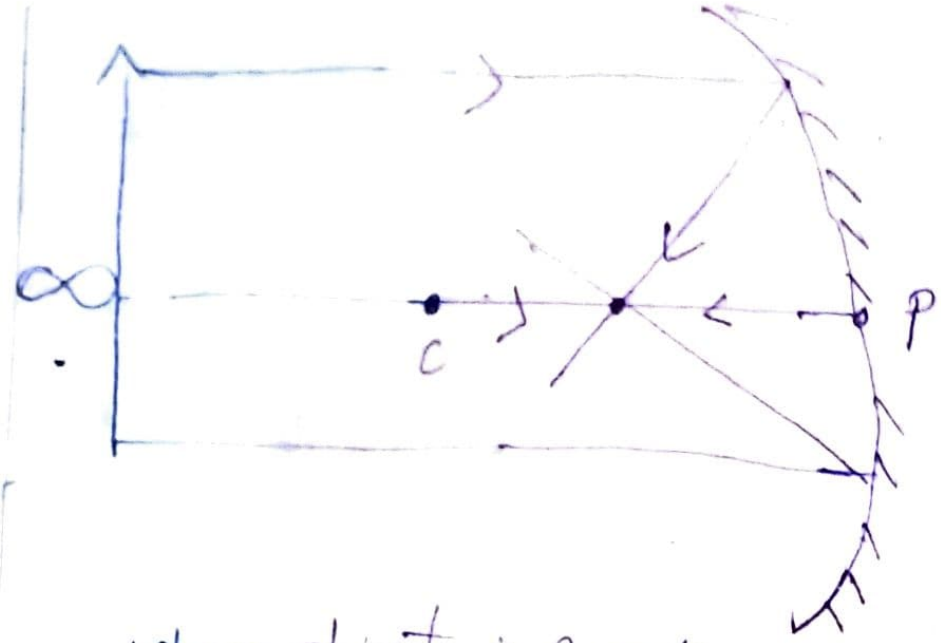
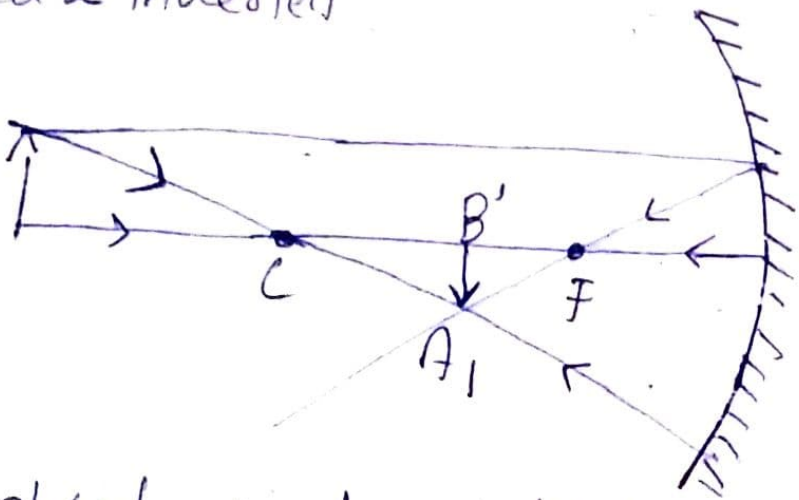
Position behind the mirror
Nature - virtual erect and enlarged

