SELF ASSESSMENT TEST SOLUTIONS

1. (i) (a) Shaving mirrors (b) Search lights/headlight as reflectors (c) By doctors

(ii) Given, u = -10 cm ; f = -15 cm

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-15} + \frac{1}{10} = \frac{-5}{-150} = \frac{1}{30}$$

v = + 30 cm

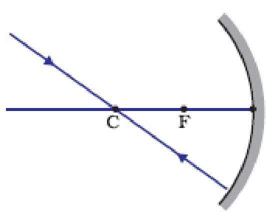
Nature of image – virtual and erect.

$$\frac{h^{I}}{h} = \frac{-v}{u} \therefore h^{I} = \frac{-30}{-10} \times 25 = 7.5 \text{ cm}$$

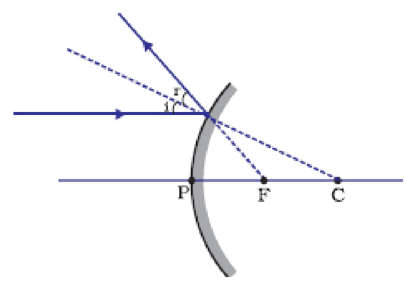
2. (a) Concave mirrors are commonly used in torches, search lights and vehicles head lights to get powerful parallel beam of light. They are often used as shaving mirrors to see a larger image of the face. The dentists use concave mirror to see large images of the teeth of patient. Large concave mirrors are used to concentrate sunlight to produce heat in solar furnace.

Convex Mirrors are commonly used as rear view mirrors in vehicles. These mirrors are fitted on the sides of the vehicles, enabling the driver to see traffic behind him. Convex mirrors are preferred because they always give an erect, though diminished image. Also, they have a wider field of view as they are curved outwards. Thus convex mirror enable the driver to view much larger area than would be possible with a plane mirror

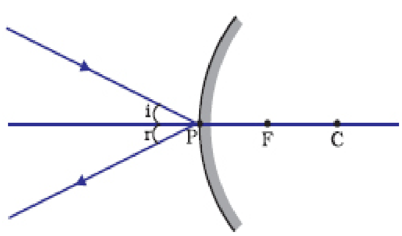
(b) (i)



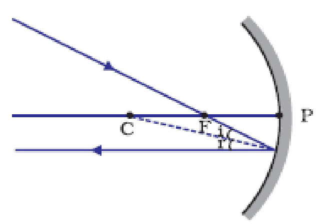
(ii)



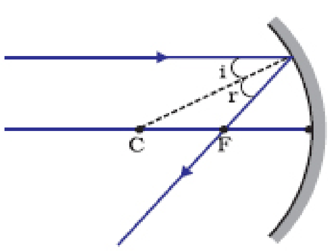
(iii)

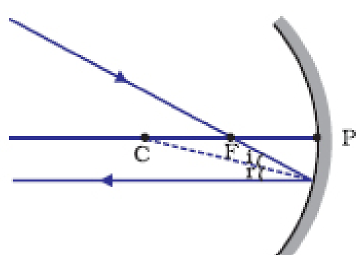


(iv)



3. (a)





(b) Given, h = x cm, h' = 3x cm, v = 80 cm, u = ?

$$m = \frac{h^{I}}{h} = \frac{-v}{u}$$

$$\therefore u = \frac{-v \times h}{h'} = \frac{-80 \times x}{3x} = \frac{-80}{3} \Rightarrow u = -26.6 \text{ cm}$$

Nature of lens : convex

The image is inverted, magnified and formed between F_1 & $2F_1$

4. (a) Given, u = - 12cm, f = +15cm

Using mirror formula, $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} + \frac{1}{12} = \frac{9}{60}$

$$\Rightarrow v = \frac{60}{9} = 6.7 \text{ cm}$$

magnification, $m = \frac{-v}{u} = \frac{-6.7}{-12} = 0.558$

$$\therefore h^{|} = 0.558 \times 4.5 = 2.5 \text{ cm}$$

As the needle is moved farther from the mirror, image moves to the focus and the size of image goes on decreasing.

(b) Concave mirrors are used in solar furnaces as they concentrate solar energy in the focal plane and help in attaining high temperatures.

(c) When one half of a convex lens is covered with a black paper the lens will produce a complete image of the object but the intensity of the image is reduced because rays from the top portion of the lens only are refracted and form the image.

