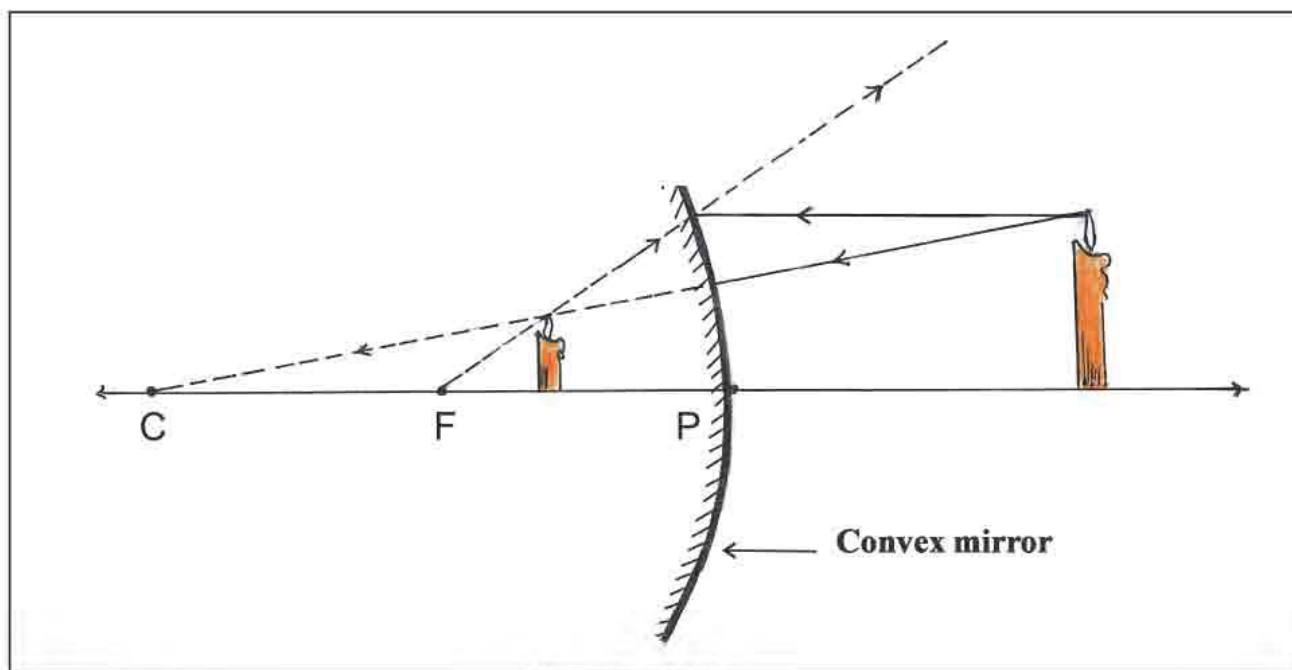


Figure 6.15

What to do?

- Place a drawing paper on plain surface
- Place the stand and mount the convex lens on it.
- Adjust a candle on stand in front of the convex mirror as shown in the fig.
- Try to obtain the image on the paper or screen, observe the image and note the observation of image.

• position of candle :

• position of image:

• What type of image is ? Erect / Inverted:

• What is the size of image? bigger / smaller, than the size of the candle:

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- Can we obtain the image on screen? Yes/ No
- Type of image : Real / virtual



Discuss how and why formation of image obtained during above activity takes place using convex mirror with your teacher and draw the diagram.

Uses of convex mirror :

Due to the type of images obtained using convex mirrors, they possess special characteristics and are accordingly useful in daily life.



Figure 6.16



Figure 6.17



Figure 6.18

Note other uses of convex lense, you have seen.



Q.1 Why is it written as “objects in the mirror are closer than they appear”, on the side glasses of motorbikes or scooter or cars?

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Q.2 Why are big convex mirrors placed in front of reception tables of some hotels or big shopping malls?

Q.3 Mention in the following figure, what is the position of rays which obtaining image of an object placed in centre of curvature in concave mirror.

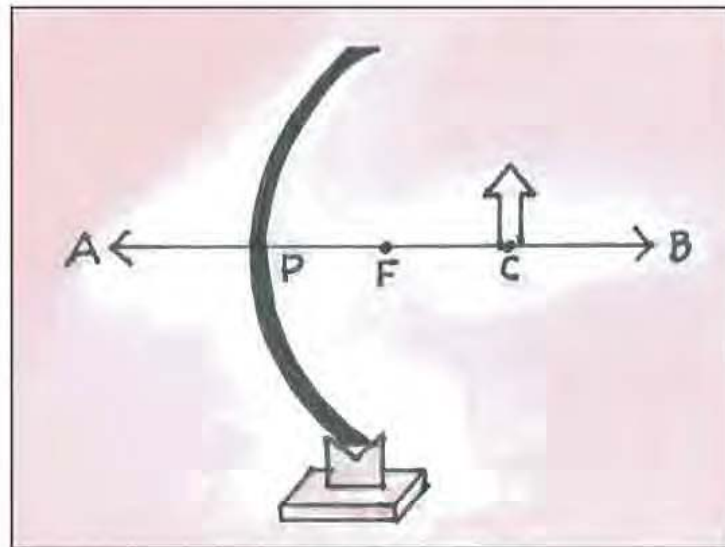


Figure 6.19

Q.4 Why are concave mirrors used in search lights?

Q.5 What type of image is obtained while using convex mirror when the object is far away from mirror?