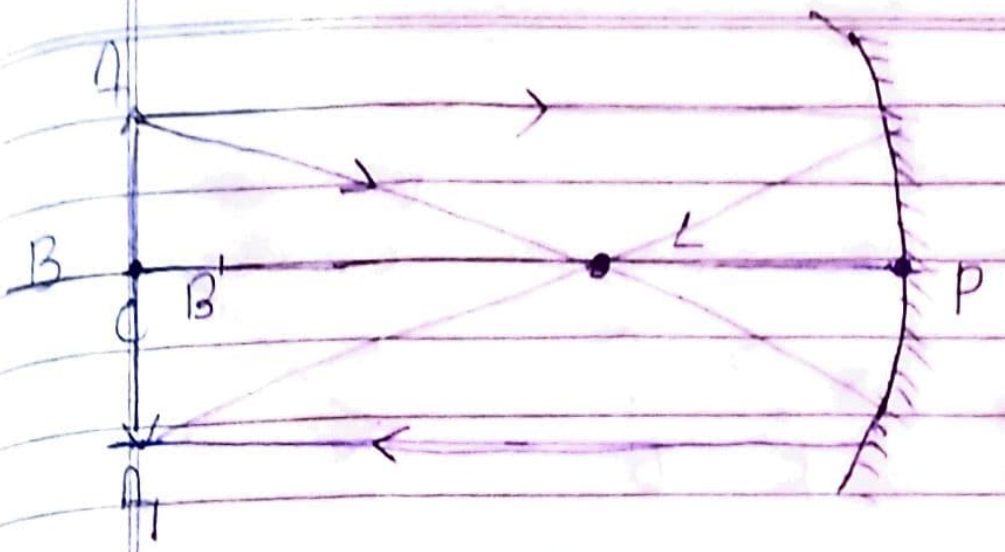
Ray Diagrams



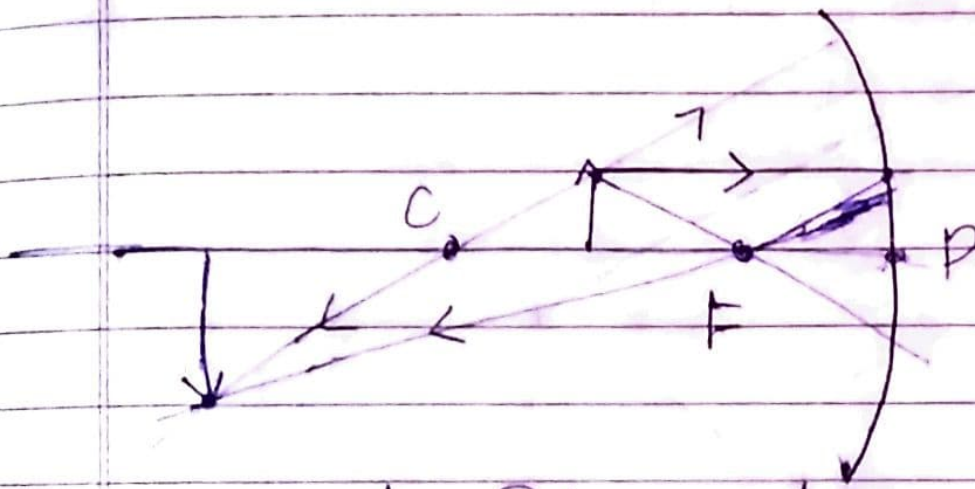
when object is at ∞, image formed at F
real & inverted



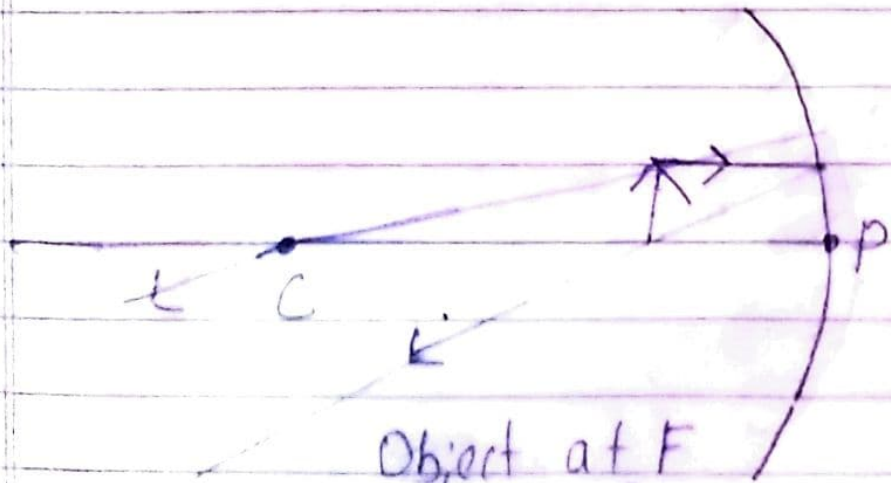
when object is beyond C image forms between C and F. (Real & inverted)