5. (a) Given, u = -60 cm, m = +1/2 cm

$$m = \frac{-v}{u} = \frac{1}{2}$$

$$\frac{-v}{-60} = \frac{1}{2} \Rightarrow v = 30 \text{ cm}$$

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

$$= \frac{1}{-60} + \frac{1}{30} = \frac{1}{60}$$

$$f = 60 \text{ cm}$$

when magnification, $m = \frac{1}{3}$

i.e., $\frac{-v}{u} = \frac{1}{3}$

$$\Rightarrow v = \frac{-u}{3}$$

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

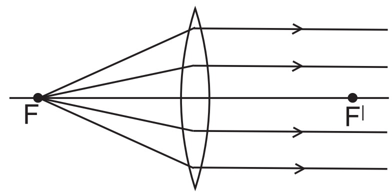
$$\Rightarrow \frac{1}{u} + \frac{1}{-u/3} = \frac{1}{60}$$

$$\frac{1}{u} + \frac{-3}{u} = \frac{1}{60}$$

$$\frac{-2}{u} = \frac{1}{60} \qquad u = -120 \text{ cm}$$

So inorder to get a magnification of 1/3, the object should be placed at 120 cm in front of the mirror.

(b) When a small electric lamp is placed at the focus of a convex lens, a parallel beam of light is produced by the lens.



6. (a) (i) The angle of incidence is equal to the angle of reflection.

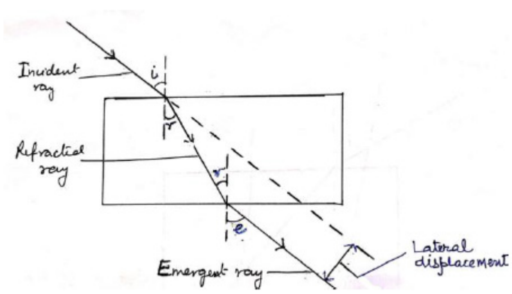
(ii) The incident ray , the normal to the mirror at the point of incidence and the reflected ray , all lie in the same plane.

(b) Virtual ,erect , as far behind the mirror as the object is in front of it and laterally inverted.

(c) Rear view mirror – convex mirror.

Advantage - large area is captured in a small convex mirror and it gives erect and diminished image.

7. (a)



(b) $n_{ga} = \frac{\text{Speed of light in air}}{\text{Speed of light in glass}} = \frac{3 \times 10^8}{2 \times 10^8} = \frac{3}{2} = 1.5$

(c) $f = \frac{1}{p}$

$= \frac{1}{-2.5 \text{ D}} = \frac{-10}{25\text{D}} = -0.4 \text{ m}$

8. Given, f = -20 cm, v = -15 cm

By using lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

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

$$\frac{1}{u} = \frac{-4+3}{60} = \frac{-1}{60} \qquad u = -60 \text{ cm}$$

So object distance is 60 cm.

$$\text{magnification, } m = \frac{v}{u} = \frac{h^{|}}{h}$$

$$\frac{-15}{-60} = \frac{h^{|}}{6}$$

$$h^{|} = \frac{6 \times (-15)}{-60} = 1.5 \text{ cm}$$

i.e., height of the image is 1.5 cm.

9. (a) (i) The central point of a lens is its optical centre.

(ii) A lens, either a convex lens or a concave lens, has two spherical surfaces. Each of these surfaces forms a part of a sphere. The centres of these spheres are called centres of curvature of the lens.

(iii) An imaginary straight line passing through the two centres of curvature of a lens is called its principal axis.

(iv) The effective diameter of the circular outline of a spherical lens is called its aperture.

(v) The rays, after refraction from the lens, are converging to a point on the principal axis. This point on the principal axis is called the principal focus of the lens.

The rays, after refraction from the lens, are appearing to diverge from a point on the principal axis. This point on the principal axis is called the principal focus of the concave lens.

(vi) The distance of the principal focus from the optical centre of a lens is called its focal length.

(b) Given, f = 12 cm, v = 48 cm

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

$$\therefore u = \frac{vf}{f-v} = \frac{48 \times 12}{-36} = -16 \text{ cm}$$

Object should be plaed at 16 cm infront of the lens.

10. (i) Given, h = + 3 cm, v = + 40 cm, P = + 4 D

$$f = \frac{1}{p} = \frac{1}{4} \text{ m} = 0.25 \text{ m} = 25 \text{ cm}$$

The lens is convex.

Using lens formula,

$$\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{40} - \frac{1}{25} = \frac{-3}{200} \qquad \Rightarrow u = \frac{-200}{3}$$

$$\text{Now, } \frac{h^1}{h} = \frac{v}{u} \qquad \Rightarrow h^1 = \frac{40}{-200/3} \times 3 = -1.8 \text{ cm}$$

(ii) Between optical centre and principal focus of a convex lens.