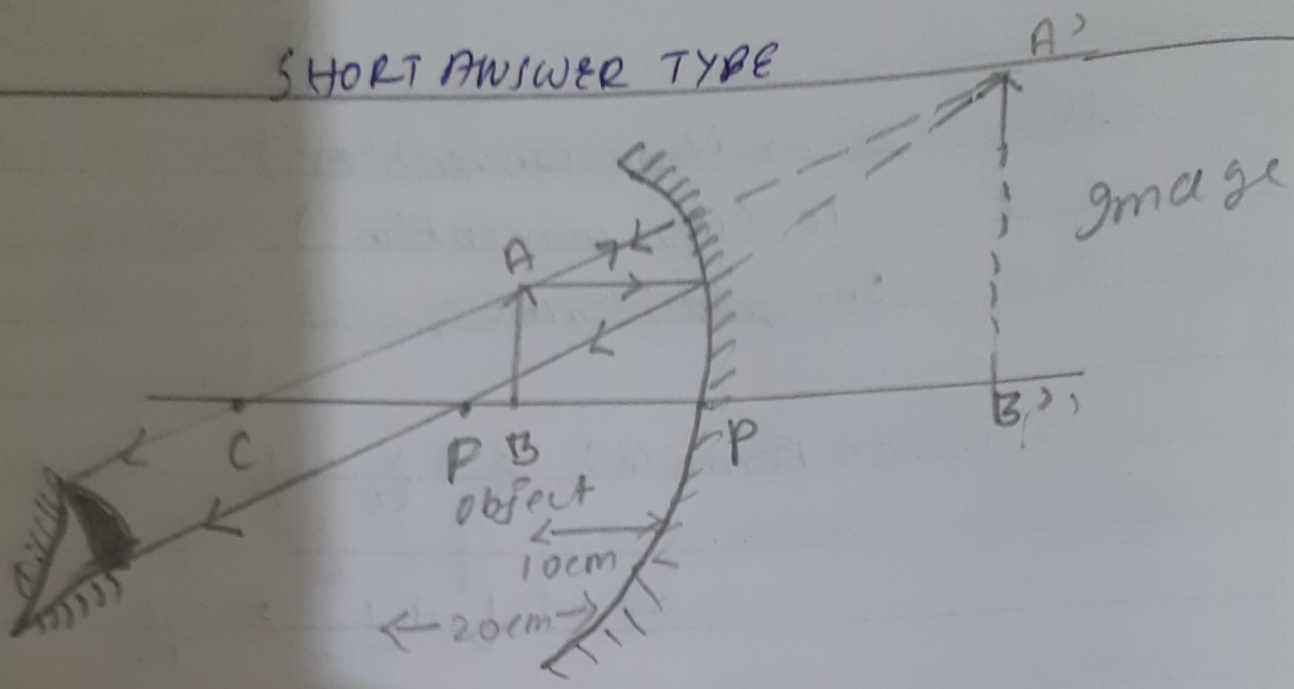
SHORT ANSWER TYPE

11: a)



(b)

$u = -10$ cm.

$f = -20$ cm.

~~[illegible]~~ $v = ?$

mirror formula:

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

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

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

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

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

(c) characteristics of image are:-
(1) virtual and erect.
(2) It is magnified.

12. $u = -36\ cm$.
$h = 10\ cm$.
$f = -12\ cm$.
$v = ?$
$h_1 = ?$
using mirror formula, we get

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

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

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

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

$\Rightarrow v = -18\ cm$. $\therefore v = +18\ cm$.
using mirror magnification,

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

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

$\Rightarrow h_2 = -\frac{1}{2}$ $\Rightarrow h = -5\ cm$

(a) height of the image = -5 cm.

$\Rightarrow m = \frac{-v}{u} = \frac{-(-18)}{36}$

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

Thus, the image is real, inverted and small in size.

13. Height of the object = 2 cm.

$f = -10$ cm.

Height of image = 6 cm.

$u = ?$

$m = \frac{\text{height of image}}{\text{height of object}} = -\frac{v}{u}$

$m = \frac{6}{2} = -\frac{v}{u}$

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

$\Rightarrow v = 3u.$

Using mirror formula,

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

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

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

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

$\Rightarrow u = 6.67$

$\therefore u = -6.67$

14. $u = -15\,cm$

$v = -10\,cm$

$f = ?$

Using the mirror formula,

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

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

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

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

$\Rightarrow f = -6\,cm$.

15. (Obj distance) $u = -8\,cm$

Height of the object $= 3\,cm$.

Height of the image $= 4.5\,cm$.

