NAME-ANUSHKA KUNDU

Hw CLASS-10 'DB'

S-CHAND

Pg - [198-199]

1. $h_1 = 1m$, $m = 2$
$h_2 = ?$

$\Rightarrow m = \frac{h_2}{h_1} \Rightarrow 2 = \frac{h_2}{1}$

$\Rightarrow h_2 = 1 \times 2 = 2 cm$

2. $f = -20 cm$
u, object distance $= -20 cm$
$v = ?$

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

$\Rightarrow \frac{1}{v} = \frac{1}{20} - \frac{1}{20} = 0$

$v = \frac{1}{0} = \infty$

3. (i) $+4 \rightarrow$ If the magnification has + sign then the nature of the image is virtual and erect.

(ii) $-3 \rightarrow$ If the magnification has $-$ sign then the nature of the image is real & inverted

4. The Relation between image distance, object distance and focal length is —

$$\frac{1}{\text{image distance}} + \frac{1}{\text{object distance}} = \frac{1}{\text{focal length}}$$

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

5. $$\frac{1}{\text{image distance}} + \frac{1}{\text{object distance}} = \frac{1}{\text{focal length}}$$

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

Where, u = distance of object from mirror
v = distance of image from mirror
f = focal length.

6. The ratio of height of an image to the height of object is called linear magnification.

7. The ratio of height of an image to the height of object is called linear magnification.

8. a) $m = \frac{h_2}{h_1}$ b) $m = -\frac{v}{u}$

9. $u = -20\,cm$ $v = ?$
$f = -10$

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

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

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

$$\Rightarrow v = -20$$

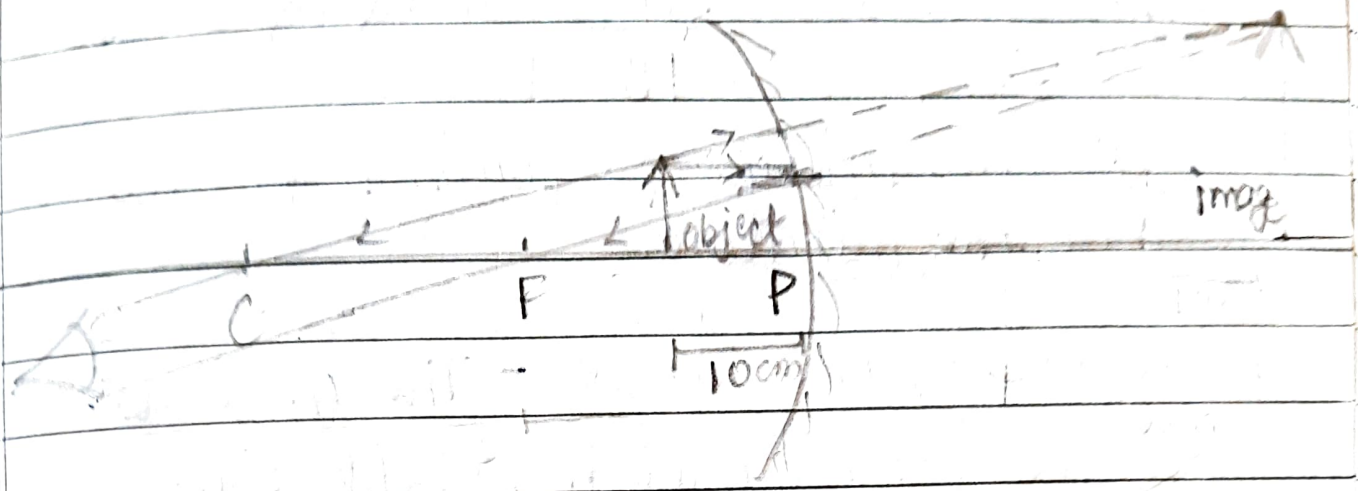
∴ The image is real & inverted.

10. a) If the magnification has a plus sign then image is Virtual & Ereet.

b) If the magnification has a negative sign then image is Real & Inverted,

11. Object distance $= -10$ cm, $f = -20$ cm

nce of 50 cm from a



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

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

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

$\Rightarrow v = +10$

(c) As, image distance is +, So the image is virtual and erect.
It's 2 characteristics of the image are -
→ It is larger than the object
→ It is formed behind the mirror.

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

(i) Position of image.

