LIGHT
REFLECTION & REFRACTION

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

(i) Between the principal focus and the centre of curvature.

(ii) At the centre of curvature.

(iii) Beyond the centre of curvature.

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

Ans:- The image formed by a concave mirror is virtual, erect and larger only when the object is placed between the pole of the mirror and its principal focus. So correct choice is (iv).

2. No matter how far you stand from a mirror, your image appears erect. the mirror is likely to be

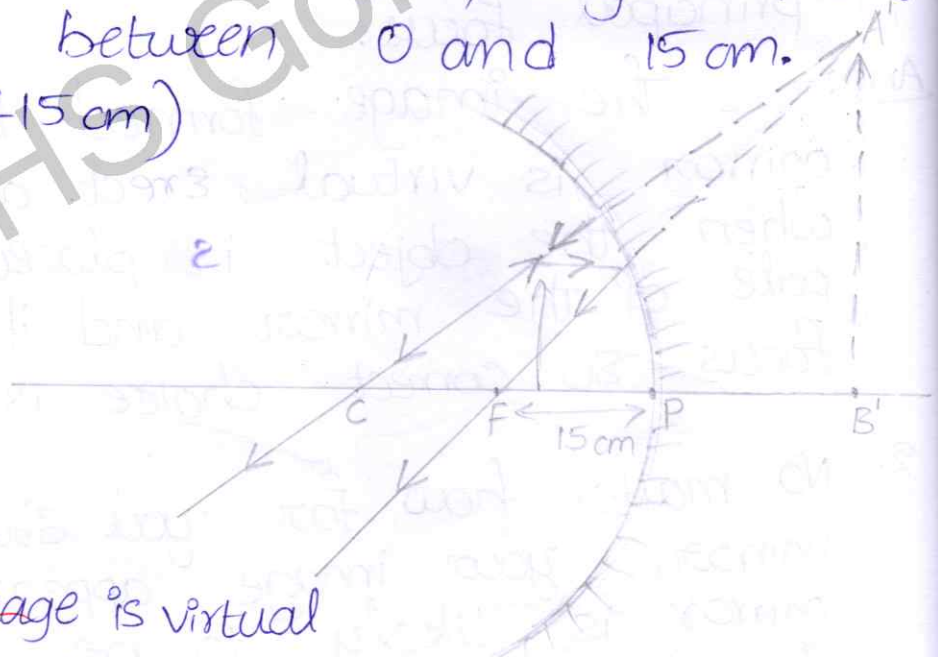
(i) only plane (ii) only concave,

(iii) only convex (iv) either plane or convex.

Ans:- A plane mirror forms an erect image of equal size; while a convex mirror forms an erect image of smaller size irrespective of the distance of object from the mirror so correct choice is (iv) plane or convex.

3. 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 the distance of the object from the mirror what is the nature of the image? Is the image larger or smallest than the object Draw a ray diagram to show the image formation in this case.

Ans:- An Erect image is formed by a concave mirror, only if the object is placed between the pole and the principal focus of the mirror (i.e, range of object distance is between 0 and 15 cm.
i.e, $0 < u < 15$ cm)



Nature: the image is virtual

Size of Image: the image is larger than the object. The ray diagram is shown in figure.

4. Name the type of mirror used in following situations:
(i) Headlights of a car.
(ii) Side/Rear view mirror of a vehicle.
(iii) Solar furnace.

support your answer with reason.

Ans:- (i) Headlights of a car use a concave mirror. concave mirror renders the rays parallel when object is placed at its principal focus. the bulb of headlight is at focus of concave mirror, the rays reflected from the mirror are in the form of a strong parallel beam, which goes straight and makes the ~~distance~~ distant objects visible for safe driving.

(ii) Side/rear view mirror of a vehicle is a convex mirror because of its larger field of view.

(iii) Solar furnace uses a concave mirror. the object to be ~~parallel~~ heated in placed at the focus of concave mirror. the parallel rays coming from the sun become incident on the mirror and get reflected at focus. that is sufficient Energy is received from the sun and collected at one point (focus) to heat the object.

5. 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.

Ans:- Given $u = -10$ cm. $f = +15$ cm. $v = ?$

From mirror formula $= \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ or $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$\Rightarrow \frac{1}{v} = \frac{1}{15} - \frac{1}{(-10)}$

$$\Rightarrow \frac{1}{v} = \frac{1}{15} + \frac{1}{10} = \frac{2+3}{30}$$

or $v = \frac{30}{5} = +6$ cm

That is the image is formed at a distance of 6 cm from the mirror behind it. The image is erect and virtual.

