HW

Chapter

Reflection of Light.

Short Answer Type Question.

(11). b) $F = 20\,cm$, $u = 10\,cm$.

We know that,

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

$$\frac{1}{v} + \left(\frac{1}{-10}\right) = \frac{1}{(-20)}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-20} + \frac{1}{10} = \frac{1}{v} = \frac{-1+2}{20} = \frac{1}{v} = \frac{1}{20}.$$

$\therefore v = 20\,cm$

c) Characteristics of image formed -

i) Image is virtual and enlarged.

ii) Image is erect.

(12). Given, $H_1 = 10\,cm$, $u = -36\,cm$, $f = -12\,cm$

We know that,

$$\Rightarrow \frac{1}{v} + \frac{1}{u} = \frac{1}{f} \quad \text{or} \quad \frac{1}{v} + \frac{1}{(-36)} = \frac{1}{(-12)}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-36} - \left(\frac{1}{12}\right) \Rightarrow \frac{1}{v} = \frac{1}{\frac{-3}{36}} \quad \frac{1}{v} = \frac{-2}{36} = \frac{-1}{18}$$

$$\Rightarrow \frac{1}{v} = \frac{-1}{18} \quad \therefore v = -18\,cm.$$

∴ The position of the image is 18 cm in front of mirror.

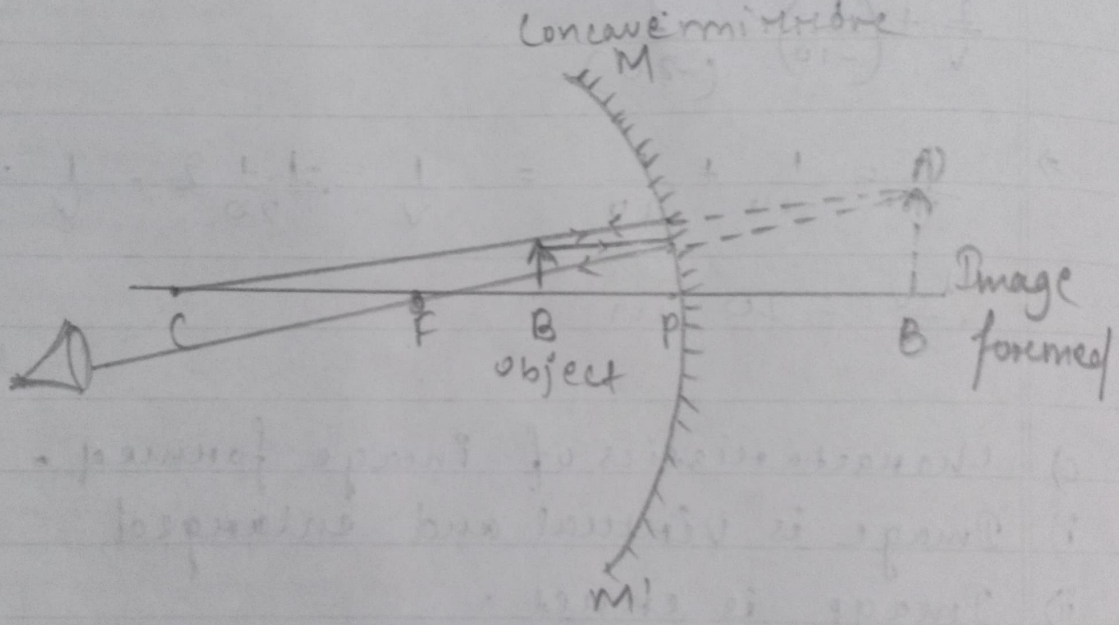
$\Rightarrow M = \frac{S_2}{H_2} = \frac{-v}{u} \Rightarrow \frac{H_2}{-10} = \frac{(+18)}{(-36)}$

$\Rightarrow \frac{H_2}{10} = \frac{18}{36} \frac{1}{2} = \frac{1}{2}$

$\Rightarrow H_2 = -5\,cm$

∴ The image formed is real and inverted

(11) a)



Ray Diagram for formation of Image.