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

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

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

$\Rightarrow \frac{1}{v} = \frac{-2}{36} = \frac{-1}{18} \Rightarrow v = -18\,cm$

So, the image is formed at the left side of the mirrcore.

(ii) Nature of the image - As, image is formed at the left side of the mirrcore, the image will be 'Real & Inverted'.

(iii) Height of the image -

$\frac{-v}{u} = \frac{h_2}{h_1} \Rightarrow \frac{-(-18)}{-36} = \frac{h_2}{10}$

$\Rightarrow -36 h_2 = 180$

$\Rightarrow h_2 = -\frac{180}{36} = -5\,cm$

13. $f = 10\,cm$
$h_1 = 2\,cm$
$h_2 = 6\,cm$
$u = ?$

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

$\frac{-v}{u} = \frac{6}{2} \Rightarrow \frac{-v}{u} = \frac{3}{1}$

$\Rightarrow +v = -3u$

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

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

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

14. $u = 15\,cm$
$v = 10\,cm$
$f = ?$

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

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

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

$\Rightarrow f = 30\,cm$

15. $h_1 = 3\,cm$
$u = -8\,cm$
$h_2 = 4.5\,cm$

(ii) $\frac{-v}{u} = \frac{h_2}{h_1} \Rightarrow \frac{-v}{-8} = \frac{4.5}{3}$

$\Rightarrow +3v = 36$

$\Rightarrow v = +\frac{36}{3} = +12$

So, the image distance will be 12 cm in the left of the mirrcore.

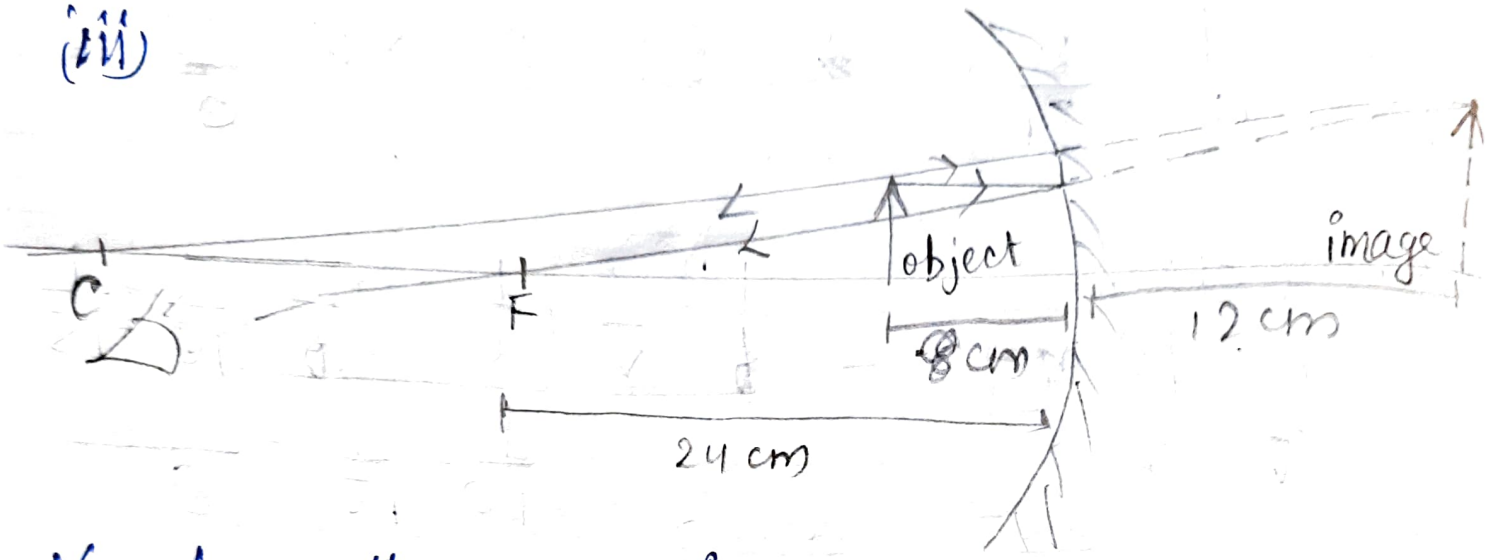
(i) $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{12} + \frac{1}{-8} = \frac{1}{12} - \frac{1}{8}$

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

$\Rightarrow f = -24$

$\therefore$ focal length is 24.