6. The magnification produced by a plane mirro is +1. what does this mean?

Ans:- The positive (+) sign of magnification (m indicates that the image is virtual and erect. The magnification, m = 1 indicates that the image is of the same size a the object. thus, the magnification of +1 produced by a plane mirror means th image formed in a plane mirror is virtual, erect and of the same size as the object.

7. An object 5 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.

Ans:- Radius of curvature of convex mirror, R = 30 cm.

∴ focal length of convex mirror, $f = \frac{R}{2} = \frac{30\text{ cm}}{2} = 15$

Now h = 5 cm, u = −20 cm, v = ? h = ?

using the mirror formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, we have

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{(-20)}$$

$$= \frac{1}{15} + \frac{1}{20} = \frac{4+3}{60}$$

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

thus, image is formed at a distance of 8.6 cm behind the convex mirror. the image is virtual and erect.

$$m = \frac{h_1}{h} = -\frac{v}{u}$$

$$\frac{h'}{5} = \frac{8.6}{-20}$$

$$\Rightarrow h' = \frac{8.6}{20} \times 5 = 2.15 \text{ cm}$$

thus, the size of the image is 2.15 cm which is positive. It indicates that the image formed is erect, virtual and diminished.

8. An object of size 7cm 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 the nature of the image.

Ans:- Here,

$h = 7\text{cm}$, $u = -27\text{cm}$, $f = -18\text{cm}$ $v = ?$, $h' = ?$

using the mirror formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, we have

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

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

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

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

$$v = -54 \text{ cm}$$

The image is formed at a distance of 54 cm in front of the mirror and '−' sign shows that image is formed on the same side as that of the object. It means image is real and inverted.

Further, we know that $m = \frac{h'}{h} = -\frac{v}{u}$

$$\frac{h'}{7} = -\frac{(-54)}{-27}$$

$$h' = -14 \text{ cm}$$

Hence, the size of the image is 14 cm. The negative sign of the image shows that is inverted thus, the nature of the image is real, inverted and enlarged.

9. Which one of the following materials cannot be used to make a lens?

(a) Water (b) Glass (c) plastic (d) clay

Ans:- Lens is made of a transparent material. Since clay is not transparent.

So correct choice is (d) clay.

10. 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.

Ans:- for real image of same size, the object must be placed at the distance 2f in front of convex lens.
So, correct choice is (b) At twice the focal length.

11. A spherical mirror and thin spherical lens have each a focal length of -15 cm. The mirror and 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 and the lens is concave.

Ans:- Concave mirror and concave lens both have negative focal length. So correct choice is
(a) both concave.

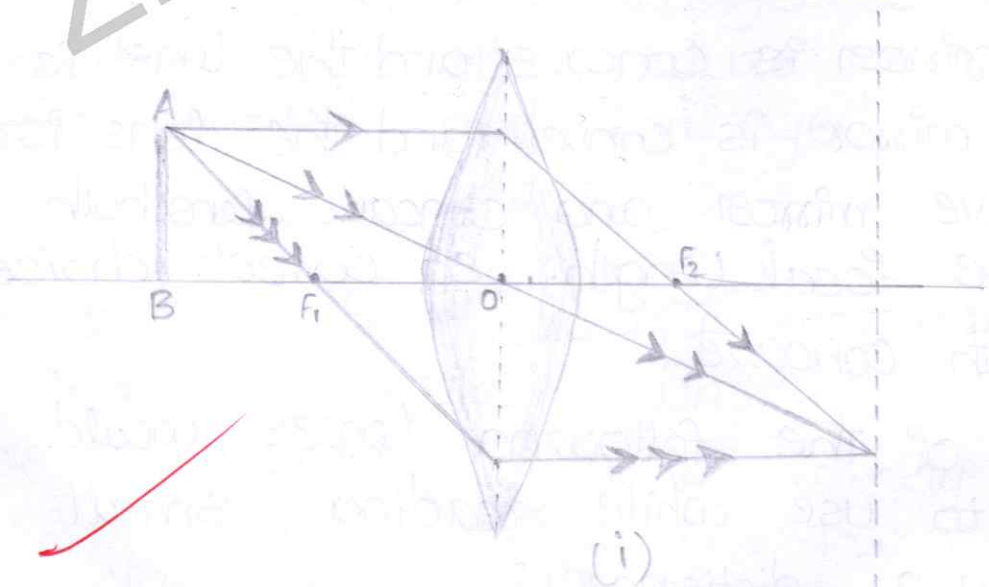
12. which of the following lences would you prefer to use while reading small letters found in a dictionary?
(a) A convex lens of focal length 50 cm.
(b) A concave lens of focal length 50 cm.
(c) A convex lens of focal length 5 cm.
(d) A concave lens of focal length 5 cm.

