Light - Reflection and Refraction: Exercise Question

Q.1 Which one of the following materials cannot be used to make a lens?
(a) Water (b) Glass (c) Plastic (d) Clay

Sol. (d) Clay.

Q.2 The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of the object?

(a) Between the principal focus and the centre of curvature
(b) At the centre of curvature
(c) Beyond the centre of curvature
(d) Between the pole of the mirror and its principal focus.

Sol. (d) Between the pole of the mirror and its principal focus.

Q.3 Where should an object be placed in front of a convex lens to get a real image of the size of the object?

(a) At the principal focus of the lens
(b) At twice the focal length
(c) At infinity
(d) Between the optical centre of the lens and its principal focus.

Sol. (b) At twice the focal length

Q.4 A spherical mirror and a thin spherical lens have each a focal length of –15 cm. The mirror and the lens are likely to be -

(a) Both concave
(b) Both convex
(c) the mirror is concave and the lens is convex.
(d) the mirror is convex, but the lens is concave.

Sol. (a) Both concave

Q.5 No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

(a) plane
(b) concave
(c) convex
(d) either plane or convex

Sol. (d) either plane or convex

Q.6 Which of the following lenses would you prefer to use while reading small letters found in a dictionary?

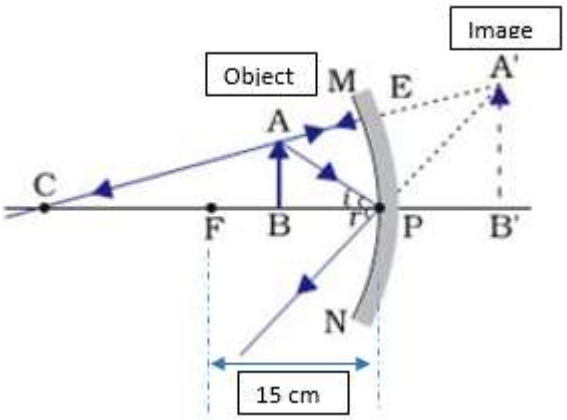
(a) A convex lens of focal length 50 cm.
(b) A concave lens of focal length 50 cm.
(c) A convex lens of focal length 5 cm.
(d) A concave lens of focal length 5 cm.

Sol. (c) A convex lens of focal length 5 cm.

Q.7 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.

Sol. The range of distance of the object from the mirror should be pole to 15 cm.
The nature of image: Virtual, Erect, and Magnified. This image is smaller than the object.

Ray Diagram:



Q.8 Name the type of mirror used in the following situations.

(a) Headlights of car.

(b) Side/ rear-view mirror of a vehicle

(c) Solar furnace

Support your answer with reason.

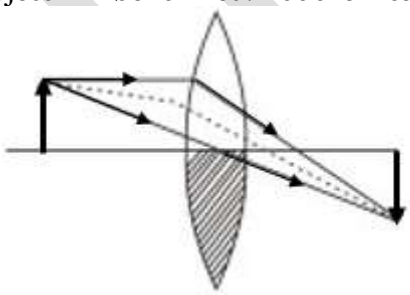
Sol. (a) Concave mirror: The bulb is placed at focus of the concave, it throws parallel beam of light after reflection.

(b) Convex mirror: To get wider field of view of behind and erect small images.

(c) Concave mirror: To converge the rays of sun at its focus, a concave mirror is used.

Q.9 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.

Sol. The complete image of the object will be formed. But the intensity of light will be reduced.



Because only the rays passing from one half of lens will be converged by the lens. So, the intensity of image will reduce.

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

Sol. **Given:** Object distance u = -25 cm

Focal length f = 10

Object height =5 cm

By using lens formula:

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

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

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

$$\frac{1}{v}=\frac{1}{10}-\frac{1}{25}=\frac{15}{250}$$

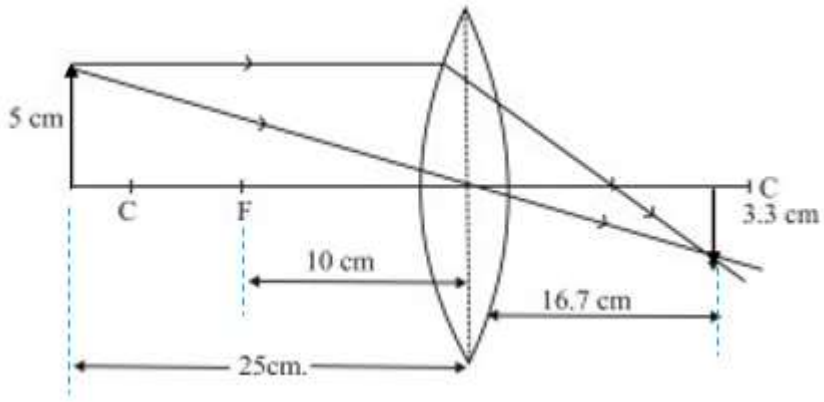
V = 250/15 = 16.66 cm

Magnification of converging lens,

$$\frac{h_i}{h_o}=\frac{v}{u}$$

$$h_i=\frac{v}{u}\text{x}h_o$$

$$h_i=\frac{50}{3\text{x}(-25)}\text{x5}=-\frac{10}{3}=-3.3cm$$



Therefore,

The image Position = 16.7 cm.

The image Size = 3.3 cm.

Nature of image: Real, inverted, diminished.

Q.11 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.

Sol.

Given: Focal length, f = −15cm,

Image distance, v = −10cm

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

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

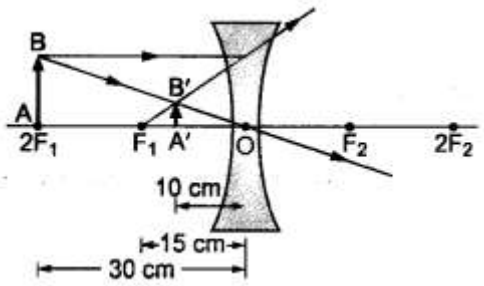
$$\frac{1}{u}=\frac{1}{v}-\frac{1}{f}$$

$$\frac{1}{u}=\frac{1}{-10}-\frac{1}{-15}$$

$$\frac{1}{u}=\frac{-3+2}{30}=-\frac{1}{30}$$

$$u=-30cm$$

Therefore u=−30cm
the ray diagram:



Q.12 An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image.

Sol. Given: Object distance, u = – 10 cm
Focal length, f = 15 cm
By using mirror formula:

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

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

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

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

$$v=6cm$$

Therefore v = 6 cm.
Now, from the magnification:

$$m=\frac{-v}{u}=\frac{-6}{-30}=\frac{1}{5}$$

Since, m < 1
So, Image is behind the mirror, virtual, erect and diminished.

Q.13 The magnification produced by a plane mirror is +1. What does this mean?

Sol. If magnification is +1, it means that an erect image is formed with same size as object.

Q.14 An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.

Sol. Given: Object length h_o = 5 cm
Object distance, u =-20 cm
Radius of curvature, R =30 cm
Focal length, f =R/2 = 30/2 = 15 cm

By using mirror formula:

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

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

$$\frac{1}{v}=\frac{1}{+15}-\frac{1}{-20}$$

$$\frac{1}{v}=\frac{4+3}{60}=\frac{7}{60}$$

$$v=\frac{60}{7}cm=8.6cm$$

Therefore, v = 8.6 cm.
From the magnification:

$$Magnification,\ m=\frac{-v}{u}=\frac{h_i}{h_o}$$

$$h_i=\frac{-v}{u}\text{ x }h_o$$

$$h_i=\frac{8.6}{-20}\text{ x }5=2.15\text{ cm}$$

The image is at 8.6 cm behind mirror, size 2.15 cm, erect, virtual and diminished.

Q.15 An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focussed image can be obtained? Find the size and the nature of the image.

Sol. Given: size of object, $h_o = 7$ cm
Object distance, u = – 27
Focal length, f = –18 cm.

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

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

$$\frac{1}{v}=\frac{1}{-18}-\frac{1}{-27}$$

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

$$v=-54cm$$

Therefore, v = – 54 cm.
From the magnification,

$$Magnification,\ m=\frac{-v}{u}=\frac{h_i}{h_o}$$

$$h_i=\frac{-v}{u}\text{ x }h_o$$

$$h_i=-\frac{-54}{-27}\text{ x }7=\text{-14 cm}$$

Thus, the screen distance 54 cm, real, inverted image of size 14 cm.

Q.16 Find the focal length of a lens of power - 2.0 D. What type of lens is this?

Sol. Given: Power, P = -2.0 D

F = 1/P = – (1/2) = -0.50m.
The type of lens is Concave lens.

Q.17 A doctor has prescribed a corrective lens of power +1.5D. Find the focal length of the lens. Is the prescribed lens diverging or converging?

Sol. Given: Power of lens, P = -1.5 D

F = 1/p = 10/15 = 0.67m.

The lens is converging.