$f = ?$

$v = ?$

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

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

$$\Rightarrow v = 4.5 \times \frac{8}{3} = 12\,cm.$$

$\therefore$ distance of image (v) is $12\,cm$.

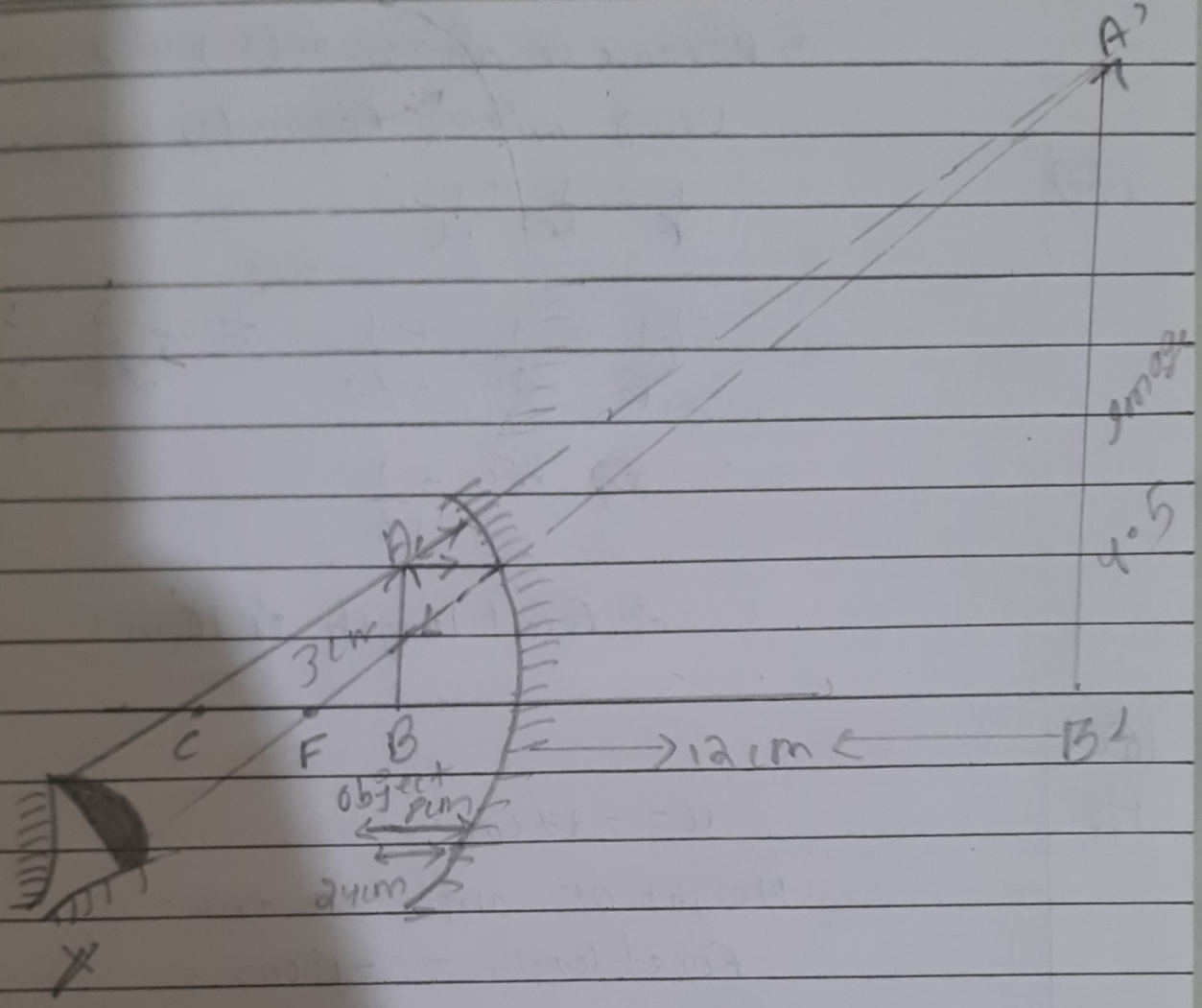
By mirror formula.

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{12} + \frac{1}{-8}$$

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

(b) Image is formed behind the mirror.

(c)



(b) (i)

$u = -20cm$

Height of the object $= 1cm$

Height of image $= -4cm$.

$v = ?$

$f = ?$

$m = \frac{\text{Height of image}}{\text{Height of object}} = \frac{-v}{u}$.

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

$v = 20 \times \frac{4}{1} = -80\ cm$.

∴ Distance of image (v) = 80 cm.

Using mirror formula, we get

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

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

$\Rightarrow \frac{1}{f} = -\frac{1}{16}$

∴ Focal length is 16cm.

(23)

17. $u = -27$ cm.