Ans:- magnifier or a simple microscope consists of Convex lens of small focal length. so, correct choice is (c). A convex lens of focal Length 5c

13. One half of a convex lens is covered with black paper. will this lense produce a complete image of the object? Verify your answer Experimentally. Explain your observations.

Ans:- Take a candle, put it in front of a Convex lens mounted on an optical bench Move the candle along the axis of the bench ~~Move the candle along the axis~~ and take its full image on a screen fig.

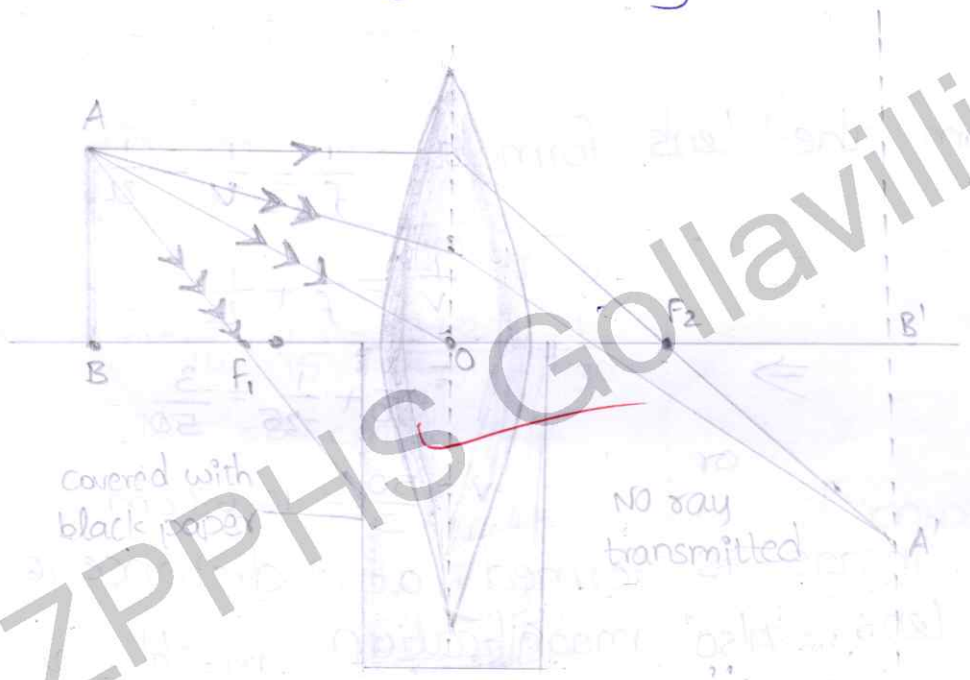
(i). Now Cover the lower half of the lens with a black paper without changing the positions of candle, lens and Screen fig.



(i)

(ii) you will observe that the full image of the candle is still seen on the screen; but the intensity of image is reduced.

the reason is that a large number of rays incident on the lens are refracted to form the image when lens is not covered.
In the case of covered lower half of lens with black paper, the rays starting from candle and incident on lens are reflected from the upper part only and form the full image, having low intensity.



(ii)

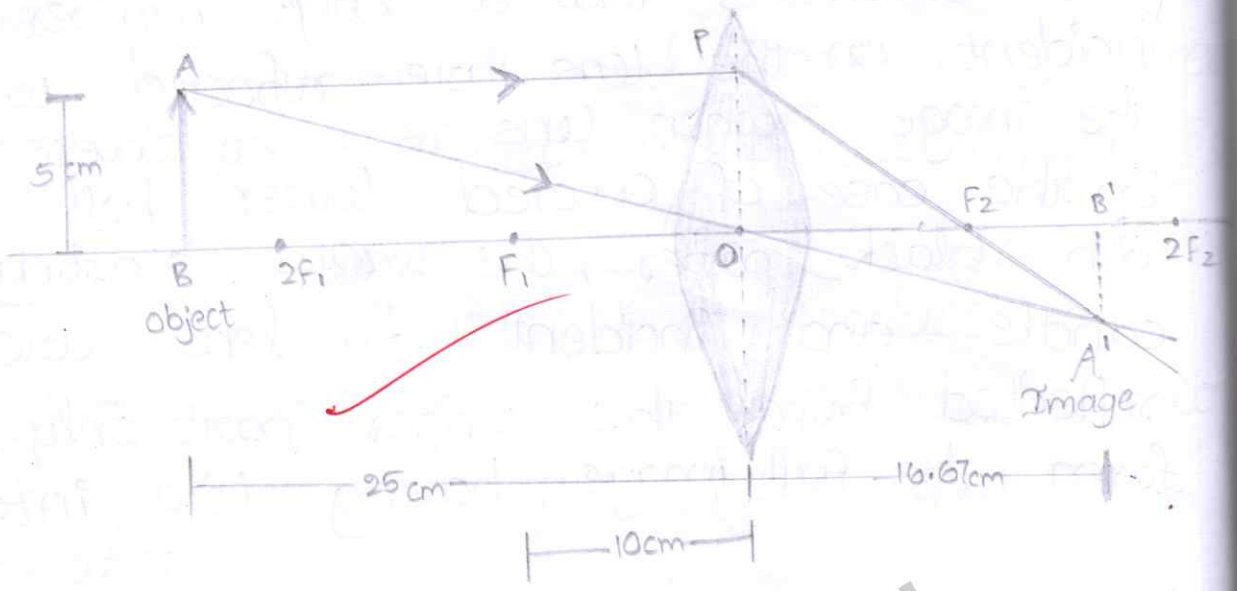
14. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed.

