Date 17.5.24
Page

Exercises

Q1) Which one of the following materials cannot be used to make a lens?

Ans) Clay.

Q2) The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be position of the object?

Ans) Between the pole of the mirror and its principal focus.

Q3) Where should an object be placed in front of a convex lens to get a real image of the size of the object?

Ans) At twice the focal length.

Q4) A spherical mirror and a thin spherical lens have each a focal length of −15 cm. The mirror and the lens likely to be

Ans) Both concave

Q5) No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

Ans) Either plane or convex

Q6) Which of the following lenses would you prefer to use while reading small letters found in a dictionary?

Ans) A convex lens of focal length 5 cm.

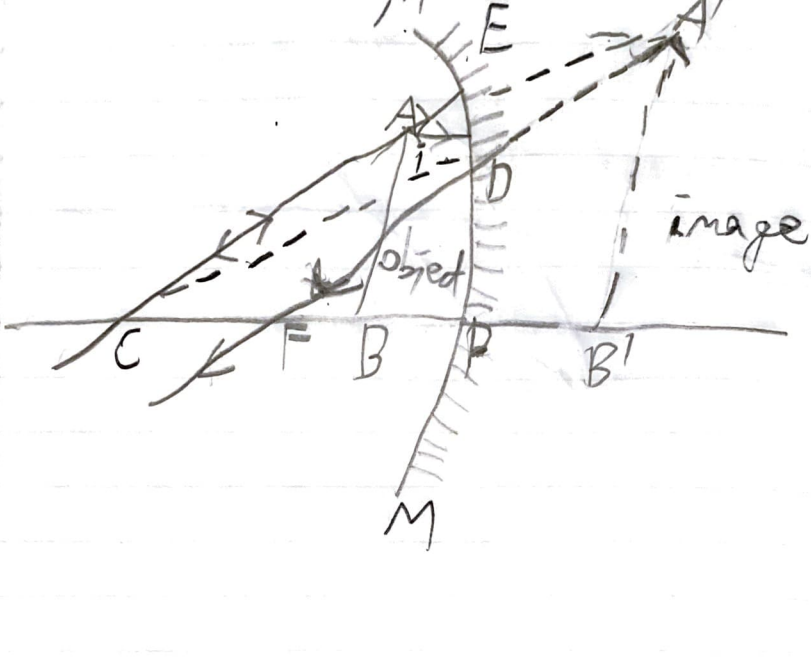
Q8) Name the type of mirror used in the following situations :-

a) Headlights of a car — Concave mirror

b) Side/Rear-view mirror of a vehicle — convex mirror

c) Solar furnace — Concave mirror

Q9) We wish to obtain an erect image of an object, using a concave mirror of focal length 15 cm. What should be the range of distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.



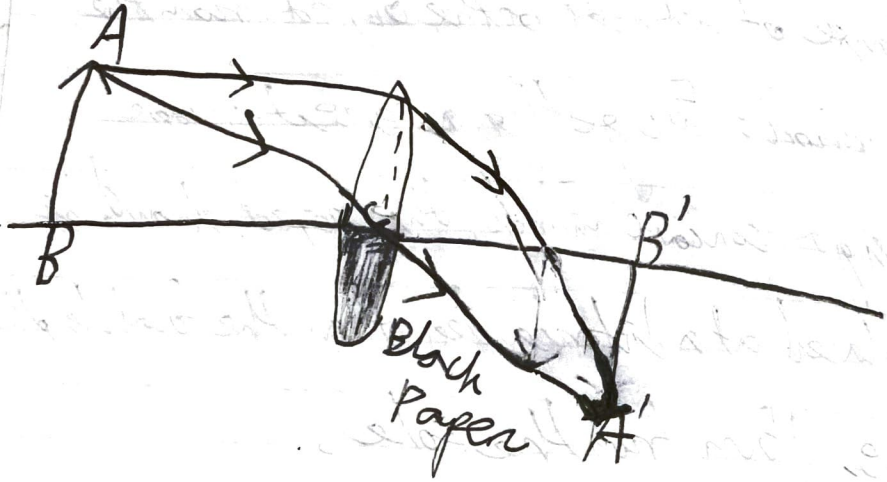
Figure

Ans) Focal length of concave mirror, $f = -15cm$

Range of distances of the object from the mirror: For getting an erect image using a concave mirror, the object should be placed at a distance less than the focal length i.e. 15cm from the pole.

Nature of the image: Image will be virtual, erect and the image is larger than the object (magnified).

Q) One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally. Explain your observations.



Figure

Ans) Yes, it will. Even if half of the convex lens is covered with black paper, the lens will produce a complete image. However the intensity of the image may be less. It can be observed experimentally by using a lighted candle and a convex lens.

Experiment -

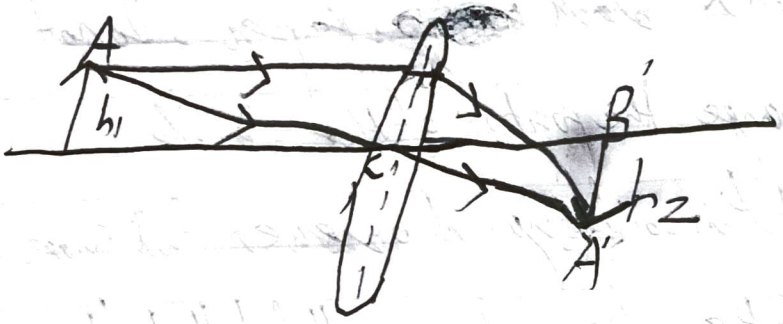
1) Take a lighted candle and place it in front of a convex lens mounted on a plane surface.