Height of object = 7cm.

Focal length = -18 cm.

$v = ?$

Height of image = ?

Using mirror formula,

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

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

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

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

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

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

Distance of image (v) = 54 cm.

$m = \frac{\text{Height of image}}{\text{Height of object}} = -\frac{v}{u}$

$\therefore = \frac{-54}{-27} = \frac{-2}{1}$

$h = -14\,cm.$

$\therefore$ Height of image = 14 cm.

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

$m = -2.$

Thus, the image is real, inverted and large in size.

18) Distance of object from the mirror -

$u = -10\,cm.$

Height of the object = 3 cm

$f = -20\,cm.$

we have $v = ?$

height of image = ?

Using mirror formula,

Using the mirror formula,

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

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

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

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

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

$$\therefore v = 20 \text{ cm}.$$

Using the magnification formula,

$$m = \frac{\text{Height of image}}{\text{Height of obj}} = -\frac{v}{u}$$

$$\frac{h_1'}{h_0} = -\frac{20}{10}$$

$$\Rightarrow \frac{h_1}{3} = -2$$

$$\Rightarrow h_1 = -6 \text{ cm}$$

∴ Height of image is 6 cm.

Again, using magnification formula,

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

$$m = \frac{-20}{10}$$

$$\Rightarrow m = -2\text{ cm}.$$

Thus, the image is virtual, erect

19.

$u = -9$ cm.

Height of object $= 2$ cm.

$f = -4$ cm.

$v = ?$

Height of image $= ?$

Using mirror formula,

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

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

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

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

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

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

$$v = 7.2 \text{ cm}.$$

$$\text{or } v = 7.2 \text{ cm}.$$

$$M = \frac{h_i^o}{h_o} = \frac{-v}{u}$$

$$\Rightarrow \frac{h_1}{1.6} = \frac{-(-7.2)}{9}$$

$$\Rightarrow \frac{h_2^o}{2} = \frac{(-7.2)}{-9}$$

$$\Rightarrow h_2^o = \frac{2 \times (-7.2)}{9}$$

$$\Rightarrow h_i^o = -1.6 \text{ cm}$$

$$\therefore h_2^o = 1.6 \text{ cm}.$$

Again using the same formula.

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

$$m = \frac{-(-7.2)}{-9}$$

$$\Rightarrow m = 0.8.$$

Thus, the image is real, inverted and small in size.

20. a) $u = -20\ cm$

$m = -3$

(a) , we have to find the focal length of the mirror.

Using magnification formula, we get

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

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

$$\Rightarrow v = -60\ cm$$

Using the mirror formula,

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

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

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

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

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

$$f = -15\ cm$$

(b) Now, if the image is virtual and 3 times magnified, then we have to find the position of the object.

Given,

$f = -15\,cm$

$m = 3$

Using magnification formula,

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

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

$$\Rightarrow v = -3u$$

$\therefore v = -3u$.

Again using mirror formula,

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

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

$$\Rightarrow f = \frac{3u}{2}$$

$$\Rightarrow u = \frac{2f}{3} = \frac{2 \times (-15)}{3}$$

$$\Rightarrow u = -10\,cm$$

21. Radius of curvature = -3cm.

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

magnification = 5.

$\therefore$ Using magnification formula,

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

$$\Rightarrow v = -u$$

$$\Rightarrow v = -5u.$$

Now by using mirror formula,

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

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

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

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

$$\Rightarrow u = \frac{(-1.5) \times 4}{5} = -\frac{6}{5}$$

$$\Rightarrow u = -1.2\text{cm}.$$

$\therefore$ Focal length $= R_2 = 32 = 1.5\text{cm}$.

22: Given) Radius of curvature = ~~+1.5~~ -1.5m.

$$f = \frac{1}{R} = \frac{1}{1.5} = 0.75\,m.$$

$u = -10m.$

$v = ?$

using mirror formula,

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

$$\therefore \frac{1}{0.75} = \frac{1}{v} + \frac{1}{-10}$$

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

$$\text{or } \frac{1}{v} = \frac{1}{10} - \frac{100}{75}$$

$$\text{or } \frac{1}{v} = \frac{1}{10} - \frac{4}{3}.$$

$$\text{or } \frac{1}{v} = \frac{3}{30} - \frac{40}{30}$$

$$\text{or } \frac{1}{v} = -\frac{37}{30}$$

$$\text{or } v = -30/37 = 0.81\,m$$

$\therefore$ The persons image will be formed at a distance of 0.81m.

23. Concave mirror is converging mirror.

$u = -20\,cm$

Height of object $= 5\,cm$.

$f = -15\,cm$.