Ans:- Here,

$u = -25$ cm (u is always negative)

$f = +10$ cm (convex lens)

$h = 5$ cm; $v = ?$ and $h' = ?$



From the lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

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

$$\Rightarrow = \frac{1}{10} + \frac{1}{-25} = \frac{3}{50}$$

or $$v = \frac{50}{3} = 16.67 \text{ cm}$$

This image is formed at a distance 16.67 cm bef the lens. Also magnification $m = \frac{h'}{h} = \frac{v}{u}$

or $$h' = \frac{v}{u} \times h$$

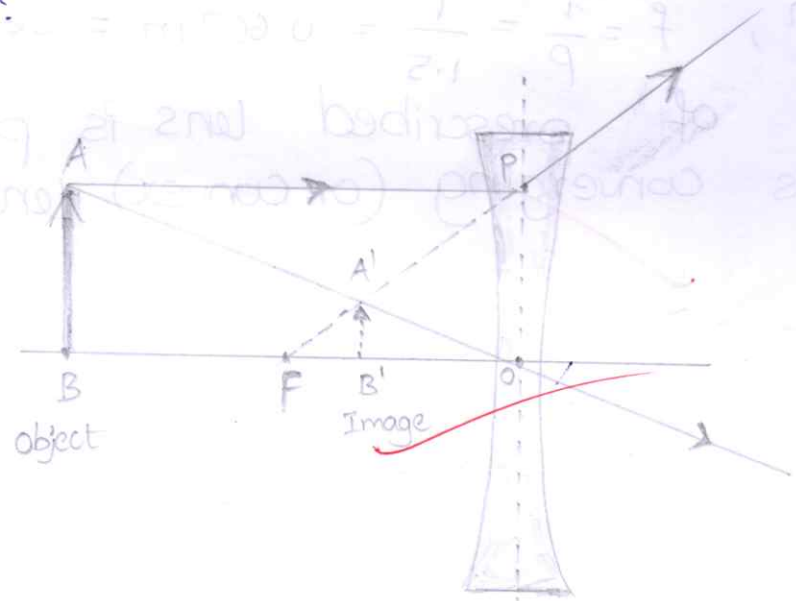
or $$= \frac{16.67}{-25} \times 5 = -3.33 \text{ cm}$$

Thus image is inverted, real and of size 3.33cm

15. A concave lens of focal length 15 cm, form an image at a distance of 10 cm from th lens. How far is the object placed from the lens? Draw the ray diagram.

Ans:- Here, focal length of the concave (divergin lens in $f = -15$ cm (negative), $v = -10$ cm (image same in concave lens)

$u = ?$



By lens formula, we have $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$.

or $\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{(-10)} - \frac{1}{(-15)}$

$= -\frac{1}{10} + \frac{1}{15} = \frac{-3+2}{30} = -\frac{1}{30}$

or $u = -30$ cm

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

Ans:- Given power, $P = -2.0$ D

If f is the focal length of lens, then $p = \frac{1}{f}$ gives

$f = \frac{1}{P} = \frac{1}{-2.0}$ m $= -50$ cm

Negative sign shows that lens is concave. thus focal length of lens is 50 cm and it is Concave lens.

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

Ans:- Given $P = +1.5$ D

As $P = \frac{1}{f(\text{in metre})}$

focal length, $f = \frac{1}{P} = \frac{1}{1.5} = 0.667\,m = 66.7\,cm$

As power of prescribed lens is positive, the lens is converging (or convex) lens.

Lesson Ended.

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