2) Move the candle along the axis of the plane to obtain the full image on the screen. Once the full image is observed, mark the position of the candle without moving it.

3) Now cover the lower exact half of the lens with a black paper. Do not change the position of the candle.

4) At this point, you will observe a full image of the candle, but you will find that the intensity is reduced. This is because the covered part of the lens does not allow light to pass through it. So the amount of light reaching the screen is reduced.

Q10) An object 5cm in length is held 25 cm away from a converging lens of focal length 10cm. Draw the ray diagram and find the position, size and the nature of the image formed.



Figure

Ans) Given $u = -25cm$, $f = 10cm$ and $h_2 = 5cm$

Using lens formula we have

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f},$$

$$\frac{1}{v} = \frac{1}{-25} + \frac{1}{10}$$

$$\frac{1}{v} = \frac{-1}{25} + \frac{1}{10}$$

$$\frac{1}{v} = \frac{-2+5}{50} = \frac{3}{50}$$

$$v = \frac{50}{3} = 16.67$$

$$\text{Magnification} = \frac{h_1}{h_2} = \frac{v}{u} = \frac{50}{3} \div -25$$

$$= \frac{50}{3} \times \frac{1}{-25} = \frac{50 \times 1}{3 \quad 25} = -\frac{50}{75} = \frac{2}{1}$$

$\frac{h}{5} = \frac{-2}{3}$

$h = \frac{-10}{3} = -3.33$ cm

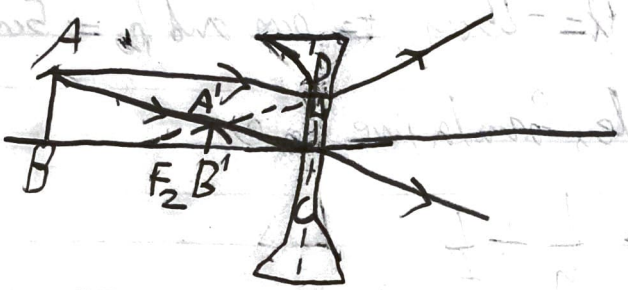
The position of image is at distance 16.67 cm from the lens. The image is formed on the right side of lens and it is real and inverted in nature.

Q11 A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens? Draw the ray diagram.

Ans) For concave lens, $f = -15$ cm, $v = -10$ cm

Using lens formula, we have,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$



Figure

$$\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{-10} - \frac{1}{-15} = -\frac{1}{30}$$

$u = -30\,cm$

Q(2) An object is placed at a distance of 10cm from a convex mirror of focal length 15cm, Find the position and nature of the image,

Ans) Here, object distance $u = -10cm$,

focal length $f = 15cm$,

Image distance $v = ?$

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

$$\frac{1}{15} = \frac{1}{v} + \frac{1}{-10}$$

$$\frac{1}{v} + \frac{1}{-10} = \frac{1}{15}$$

$$\frac{1}{v} = \frac{1}{10} + \frac{1}{15}$$

$$\frac{1}{v} = \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$$

$v = 6$ cm

Here + sign of v indicates that image is at the back of the mirror. It must be virtual, erect and smaller in size than the object.

Q[3] The magnification produced by a plane mirror is $m = +1$. What does it mean?

Ans) As $m = \frac{h_2}{h_1} = +1$, $h_2 = h_1$, i.e., size of the image is equal to size of the object. Further, + sign of m indicates that the image is erect and hence virtual.

Q(4) An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of reading of curvature 30 cm. Find the position of the image, its nature and sizes.

Ans) Here, object size, $h_1 = 5.0$ cm

object distance $u = 20$ cm

reading of curvature $R = 30$ cm

image distance $v = ?$, image size $h_2 = ?$

As $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} = \frac{2}{R}$,

$$\frac{1}{v} = \frac{2}{R} - \frac{1}{u} = \frac{2}{30} + \frac{1}{20} = \frac{4+3}{60} = \frac{7}{60}$$

or $v = \frac{60}{7} = 8.57$ cm

Positive sign of v indicates that image is at the back of the mirror. It must be virtual and erect.

As $m = \frac{h_2}{h_1} = \frac{-v}{u}$, $\frac{h_2}{5.0} = \frac{-60/7}{-20} = \frac{3}{7}$

$h_2 = \frac{3}{7} \times 5.0 = \frac{15.0}{7} = 2.1\,cm$

The size of the image is 2.1 cm

Q15) An object of size 7.0cm is placed at 27cm in front of a concave mirror of focal length 18cm. At what distance from the mirror, should a screen be placed so that a sharp focused image can be obtained? Find the size and nature of the image.

Ans) Here, object size, $h_1 = 7.0\,cm$

object distance $u = -27\,cm$

focal length, $f = -18\,cm$

image distance, $v = ?$ image size, $h_2 = ?$

As, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$$\frac{1}{v} = \frac{1}{-18} + \frac{1}{27} = \frac{-3+2}{54} = \frac{-1}{54}$$

$$\therefore v = -54\,cm$$

The screen should be held in front of the mirror at a distance of 54cm from the mirror. The image obtained on the screen will be real.

As $m = \frac{h_2}{h_1} = -\frac{v}{u}$ $\quad \frac{h_2}{7.0} = \frac{(-54)}{(-27)}$

$h_2 = -14.0\ cm$

Negative sign of h_2 shows that the image is inverted