$v = ?$

Height of image $(h_i) = ?$

Using mirror formula,

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

$$\frac{1}{-15} = \frac{1}{v} + \frac{1}{-20} \quad \text{or} \quad \frac{1}{v} = \frac{1}{20} - \frac{1}{15}$$

$$\text{or } \frac{1}{v} = \frac{3-4}{60} = \frac{1}{60}$$

$$\text{or } v = -60\,cm.$$

Now using magnification formula,

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

$$\text{or } \frac{h_i}{5} = -\frac{-60}{-20}$$

$$\text{or } h_i/5 = 3$$

$$\text{or } h_i = -3 \times 5 = -15\,cm$$

∴ Height of the image will be 15 cm.

Q4:

Given, $u = -10cm$; $m = 3$; $R = ?$

Using magnification formula,

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

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

Now using mirror formula

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

$$\frac{1}{f} = \frac{1}{30} + \frac{1}{-10} \text{ or } \frac{1}{f} = \frac{1}{30} - \frac{3}{30} = \frac{-2}{30}$$

$$\text{or } \frac{1}{f} = -\frac{1}{15} \text{ or } f = -15cm.$$

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

Q5:

$u = -300mm$; $h_o = 50mm$; $f = -100mm$

$v = ?$; $h_i = ?$

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

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

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

$$\Rightarrow \frac{1}{v} = \frac{-2}{300} \Rightarrow v = -150cm.$$

Then,

$$m = h_i/h_o = -v/u.$$

$$h_i/50 = -\frac{-150}{-300} = -\frac{1}{2} \Rightarrow h_i = \frac{-50}{2}$$

$$= -25mm$$

26) Given, Focal length of the concave mirror (f) = 20 cm.

$m = -1/4$.

Using magnification formula,

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

Using the mirror formula, we get.

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

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

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

27) Given, $m = -1/2$; $u = -50$ cm.

Using magnification formula, $m = -v/u$

$$v = -mu$$

$$\Rightarrow v = -(-1/2 \times -50)$$

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

Using mirror formula,

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

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

$$= -\frac{2}{50} - \frac{1}{50} = \frac{3}{-50}$$

$$\Rightarrow f = -50/3 \text{ cm}.$$

Now $m_p = -1.5$; using mirror formula

$$\frac{1}{f} = \frac{1}{-m_p u} + \frac{1}{u} \quad \text{or} \quad \frac{-3}{50} = \frac{-5}{u} + \frac{1}{u}$$

$$\text{or} \quad \frac{-3}{50} = \frac{6}{u}.$$

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

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

Using Magnification formula & $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

so or $\frac{1}{-12} = \frac{1}{v} + \frac{1}{-20}$

$$\frac{1}{-12} = \frac{1}{v} - \frac{1}{20} \quad \text{or} \quad \frac{1}{20} - \frac{1}{12} = \frac{1}{v}$$

$$\text{or} \quad \frac{3-5}{60} = \frac{1}{v} \quad \text{or} \quad -\frac{2}{60} = \frac{1}{v} \quad \text{or} \quad v = \frac{60}{-2}$$

$$v = -30 \text{ cm}.$$

$m = -\frac{v}{u}$ $\quad m = -\frac{-30}{-20} = -1.5$.

∴ Image is real, inverted and enlarged.

(b) $u = -4$ cm; $f = -12$ cm; $v = ?$

Using the mirror formula, we see

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

$$\frac{1}{-12} = \frac{1}{v} + \frac{1}{-4} \quad \text{or} \quad \frac{1}{4} - \frac{1}{12} = \frac{1}{v}$$

$$\text{or} \quad \frac{3-1}{12} = \frac{1}{v} \quad \text{or} \quad 2/12 = 1/v$$

$m = -v/u = -6/-4 = 1.5$

∴ Image is virtual and erect.

29: $u = -5\,cm$; $h_i^o = -1\,cm$; $h_o = 2.5\,mm = 0.25\,cm$

$v = ?$; $f = ?$

$m = h_i^o/h_o = -v/u$ or $1/0.25 = -v/-5$

or $v = -5/0.25 = -20\,cm$.

Now, using mirror formula.

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

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

∴ $f = -4\,m$.

30: $u = -15\,cm$; $f = -30\,cm$; $v = ?$

Using mirror formula,

$1/f = 1/v + 1/u$.

$1/-30 = 1/v - 1/15$ or $\frac{1}{v} = \frac{1}{15} - \frac{1}{30}$

or $\frac{1}{v} = \frac{2-1}{30} = \frac{1}{30}$.

$v = 30\,cm$.

Image formed behind the mirror.

$m = -v/u = -30/-15 = 2$.

∴ The image is 2 times magnified than the object.