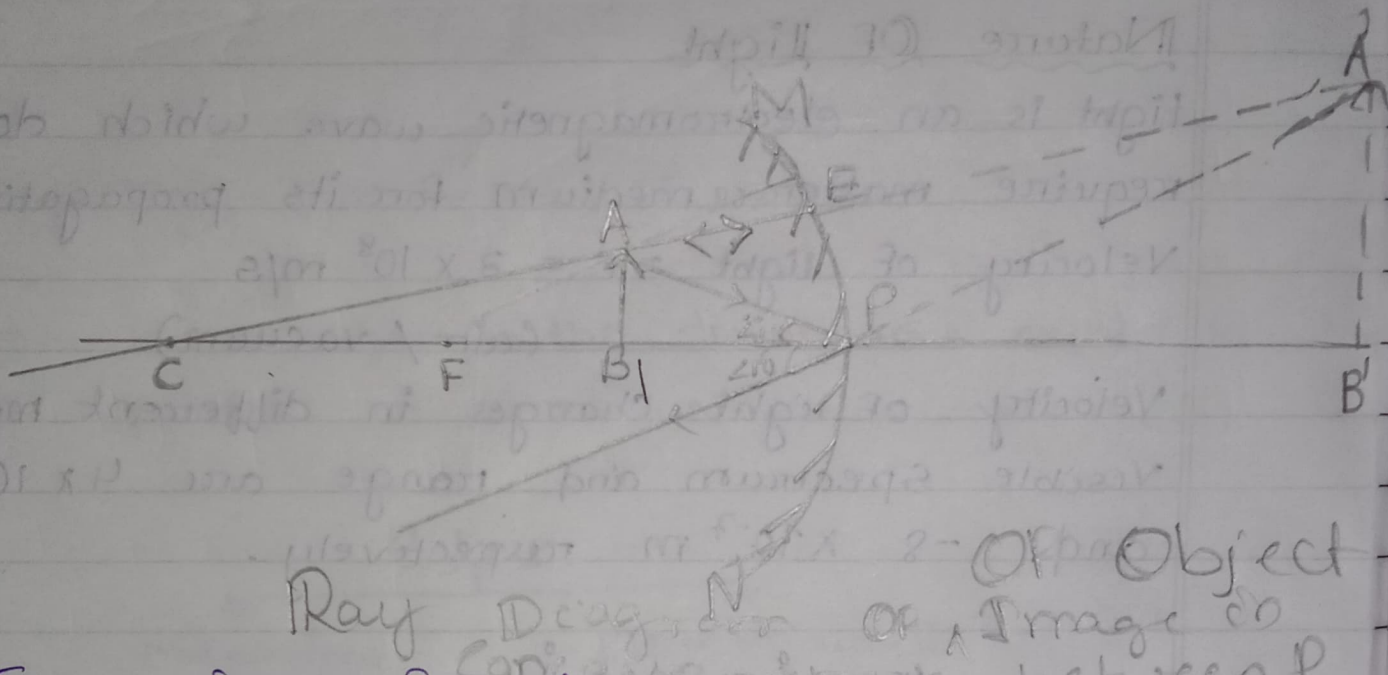
Short Answer Type Questions

11. a) Object distance (u) = -10 cm

Focal length (f) = -20 cm

a) As object is between pole and principal focus, the ray diagram ~~is at~~ will be as follows:-



Ray Diagram of Object & Image is Convex mirror between P and F

b) From mirror formula,

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

$$\Rightarrow -\frac{1}{v} = \frac{1}{-10} - \left(\frac{1}{-20}\right) = \frac{1}{-10} + \frac{1}{20} = \frac{-2+1}{20}$$

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

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

$\therefore$ $v = 20$ cm

c) The image formed in concave mirror is behind the mirror, enlarged, virtual and erect.

12. $u = -36$ cm

$f = -12$ cm

We know that,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{-36} = \frac{-1}{12}$$

$$\Rightarrow \frac{1}{v} = \frac{-1}{12} + \frac{1}{36} = \frac{-3+1}{36} = \frac{-2}{36} = \frac{1}{18}$$

$\Rightarrow v = -18$ cm

Magnification $= \frac{h'}{h} = \frac{-v}{u}$

$$\text{or } \frac{h'}{10} = \frac{-(-18)}{36} \Rightarrow h' = -5 \text{ cm}$$

Image formed is real and inverted. So, position of the image is 18 cm infront. Height of the image $= -18$ cm. Nature of image formed is real and inverted.

13. focal length(f) -10 cm

Height of concave object (h) $= 2$ cm

Height of image (h') $= 6$ cm

Image is erect.

