ASSIGNMENT

Short Type Answers

Q-11)

(b) $f = (-20\,cm)$, $u = (-10\,cm)$

To find : v (image distance)

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

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

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

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

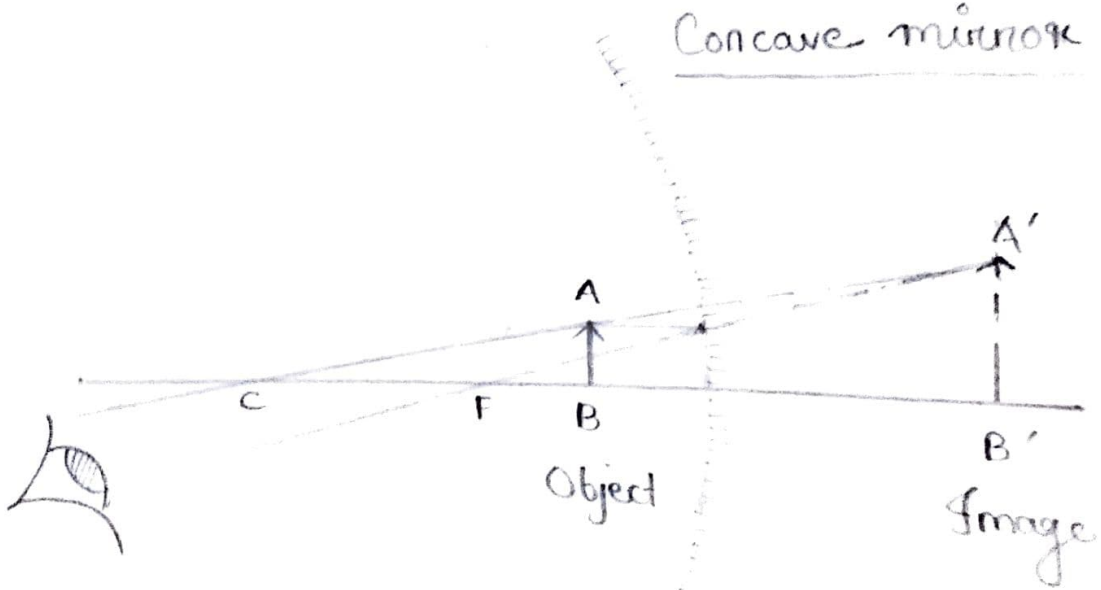
$$\Rightarrow \frac{1}{v} = \frac{1}{20}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{20}$$

$$\Rightarrow v = 20\,cm$$

$\therefore$ Image distance is 20 cm

(a)



(c) Characteristics of the Image formed:

(i) Image is virtual

(ii) Image is erect

12.) $h_1 = 10\,cm$, $u = (-36\,cm)$, $f = (-12\,cm)$

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

$$\Rightarrow \frac{1}{v} + \frac{1}{(-36)} = \frac{1}{(-12)}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{(-12)} - \frac{1}{(-36)}$$

$$\Rightarrow \frac{1}{v} = \frac{-3+1}{36}$$

$$\Rightarrow \frac{1}{v} = \frac{-2}{36}$$

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

$$\Rightarrow v = (-18)\,cm$$

$$\text{Magnification} = \frac{h_2}{h_1} = -\frac{v}{u}$$

$$\Rightarrow \frac{h_2}{h_1} = \frac{-(-18cm)}{-36cm} \Rightarrow \frac{h_2}{10} = \frac{-1}{2}$$

$\Rightarrow h_2 = -10/2$

$\Rightarrow h_2 = (-5)\,cm$

The image formed is real and inverted.

13) $f = (-10cm)$, $h_1 = 2cm$, $h_2 = 6cm$ (erect image)

To find: u

magnification $(m) = \left(-\frac{v}{u}\right) = \left(\frac{h_2}{h_1}\right)$

$\Rightarrow \left(-\frac{v}{u}\right) = \left(\frac{2cm}{2cm}\right)\left(\frac{6}{2}\right)$