(13). Given, $f = 10\,cm$, $H_2 = 2\,cm$, Bm (erect image)

$M = \frac{H_2}{H_2} = \frac{6}{2} = 3.$

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

$\Rightarrow 3u = -v \Rightarrow v = -\frac{3u}{1} \rightarrow (1)$

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \rightarrow \frac{1}{-3} \cdot \frac{1}{u} = \frac{1}{(-10)}$

$\Rightarrow \frac{1}{u} - \frac{1}{3u} = \frac{-1}{10}$ ——— ①

$\Rightarrow \frac{3-1}{3u} = \frac{-1}{10} \Rightarrow \frac{2}{3u} = \frac{-1}{10} \Rightarrow u = \frac{-20}{3}$.

$u = -6.66$ cm.

(14) Given $u = -13$ cm, $v = -10$ cm

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

$\Rightarrow \frac{1}{-10} + \frac{1}{-15} = \frac{1}{f} \Rightarrow \frac{1}{f} = \frac{1}{-10-15}$.

$\Rightarrow \frac{1}{f} = \frac{-3-2}{30} \Rightarrow \frac{1}{f} = \frac{-5}{30} \frac{1}{6}$

$\Rightarrow \frac{1}{f} = \frac{1}{6} \therefore f = -6$ cm.

∴ The focal length of the concave mirror is 6cm.

(15) i) Given $H_1 = 3$ cm, $u = -8$ cm & $H_2 = 4.5$. (virtual image)

$m = \frac{H_2}{H_2} = \frac{4.5}{3} = 1.5$.

$m = \frac{-v}{u} \Rightarrow 1.5 = \frac{-v}{(-8)}$ & $v = -1.5 \times 8$

$v = 12\,cm$

$\Rightarrow$ we have $\frac{1}{u} + \frac{1}{v} = \frac{1}{f} \Rightarrow \frac{1}{12} + \left(\frac{1}{-8}\right) = \frac{1}{f}$

$\Rightarrow \frac{1}{f} = \frac{1}{12} - \frac{1}{8} = \frac{2}{3} \div 24 = \frac{-1}{24}$

$\Rightarrow f = -24\,cm.$

ii) So the image is formed 12cm behind the concave mirror.

(16). i) Given $H_2 = -4cm$, $H_1 = 1cm$, $u = -20cm$

$H_2 \rightarrow$ real image.

$M = \frac{H_2}{H_1} = \frac{-v}{u} \Rightarrow \frac{-4}{1} = \frac{-v}{-20}$

$\Rightarrow v = -80\,cm$

Image formed in front of concave mirror.

ii) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-80} + \frac{1}{-20} = \frac{1}{f}$

$\Rightarrow \frac{1}{f} = \frac{-1}{80} - \frac{1}{20} = \frac{\frac{-1}{-4}}{80} = \frac{-5}{80} = \frac{-1}{16}$

$f = -16\,cm.$

(17): Given $H_1 = 7cm$, $u = -27cm$, $f = -18cm$

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} \Rightarrow \frac{1}{-18} - \left(\frac{1}{-27}\right) = \frac{-1}{v}$

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

$\Rightarrow v = -54$ cm.

$\Rightarrow$ The screen should be placed infront of the concave mirror of 54 cm.

$\rightarrow m = \frac{-v}{u} = \frac{H_2}{H_1} \Rightarrow -\left(\frac{-54}{-27}\right) = \frac{H_2}{7}$.

$\Rightarrow H_2 = -14$ cm.

$\rightarrow$ Image is 14 cm in size, real & inverted.

(18) Given $H_1 = 3$ cm, $u = 10$ cm, $f = -20$ cm.

A/Q,

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-20}$

$\Rightarrow = \frac{-1+2}{20} = \frac{1}{20} \Rightarrow \frac{1}{v} = \frac{1}{20}$.

$\rightarrow v = 20$ cm.

$\therefore$ The image is formed at a distance of 20 cm behind mirror and

$\frac{m}{20} = \frac{-v}{u} = \frac{H_2}{H_1}$

$\Rightarrow \frac{(-20)(-}{10} = \frac{H_2}{3} \Rightarrow \frac{H_2}{3} = \frac{2}{1}$.

$H_2 = 6$ cm

$\Rightarrow$ Image is 6 cm in size, virtual & erect.