As we know, $m = \frac{h'}{h} = \frac{6}{2} = 3$

We also know $m = \frac{-v}{u} = 3$

$\Rightarrow 3u = -v \Rightarrow -3u = v$ (1)

We have, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

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

$\Rightarrow \frac{3-1}{3u} = \frac{-1}{10} \Rightarrow u = \frac{-20}{3} = 6.66\ cm$

∴ The object must be placed at a distance of 6.66 cm on left side of mirror.

14. $u = -15\ cm$

$v = -10\ cm$

We know that,

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

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

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

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

$\Rightarrow f = 6\ cm$

15. Height of object (h) = 3 cm

$u = -8$ cm

Height of image (h') = 4.5 cm

i) Magnification (m) $\frac{h'}{h} = \frac{4.5}{3}$ cm

We know, $m = \frac{-v}{u} = \frac{-v}{-8} = \frac{4.5}{3}$

$\Rightarrow -v = \frac{4.5}{3} \times -8$

$\Rightarrow -v = \frac{45}{10} \times \frac{1}{3} \times -8$

$\Rightarrow -v = -12$

$\Rightarrow v = 12$ cm.

We know that, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

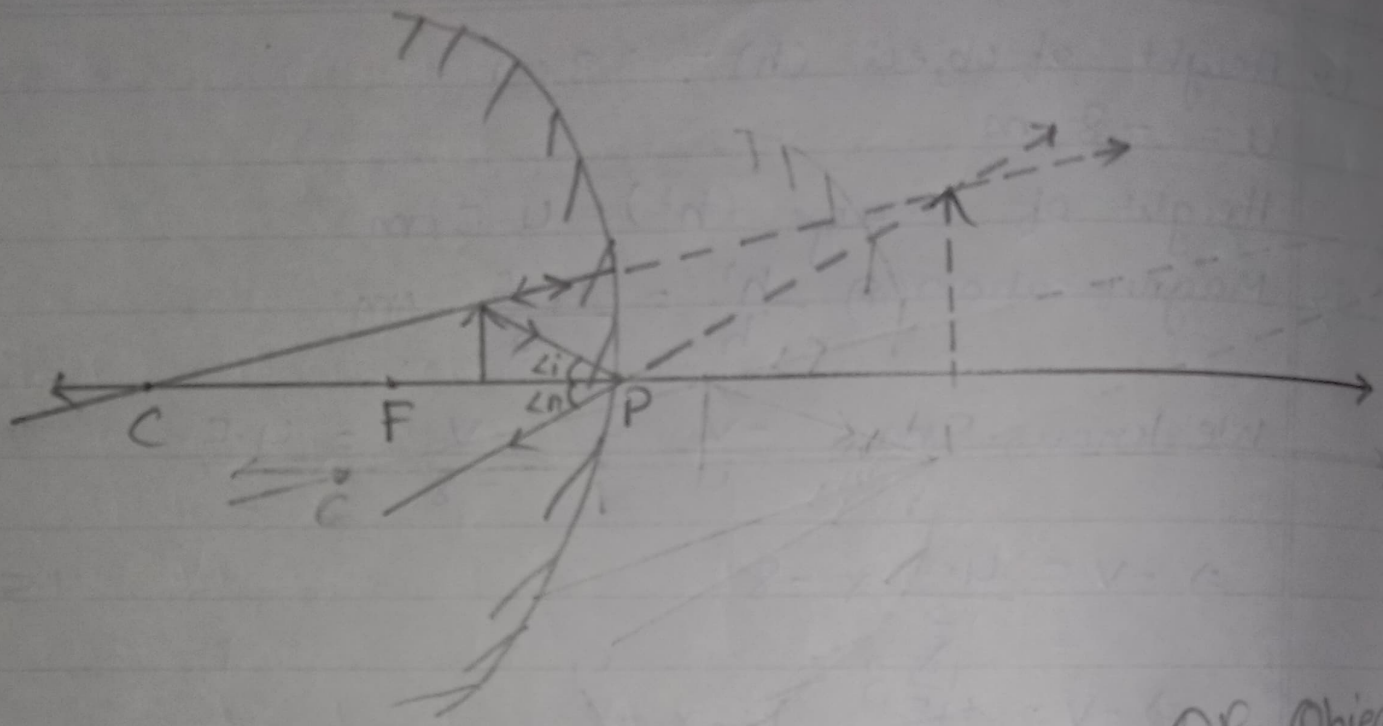
$\Rightarrow \frac{1}{f} = \frac{1}{12} + \frac{1}{-8} = \frac{-2+3}{24} = \frac{1}{24}$

$\Rightarrow f = -24$ cm

ii) The image is 12 cm behind the mirror (on its right side)

16. i) $m = \frac{-v}{u}$

$\Rightarrow -4 = \frac{-v}{-20} \Rightarrow v = -80$ cm



Ray Diagram Of Image Formed Of Object In Concave Mirror Between P And F

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

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

$\Rightarrow f = -16\ cm$

17. $h_o = 7cm$

$u = -27\ cm$

$f = -18\ cm$

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

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

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

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

∴ The screen should be placed infront of the concave mirror at a distance of 54 cm.