$\Rightarrow \left(-\frac{v}{u}\right) = 3$

$\Rightarrow -v = 3u$

$\Rightarrow v = (-3u)$

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

$$\Rightarrow \frac{1}{(-3u)} + \frac{1}{u} = \frac{1}{f}$$

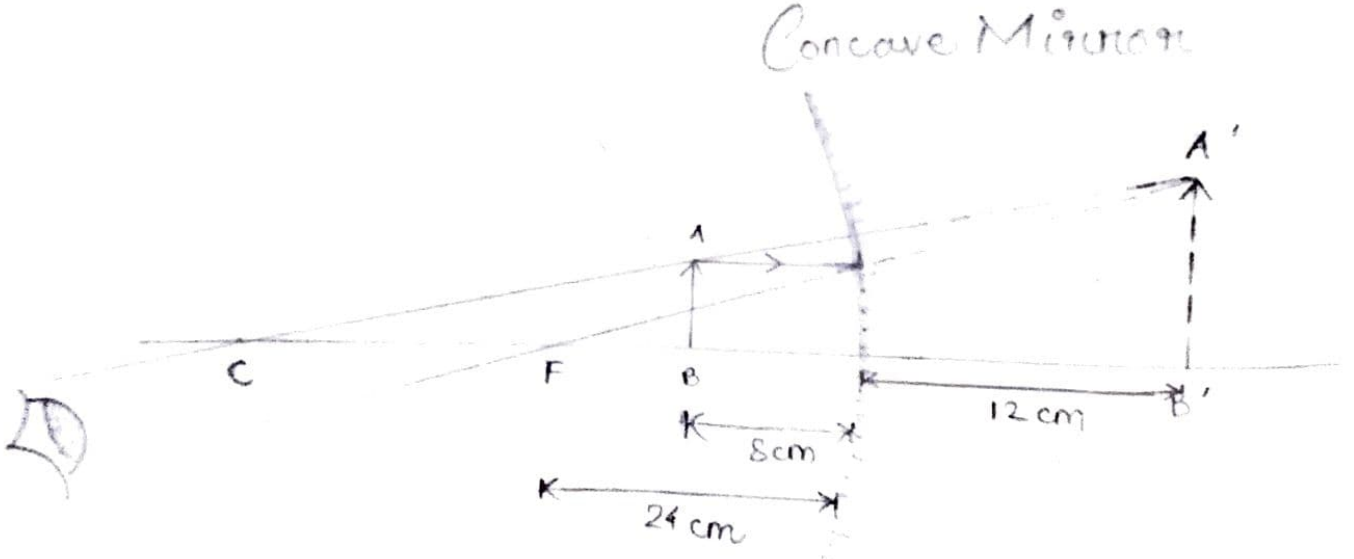
$$\Rightarrow \frac{-1+3}{3u} = \frac{1}{f}$$

$$\Rightarrow 2f = 3u$$

(ii) $v = 12$ cm (proved above)

∴ the image is formed 12cm behind the concave mirror.

(iii)



16) (i) $h_2 = (-4)\,cm$ [real image]

$h_1 = 1\,cm$

$u = (-20)\,cm$

To find : v

Magnification (m) $= \frac{h_2}{h_1} = \left(\frac{-v}{u}\right)$

$$\frac{-4}{1} = \frac{-v}{-20}$$

$$\Rightarrow -4 = \frac{v}{20}$$

$$\Rightarrow v = (-80\,cm)$$

Image forms in front of the concave mirror

(ii) $$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{-20} + \frac{1}{-80} = \frac{1}{f}$$

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

$$\frac{-1}{80}$$

$\Rightarrow f = (-16\ cm)$

17. $\Rightarrow h_1 = 7cm$, $u = (27cm)$, $f = (-18cm)$

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

$$\Rightarrow \frac{1}{v} = \frac{1}{(-18)} - \frac{1}{(-27)}$$

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

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{54}$$

$$\Rightarrow v = (-54)\ cm$$

The screen should be placed at a distance of 54 cm in front of the concave mirror.

$$m = \frac{-v}{u} = \frac{h_2}{h_1}$$

$$\Rightarrow -\left(\frac{-54}{-27}\right) = \frac{h_2}{7}$$

$$\Rightarrow -2 = \frac{h_2}{7}$$

$$\Rightarrow h_2 = -14 \text{ cm}$$

Image is real and inverted. and is 14 cm in length.

18. Given : $h_1 = 3$ cm , $u = 10$ cm , $f = 20$ cm

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

$$\Rightarrow 1/v = 1/f - 1/u$$

$$\Rightarrow 1/v = \frac{1}{(-20)} - \frac{1}{(-10)}$$

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

$$\Rightarrow 1/v = \frac{1}{20} \Rightarrow v = 20 \text{ cm}$$

The image is formed 20 cm behind the mirror.

$$m = \frac{-v}{u} = \frac{h_2}{h_1}$$

$$\Rightarrow \frac{-20}{-10} = \frac{h_2}{3}$$

$$\Rightarrow 2 = \frac{h_2}{3}$$

$$\Rightarrow h_2 = 6\text{ cm}$$

Image is virtual and erect and is 6cm in length.