(18) Given $u = -20$ cm, $m = -3$ (real image)

$m = \frac{-v}{u} \Rightarrow m = -3 = \frac{-v}{-20}$

$\Rightarrow -3 \times 20 = v \Rightarrow v = -60$ cm.

$\Rightarrow$ we have $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$\Rightarrow \frac{1}{-60} + \frac{1}{-20} = \frac{1}{f} \Rightarrow \frac{1}{f} = -\frac{1}{60} - \frac{1}{20} = \frac{-4}{60}$

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$\therefore \frac{1}{f} = -\frac{1}{15} \Rightarrow f = -15$ cm.

(b) virtual image $m = 3$ and $f = -15$ cm.

$m = \frac{-v}{u} \Rightarrow m = \frac{2}{} = -\frac{v}{u} \Rightarrow v = -3u$

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-3u} + \frac{1}{u} = \frac{1}{-15}$

$\Rightarrow \frac{-1+3}{3u} = -\frac{1}{15} \Rightarrow u = \frac{-2 \times 15}{3} = -10$ cm

$\therefore$ Object should be placed 10 cm from the concave mirror.

(19) Given $H_1 = 2$cm, $u = -9$cm, $f = -4$cm

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

$\Rightarrow \frac{1}{v} = \frac{-1}{4} + \frac{1}{9} \Rightarrow \frac{1}{v} = \frac{-9+4}{36} \Rightarrow \frac{1}{v} = \frac{-5}{36}$.

$v = -7.2$ cm.

→ The image is formed at a distance 7.2 cm infront of the mirror.

* $m = \frac{-v}{u} = \frac{-(7.2)}{-9} = -0.8$

$m = \frac{H_2}{H_2} \Rightarrow \frac{-0.8}{\frac{H_2}{2.0}} \Rightarrow H_2 = -1.6 \text{ cm}$

→ So image is 1.6 cm in size, real & inverted.

(21). $R = -3\text{cm}$ (concave), $m = 5$ (virtual), $f = \frac{R}{2}$
$= \frac{-3}{2} = -1.5 \text{ cm}$.

$m = 5 = \frac{-v}{u} \Rightarrow v = -5u$.

* $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-5u} + \frac{1}{u} = \frac{1}{-1.5}$

$\frac{4}{5u} = \frac{1}{1.5} \Rightarrow u = -1.2 \text{ cm}$.

∴ The mirror should be placed 1.2 cm away from the dental cavity.

(22). Given $R = -1.5$ (concave), $u = -10 \text{ cm}$, $f = \frac{R}{2} = \frac{-1.5}{2}$

$= f = \frac{R}{2} = \frac{-1.5}{2} = -0.75 \text{ m}$. ⇒

* $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} - \frac{1}{(-10)} = \frac{1}{(0.75)} \Rightarrow \frac{1}{v} = \frac{1}{10} - \frac{1}{0.75}$

$\Rightarrow \frac{1}{V} = -\frac{1}{10} + \frac{100}{75} \Rightarrow \frac{1}{V} = \frac{-30}{37} \Rightarrow -0.81m$.

∴ The person's image will be 0.81m in front of concave mirror.

(23). $H_1 = 5.0$ cm, $u = -20$ cm, $f = -15$ cm

$\frac{1}{V} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{V} + \frac{1}{-20} = \frac{1}{-15} \Rightarrow \frac{1}{V} = \frac{-5}{300}$

$\Rightarrow \frac{1}{V} = -60$ cm.

∴ The screen should be placed 60 cm in front of mirror.

$M = \frac{H_2}{H_1} = \frac{-V}{u} \Rightarrow \frac{H_2}{5} = \frac{-(-60)}{(-20)} = -3$

$\Rightarrow H_2 = -15$ cm & Height $= -15$ cm.

(24). $M = 3$ (virtual), $u = -10$ cm, $M = \frac{-V}{u}$

$\Rightarrow 3 = \frac{-V}{-10} \Rightarrow V = 30$ cm.

$\Rightarrow \frac{1}{V} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{30} + \frac{1}{-10} = \frac{1}{f} \Rightarrow \frac{10}{-30} \div 300 = \frac{1}{f}$.

$\Rightarrow \frac{-20}{300} = \frac{1}{f} \Rightarrow f = -15$ cm.

Radius of curvature $= R = 2f$

$= 2 \times -15 = -30$ cm.