(iii)



16. $h_2 = -4\,cm$
$h_1 = 1\,cm$
$u = 20\,cm$

(i) $v = ?$

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

$$\Rightarrow \frac{-4}{1} = \frac{-v}{20} \quad \Rightarrow -v = -80$$

$$\Rightarrow v = 80\,cm$$

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

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

$f = 16$

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

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

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

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

$$\Rightarrow v = -54\,cm$$

∴ At 54cm in front of the mirror should the screen be placed so that a sharp focused image can be obtained.

(ii) Putting the value of v in,

$$-\frac{v}{u} = \frac{h_2}{h_1} \Rightarrow \frac{+(-54)}{+27} = \frac{h_2}{7}$$

$$\Rightarrow 27h_2 = -378$$

$$\Rightarrow h_2 = \frac{-378}{27} = \frac{63}{4}$$

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

(iii) Nature of the image is Real & Inverted.

18 $h_1 = 3\text{cm}$
$u = -10\text{cm}$
$f = -20\text{cm}$

• Position of the image

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

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

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

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

$$\Rightarrow v = 20 \text{ cm}$$

∴ The image formed is 20cm behind the mirror

- Nature of the image - As the image is formed behind the mirrcore then it is 'Virtual and Erect'

- Size of the image - $\frac{h_2}{h_1} = -\frac{v}{u}$

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

$\Rightarrow \frac{h_2}{3} = 2 \Rightarrow h_2 = 6\ cm$

19. $f = 4cm$
$h_1 = 2cm$
$u = -9\ cm$

- Position of the image

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \quad \Rightarrow \frac{1}{-4} = \frac{1}{v} + \frac{1}{-9}$

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

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

$\Rightarrow \frac{1}{v} = \frac{-5}{36} \quad \Rightarrow -5v = 36$

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

$\therefore$ The image foremed is 7.2cm in front of the concave mirrcore.

- Nature of the Image -

As the image formed is in freont of the

mirrore, the nature of the image would be Real & Inverted.

- size of the image - $\frac{h_2}{h_1} = \frac{-v}{u}$

$\Rightarrow \frac{h_2}{2} = \frac{+(-7.2)}{+9}$ $\Rightarrow 9h_2 = -14.4$

$\Rightarrow h_2 = \frac{-14.4}{9}$

$= -1.6\ cm$

∴ The image formed is 1.6 cm below the principal axis.

20. $u = -20\ cm$

$m = -3$ [∵ Image is real]

$m = \frac{-v}{u} \Rightarrow -3 = \frac{+v}{+20} \Rightarrow v = -60\ cm$

∴ The image is formed 60 cm in front of the mirrore

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

$\Rightarrow \frac{1}{f} = \frac{1}{-60} - \frac{1}{20} = \frac{-1-3}{60} = \frac{-4}{60} = -15$

∴ The focal length is 15 cm

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

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

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

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

$\Rightarrow 3u = 30 \quad \Rightarrow u = 10cm$

21. $R = 3\,cm \qquad f = -1.5cm$

$m = 5\,cm$

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

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

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

$$\Rightarrow \frac{1}{-1.5} = \frac{4}{5u} \Rightarrow 5u = -6.0$$

$$\Rightarrow u = \frac{-6}{5} = -1.2cm$$

22. $R = 1.5\,m \; ; \; f = \frac{R}{2} = \frac{1.5}{2} = -0.75\,m$

$u = -10m$

$v = ?$

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

$$\Rightarrow \frac{1}{v} = \frac{1}{-0.75} + \frac{1}{10} = -\frac{100}{75} + \frac{1}{10}$$

$$\Rightarrow \frac{1}{f} = \frac{-200+15}{150} = \frac{-185}{150} \quad (37, 30)$$

$$\Rightarrow \frac{1}{f} = \frac{-37}{30} \Rightarrow -37f = 30 \Rightarrow f = \frac{30}{-37}$$

$= -0.81\,m$

23. $h_1 = 5cm$
$u = -20cm$
$f = -15cm$

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

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

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

$\Rightarrow v = -60cm$

∴ The image will be formed 60cm in front of the mirrore.

So, The screen should be placed at a distance of 60 cm to obtain a sharp image.