19) $h_1 = 2\text{cm}$, $f = (-4\text{cm})$, $u = (-9\text{ cm})$

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

$$\Rightarrow \frac{1}{v} + \frac{1}{(-9)} = \frac{1}{(-4)}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{(-4)} - \frac{1}{(-9)}$$

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

$$\Rightarrow 1/v = \frac{-5}{36} \Rightarrow v = \frac{-36}{5} \Rightarrow v = -7.2\text{ cm}$$

The image is formed at a distance of 7.2 cm in front of the mirror.

$$m = \frac{-v}{u} = \frac{h_2}{h_1}$$

$$-\left(\frac{+7.2}{+9}\right) = \frac{h_2}{2}$$

$$\Rightarrow -0.8 = \frac{h_2}{2}$$

$$\Rightarrow h_2 = -1.6 \text{ cm}$$

The image is real and inverted and 1.6cm in length.

20) (a) $u = (-20 \text{ cm})$, $m = (+3)$ [Real image]

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

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

$$\Rightarrow 3 = \frac{v}{(-20)} \Rightarrow v = (-60 \text{ cm})$$

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

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

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

$$\Rightarrow \frac{-1-3}{60} = \frac{1}{f}$$

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

$$\Rightarrow \frac{-1}{15} = \frac{1}{f}$$

$$\Rightarrow f = (-15\text{ cm})$$

$\therefore$ The focal length is 15 cm

(b) $m = 3$, $f = (-15\text{ cm})$ [Virtual image]

$$m = \frac{(-v)}{u}$$

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

$\Rightarrow \quad v = (-3u)$

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

$$\Rightarrow \quad \frac{1}{(-3u)} + \frac{1}{u} = \frac{1}{f}$$

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

$$\Rightarrow \quad 2f = 3u$$

$$\Rightarrow \quad 2(-15) = 3u$$

$$\Rightarrow \quad \frac{-30}{3} = u$$

$$\Rightarrow \quad u = (-10\ cm)$$

$\therefore$ The ~~objet~~ object should be placed 10 cm from the concave mirror.

21) Radius of Curvature (R) = (-3cm) [Concave mirror]
Magnification (m) = 5 [Virtual image]

$$\text{focal length} = \frac{\text{Radius}}{2} = \frac{(-3)}{2} = -1.5\,\text{cm}$$

$$m = 5 = \left(\frac{v}{u}\right)$$

$$\Rightarrow -v = 5u$$

$$\Rightarrow v = (-5u)$$

(a) (i)

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

$$\Rightarrow \frac{1}{(-5u)} + \frac{1}{u} = \frac{1}{f}$$

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

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

$$\Rightarrow 4f = 5u$$

$$\Rightarrow 4(-1.5) = 5u$$

$$\Rightarrow 4(-0.3) = u \Rightarrow u = (-1.2\,\text{cm})$$

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

22) $R = (-1.5m)$, $u = (-10m)$

$$f = \frac{R}{2} = \frac{(-1.5m)}{2} = (-0.75)m$$

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

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

$$\Rightarrow \frac{1}{v} = \left(\frac{-1.5m}{2}\right) - \left(\frac{1}{-10}\right)$$

$$\Rightarrow \frac{1}{v} = \frac{-1.5m}{2} + \frac{1}{10}$$

$$\Rightarrow \frac{1}{v} = \frac{-7.5 + 1}{10}$$

$$\Rightarrow \frac{1}{v} = \frac{-6.5}{10} \Rightarrow \frac{1}{v} = -0.65$$

$$\Rightarrow \frac{1}{v} = \frac{1}{(-0.75)} - \left(\frac{1}{(-10)}\right)$$

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{\frac{75}{100}}$$

$$\Rightarrow \frac{1}{v} = \frac{-100}{75} + \frac{1}{10}$$

$$\Rightarrow \frac{1}{v} = \frac{-200 + 15}{150}$$

$$\Rightarrow \frac{1}{v} = \frac{-185}{150}$$

$$\Rightarrow v = -\frac{\cancel{150}^{30}}{\cancel{185}_{37}}$$

$$\Rightarrow v = -\frac{30}{37}$$

$$\Rightarrow v = 0.81\ m$$

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

23) $h_1 = 5\,cm$, $u = (-20\,cm)$, $f = (-15\,cm)$

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

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

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

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{60}$$

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

$$\Rightarrow v = (-60)\,cm$$

$$m = \frac{h_2}{h_1} = \frac{(-v)}{u}$$

$$\Rightarrow \frac{h_2}{5} = \frac{-(-60)}{(-20)} \Rightarrow \frac{h_2}{5} = -3 \Rightarrow h_2 = (-15)\,cm$$

real ~~image~~

∴ The height of image is 15 cm

24) $m = 3$ (virtual image)

$u = (-10\ cm)$

$$m = \left(\frac{-v}{u}\right)$$

$$\Rightarrow 3 = \left(\frac{-v}{-10}\right)$$

$$\Rightarrow v = 30\ cm$$

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

$$\Rightarrow \frac{1}{f} = \frac{1}{30} + \frac{(-1)}{10}$$

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

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

$$\Rightarrow f = (-15)\ cm$$

$$\frac{R}{2} = f \Rightarrow \frac{R}{2} = (-15\ cm) \Rightarrow R = (-30\ cm)$$

So the Radius of the Curvature of the Concave mirror is 30 cm.