$\Rightarrow m = \frac{-v}{u} = \frac{h'}{h} = \frac{(-54)}{-27}$

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

$\Rightarrow \frac{h'}{7} = \frac{54}{-27} = -2$

$\Rightarrow h' = -2 \times 7 = -14$ cm.

∴ The image size is 14 cm and the nature of image is real and inverted.

18. $h = 3$ cm

$u = -10$ cm

$f = -20$ cm

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

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

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

The image is formed at a distance of 20cm behind the converging mirror.

$m = \frac{-v}{u} = \frac{h'}{h} = \frac{-20}{-10} = \frac{h'}{3} = 2$

$\Rightarrow h' = 2 \times 3 = 6$ cm

∴ The nature of the image is erect and virtual. The image is of 6cm in height and at 20 cm distance behind the mirror.

19. Focal length (f) = -4 cm
height of object (h) = 2cm
~~Dista~~ u = -9cm
~~We kno~~ $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{-4} - \left(\frac{1}{-9}\right) = \frac{1}{-4} + \frac{1}{9} =$

$= \frac{9 + (-4)}{-36} = \frac{5}{-36} \Rightarrow v = -7.2\ cm$

∴ Distance of image (v) = -7.2 cm

Magnification = $\frac{h'}{h} = \frac{-v}{u} = \frac{-(-7.2)}{-9} = \frac{h'}{2}$

$\Rightarrow \frac{7.2}{-9} = \frac{h'}{2} \Rightarrow h' = \frac{72}{10} \times \frac{1}{-9} \times 2 = \frac{-72}{45}$
5

$\Rightarrow h' = -1.6\ cm$

∴ The size of the image 1.6 cm which is erect, real and 7.2 cm infront of mirror.

20. a) u = -20 cm
m = -3
$m = \frac{-v}{u} \Rightarrow m = -3 = \frac{-v}{-20}$

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

$\Rightarrow v = -60$ cm.

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

$$\Rightarrow \frac{1}{f} = \frac{-1+3}{-60} = \frac{4}{-60} = \frac{-1}{15}$$

$\Rightarrow f = -15$ cm

b) $m = 3$, $f = -15$ cm

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

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

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

$$\Rightarrow u = \frac{-2 \times 15}{}$$

b) $m = \frac{-v}{u} = \frac{h'}{h} =$

A/q $h' = 3h$

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

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

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

$$\Rightarrow u = \frac{-2 \times 15}{} = -10 \text{ cm}$$

$\therefore$ The object must be placed 10cm from the concave mirror.

21. $R = -3\ cm$

$m = 5$

$f = \frac{R}{2} = \frac{-3}{2} = -1.5\ cm$

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

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

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

$\Rightarrow \frac{1 + (-5)}{-5u} = \frac{1}{-1.5}$

$\Rightarrow \frac{-4}{-5u} = \frac{1}{-1.5} \Rightarrow \frac{4}{5u} = \frac{1}{-1.5}$

$\Rightarrow 4 = \frac{1}{-1.5} \times 5u \Rightarrow 5u = \frac{4}{\frac{1}{-1.5}} = 4 \times \frac{-1.5}{1}$

$= -6.0$

$\Rightarrow u = \frac{-6.0}{5} = -1.2\ cm$

$\therefore$ Mirror should be placed at 1.2 cm ~~infront~~ away from dental cavity.

22. $R = -1.5\ m$, $u = -10\ m$

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

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

$\Rightarrow \frac{1}{v} = \frac{1}{10} - \frac{100}{75} = \frac{1}{10} - \frac{4}{3} = \frac{3-40}{30} = \frac{-37}{30}$

$= -0.81$ m

$\therefore$ The person's image will be at distance of 0.81 m infront of mirror.

23. $h = 5.0$ cm $= 5$ cm

$u = -20$ cm

$f = -15$ cm

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

$\Rightarrow \frac{1}{v} = \frac{1}{-15} - \frac{1}{-20} = \frac{1}{-15} + \frac{1}{20} = \frac{4+(-3)}{-60}$

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

$\Rightarrow v = -60$ cm

$\therefore$ The screen should be placed 60 cm infront of the mirror.