24. $m = 3$ cm
$u = 10$ cm
$R = ? \Rightarrow 2f$

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

$\Rightarrow -v = 30$ ~~$\times -30$~~

$\Rightarrow v = +30$

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

$\Rightarrow \frac{1}{f} = \frac{1}{30} - \frac{1}{10} = \frac{1-3}{30} = \frac{-2}{30}$

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

$R = 2f \Rightarrow R = 2 \times 15 = 30$ cm

25. $h_1 = 50\,mm$
$f = -100\,mm$
$u = -300\,mm$
$h_2 = ?$

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

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

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

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

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

$$\frac{h_2}{h_1} = \frac{-v}{u} \Rightarrow \frac{h_2}{50} = \frac{+(-150)}{+300}$$

$$\Rightarrow 300\,h_2 = -7500$$

$$\Rightarrow h_2 = -\frac{7500}{300} = -25\,cm$$

26. $u = ?$
$f = 20\,cm$
$h_2 = -\frac{1}{4} h_1$

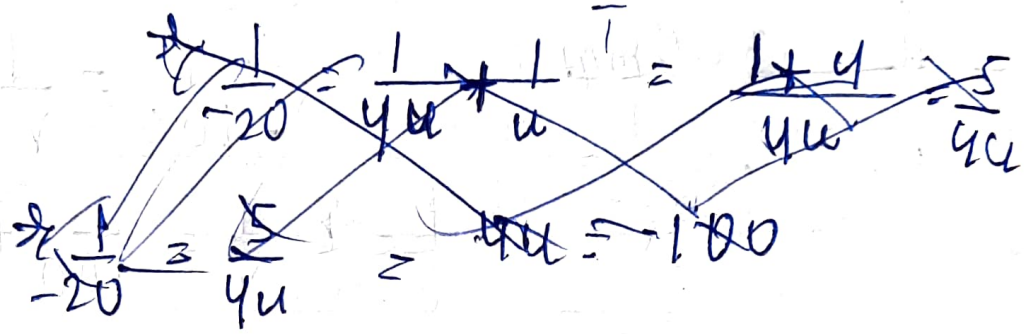
$$\frac{h_2}{h_1} = \frac{-v}{u}$$

$$\Rightarrow \frac{-\frac{1}{4}h_1}{h_1} = \frac{-v}{u} \Rightarrow \frac{\frac{h_1}{u}}{h_1} = \frac{-v}{u}$$

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

$$\Rightarrow v = \frac{u}{4}$$

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



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

$$\Rightarrow \frac{1}{-20} = \frac{5}{u} \Rightarrow u = -100\,cm$$

2). $u = -50\,cm$

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

$\Rightarrow 2v = -50 \Rightarrow v = \frac{-50}{2} = -25$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-25} - \frac{1}{50} = \frac{-2-1}{50}$$

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

$\Rightarrow -3f = 50$

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

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

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

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

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

$$\Rightarrow \frac{3}{-50} = \frac{5}{u} + \frac{1}{u} \Rightarrow \frac{3}{-50} = \frac{6}{u}$$

$$\Rightarrow 3u = -300$$

$$\Rightarrow u = -100\ cm$$

28 (i) $u = -20\ cm$

$f = -12\ cm$

• Position of image -

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

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

$$\Rightarrow \frac{1}{v} = \frac{1}{-12} + \frac{1}{20} = \frac{-5+3}{60}$$

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

$$\Rightarrow v = -30$$

• Nature of the image

As, the image is formed in front of the mirror so the nature of the image is 'Real & Inverted'

b) $u = 4$ cm

$f = 12$ cm

• Position of the image

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

$$\Rightarrow \frac{1}{v} = \frac{1}{-12} + \frac{1}{4} = \frac{-1+3}{12} = \frac{2}{12} = \frac{1}{6}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{6} \quad \Rightarrow v = 6 \text{ cm}$$

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

• Nature of the image - As, the image foremed is behind the concave mirror so, the nature of the image is 'Virtual & Erect.

29. $h_2 = -1$ cm

$u = -5$ cm

$h_1 = 0.25$ cm

$v = ?$

$f = ?$

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

$$\Rightarrow \frac{-1}{0.25} = \frac{-v}{-5}$$

$$\Rightarrow -0.25v = -5$$

$$\Rightarrow v = \frac{5}{-0.25} = \frac{500}{25} = -20$$

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

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

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

30. $R = 60cm$

$f = -30cm$

$u = -15cm$

• Position of the image

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

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

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

The image formed is at a distance 30cm behind the mirror.

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