25-) $h_1 = 50\ mm$, focal length $= (-100\ mm)$

$u = (-300\ mm)$

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

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{100} + \frac{1}{300}$$

$$\Rightarrow \frac{1}{v} = \frac{-3+1}{300}$$

$$\Rightarrow \frac{1}{v} = \frac{-2}{300}$$

$$\Rightarrow v = -150\ mm$$

$$m = \left(\frac{-v}{u}\right) = \frac{h_2}{h_1}$$

$$m = -\left(\frac{-150\ mm}{-300\ mm}\right) = \frac{h_2}{h_1}$$

$$\Rightarrow \frac{-1}{2} = \frac{h_2}{50\ mm}$$

$$\Rightarrow h_2 = (-25\ mm)$$

∴ The image is real and 25 mm high

26) $f = (-20\,cm)$, $m = (-1/4)$ [Real Image]

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

$$-1/4 = -\frac{v}{u}$$

$$\Rightarrow u = 4v$$

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

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

$$\Rightarrow \frac{5}{4v} = \frac{1}{f}$$

$$\Rightarrow 5f = 4v$$

$$\Rightarrow 5(-20\,cm) = 4v$$

$$\Rightarrow 4v = -100\,cm$$

$$\Rightarrow v = (-25\,cm)$$

$$u = 4v = 4(-25\,cm) = -100\,cm$$

The object should be placed 100 cm to the left to the mirror.

27.) $u = (-50\ cm)$, $m = (-1/2)$ [Real image]

Case : 1

$$m = \left(\frac{-v}{u}\right)$$

$$\Rightarrow -1/2 = \frac{-v}{-50}$$

$$\Rightarrow v = (-25\ cm)$$

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

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

$$\Rightarrow \frac{1}{f} = \frac{-2-1}{50}$$

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

Case : 2

$m = (-1/5)$

$f = \left(\frac{-50}{3}\right)$

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

$\Rightarrow (+1/5) = (+v/u)$

$\Rightarrow 5v = u$

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

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

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

$\Rightarrow \frac{6}{5v} = \frac{1}{f}$

$\Rightarrow 6f = 5v$

$\Rightarrow 6\left(\frac{-50}{3}\right) = 5v$

$\Rightarrow v = -20\ cm \qquad u = 5v$

$\Rightarrow u = 5(-20\ cm) = (-100\ cm)$

The object should be placed 100 cm away from the concave mirror.

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

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

$\Rightarrow \frac{1}{v} + \frac{1}{(-20)} = \frac{1}{(-12)}$

$\Rightarrow \frac{1}{v} = \frac{-1}{12} - \frac{(-1)}{20}$

$\Rightarrow \frac{1}{v} = \frac{-5+3}{60}$

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

$\Rightarrow v = (-30)\ cm$

The image is formed at a distance of ~~30 cm~~ 30 cm in front of mirror.

Image is real and inverted.

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

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

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{12} - \frac{(-1)}{4}$$

$$\Rightarrow \frac{1}{v} = \frac{-1+3}{12}$$

$$\Rightarrow \frac{1}{v} = \frac{2}{12}$$

$$\Rightarrow v = 6\,cm$$

The image is 6cm behind the mirror.

It is Virtual and Erect.

29) $h_2 = 1\,cm = 10\,mm$ (Real image)

$h_1 = 2.5\,mm$, $u = (-5\,cm) = (-50\,mm)$

$$m = \frac{-h_2}{h_1} \quad [\text{Real image}]$$

$$\Rightarrow m = \frac{-10}{2.5}$$

$$\Rightarrow m = -4 \quad \text{---} (1)$$

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

$$\Rightarrow -4 = \frac{-v}{(-50)} \quad [\text{Putting } m = (-4) \text{ in } (1)]$$

$$\Rightarrow v = -200\,mm = -20\,cm$$

The image is formed 20 cm infront of mirror.

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

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

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

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

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

$$\Rightarrow \frac{1}{f} = -\frac{1}{4}$$

$$\Rightarrow f = -4\,cm$$

$\therefore$ The focal length is 4cm.

30) Radius of Curvature $= R = (-60\,cm)$ [Concave mirror]

$f = (-30\,cm)$, $u = (-15\,cm)$

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

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{30} - \frac{(-1)}{15}$$

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

$$\Rightarrow \frac{1}{v} = \frac{-1+2}{30}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{30}$$

$$\Rightarrow v = 30\,cm$$

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

$$\Rightarrow m = \frac{-30\,cm}{-15\,cm}$$

$$\Rightarrow m = 2$$

$\therefore$ The image is ~~formed~~ 30 cm ~~behind~~ behind the mirror and the magnification is 2