(25) $H_1 = 50\ mm$, $f = -100\ mm$, $u = -300\ mm$.

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

$\Rightarrow \frac{1}{v} + \frac{1}{-300} = \left(\frac{1}{-100}\right) \Rightarrow \frac{1}{v} = \frac{-2}{300} \Rightarrow v = -150\ mm.$

* $m = -\frac{v}{u} \Rightarrow \frac{H_2}{H_1} \Rightarrow \frac{-1(-150)}{-300} = \frac{H_2}{50}$

$\Rightarrow \frac{-1}{2} = \frac{H_2}{50} \Rightarrow H_2 = -25\ mm.$

∴ The image will be 25 mm high.

(26) $f = -20\ cm$, $m = -\frac{1}{4}$ (real image), $m = -\frac{v}{u}$

$\Rightarrow \frac{-1}{u} = \frac{-v}{4} \Rightarrow -u = -4v \Rightarrow u = 4v.$

* $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{4v} = \frac{1}{(-20)}$

$\Rightarrow \frac{4+1}{4v} = \frac{-1}{20} \Rightarrow \frac{5}{4v} = \frac{-1}{20} \Rightarrow -4v = 100$

$v = -25\ cm.$

* $u = 4v$, $u = 4 \times -25 = -100\ cm.$

∴ The object should be place 100 cm to the left of the mirror.

(27) Case I → $u = -50$ cm, $m = -\frac{1}{2}$,

$$m = -\frac{v}{u} \Rightarrow \frac{1}{2} = \frac{-v}{-50} \Rightarrow v = -\frac{50}{2} \Rightarrow v = -25 \text{ cm}.$$

$$\rightarrow \frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-25} + \frac{1}{-50} = \frac{1}{f}$$

$$\Rightarrow -\frac{30}{50} = \frac{1}{f} \Rightarrow f = -\frac{50}{3} \text{ cm}$$

Case I → $m = -\frac{1}{5}$, $f = -\frac{50}{3}$ cm

$$m = -\frac{1}{5} = -\frac{v}{u} \Rightarrow v = \frac{u}{5}.$$

$$\rightarrow \frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{5}{u} + \frac{1}{u} = -\frac{3}{50}$$

$$\Rightarrow \frac{6}{u} = \frac{-3}{50} \Rightarrow u = -100 \text{ cm}.$$

(28) a) $u = -20$ cm, $f = -12$ cm,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{-20} = \frac{1}{-12} \Rightarrow \frac{1}{v} = \frac{1}{12} + \frac{1}{20}$$

$$\frac{1}{v} = \frac{-80}{240} \Rightarrow v = -30 \text{ cm}.$$

∴ The image is formed at a distance of 30cm infront of the mirror. Hence, the image is real & inverted.

b) $u = -4\,cm$, $f = -12\,cm$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{-4} = \frac{1}{-12}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-12} + \frac{1}{-4} \Rightarrow \frac{1}{v} = \frac{-1}{12} \Rightarrow v = 6\,cm.$$

∴ The image is formed at a distance of 6 cm behind mirror hence virtual & erect.

(29) $H_2 = 1\,cm = 10\,mm$, $H_1 = 2.5\,mm$, $u = -5\,cm = -50\,mm$

$$m = -\frac{H_2}{H_1} = m = -\frac{10}{2.5} \Rightarrow m = -4.$$

$$\Rightarrow m = -\frac{v}{u} \Rightarrow -4 = \frac{-v}{-50} \Rightarrow v = -200\,mm.$$

$v = -20\,cm.$

∴ The image is formed 20 cm infront of mirror

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-20} + \frac{1}{5} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = \frac{-25}{100} \Rightarrow f = -4\,cm$$

(30) $R = -60\,cm$ (concave), $f = -30\,cm$, $u = -15\,cm$.

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

$$\Rightarrow \frac{1}{-v} = \frac{1}{15} + \frac{1}{-30} \Rightarrow \frac{1}{v} = \frac{1}{30} \Rightarrow v = 30\,cm$$

$m = -\frac{v}{u} \Rightarrow m = \frac{-30}{-15}$, $m = 2$.

∴ So the image is formed 30 cm behind the mirror and the magnification is + 2.