$m = \frac{h'}{h} = \frac{-v}{u} = \frac{h'}{5} = \frac{-(-60)}{-20}$

$\Rightarrow \frac{h'}{5} = \frac{60}{-20} \Rightarrow h' = \frac{60}{-20} \times 5 = -15$ cm

$\therefore$ The height of the image is 15 cm which is inverted.

24. $m = 3$, $u = -10$ cm

$\therefore m = \frac{-v}{u} \Rightarrow 3 = \frac{-v}{-10} \Rightarrow v = 30$ cm

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{30} + \frac{1}{-10} = \frac{-10 + (-30)}{-300}$

$= \frac{20}{-300} = \frac{1}{-15}$

$\Rightarrow f = -15$ cm

$\therefore$ Radius of curvature $= R = 2f = 2 \times -15$

$= -30$ cm

$\therefore$ Radius of curvature is 30 cm.

25. $h = 50$ mm, $f = -100$ mm, $u = -300$ mm

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

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

$\Rightarrow \frac{1}{v} = \frac{-3+1}{+300} = \frac{-2}{300} = \frac{-1}{150}$

$\Rightarrow v = -150$ mm

$m = \frac{-v}{u} = \frac{h'}{h} = \frac{-(-150)}{-300} = \frac{h'}{50}$

$\Rightarrow \frac{150}{-300} = \frac{h'}{50}$

$\Rightarrow h' = \frac{150}{-300} \times 50 = -25$ mm.

∴ The image will be 25 mm high.

26. $f = -20$ cm, $m = \frac{-1}{4}$

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

$$\Rightarrow -u = -4v \Rightarrow u = 4v$$

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

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

$$\Rightarrow -4v = 100 \Rightarrow v = \frac{-100}{4} = -25 \text{ cm}.$$

$$\Rightarrow u = 4v$$

$$\Rightarrow u = 4 \times (-25) = -100 \text{ cm}$$

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

27. Case-1 :- $u = -50$ cm, $m = \frac{-1}{2}$

$$m = \frac{-v}{u} \Rightarrow \frac{-1}{2} = \frac{-v}{-50} \Rightarrow -v = \frac{-1}{2} \times -50$$

$$\Rightarrow -v = 25 \text{cm}$$

$$\Rightarrow v = -25 \text{ cm}$$

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

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

$$\Rightarrow \frac{2+1}{-50} = \frac{3}{-50} = \frac{1}{f} \Rightarrow f = \frac{-50}{3} \text{ cm}$$

Case 2 :- $m = \frac{-1}{5}$, $f = \frac{-50}{3}$ cm

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

$$v = \frac{u}{5}$$

We know, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} = \frac{5}{u} + \frac{1}{u} = \frac{-3}{50}$

$\Rightarrow \frac{6}{u} = \frac{-3}{50}$

$\Rightarrow 6 = \frac{-3}{50} \times u$

$\Rightarrow u = \frac{6}{\frac{-30}{50}}$

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

$\Rightarrow u = -100$ cm

∴ The object should be placed 100 cm infront of the mirror.

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

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

$\Rightarrow \frac{1}{v} = \frac{-1}{12} + \frac{1}{20} = \frac{-20+12}{240} = \frac{-8}{240}$

$\Rightarrow v = -30$ cm.

∴ The image is formed at a distance of 30cm infront of mirror which is real and inverted.

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

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

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

$\Rightarrow \frac{-1+3}{12} = \frac{2}{12} = \frac{1}{6} \Rightarrow v = 6cm$

∴ The image is formed at a distance of 6cm behind the mirror.

29. $h' = 1cm = 10mm$

$h = 2.5mm$, $u = -5cm = -50mm$

$\because m = \frac{h'}{h} \Rightarrow m = \frac{-10}{-2.5} = -4$.

Also, $m = \frac{-v}{u} \Rightarrow -4 = \frac{-v}{-50}$

$\Rightarrow -v = -4 \times -50 = 200 \Rightarrow v = -200mm$

$\Rightarrow v = -20cm$

∴ Image is formed 20 cm or 200 mm infront of the mirrore.

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

$= \frac{-25}{100}$

$\Rightarrow f = -4$ cm

$\therefore$ The focal length of the mirror is 4cm.

30. $R = 60$ cm

$f = -30$ cm

$u = -15$ cm

We know that,

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

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

$$\Rightarrow \frac{1}{v} = \frac{1}{-30} - \left(\frac{1}{-15}\right) = \frac{1}{-30} + \frac{1}{15} = \frac{1 + (-2)}{-30}$$

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

$\Rightarrow v = 30$ cm

$\therefore$ The image of nose is 30 cm behind the concave or shaving mirror.

We know that, $m = \frac{-v}{u} = \frac{-30}{-15} = 2$.

$\therefore$ The image of nose is formed 30 cm behind the concave or shaving mirror and the magnification is +2.