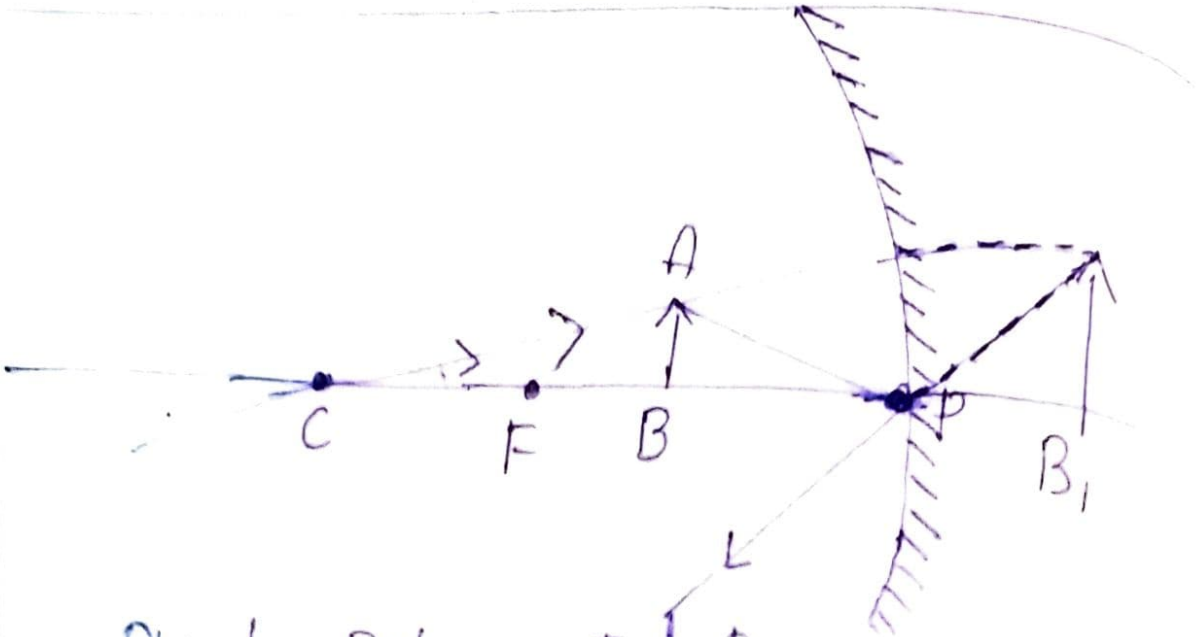
When object is at C image will formed at C (Real & inverted).



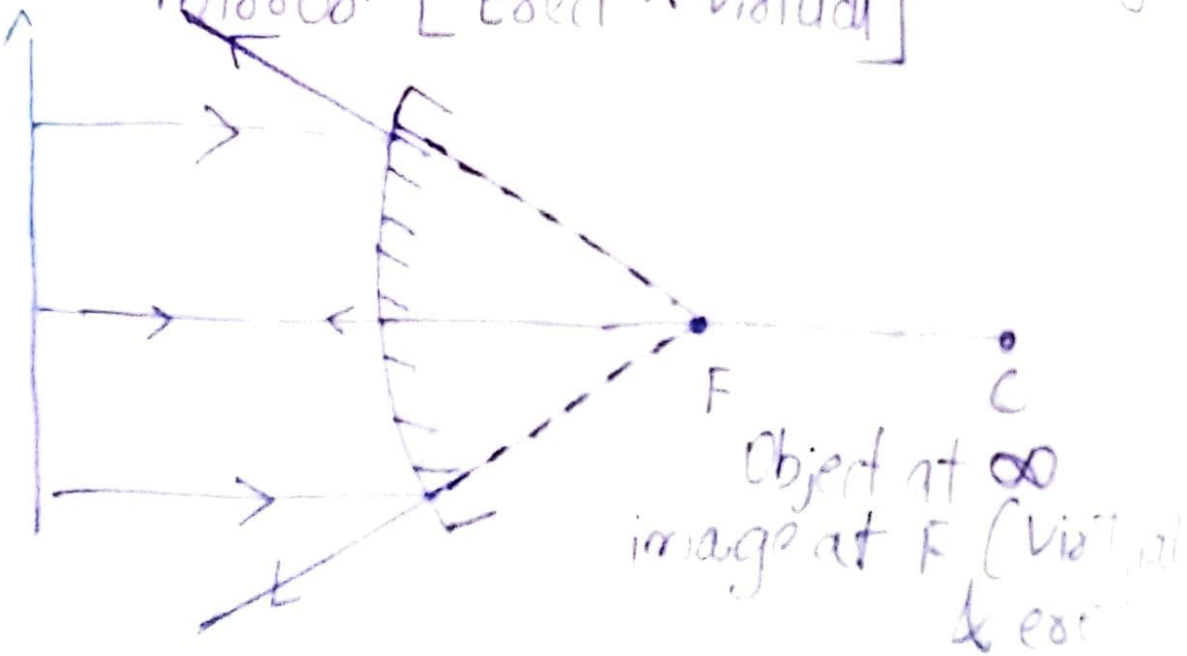
Object - Between C & F
image - Beyond C (Real & inverted)



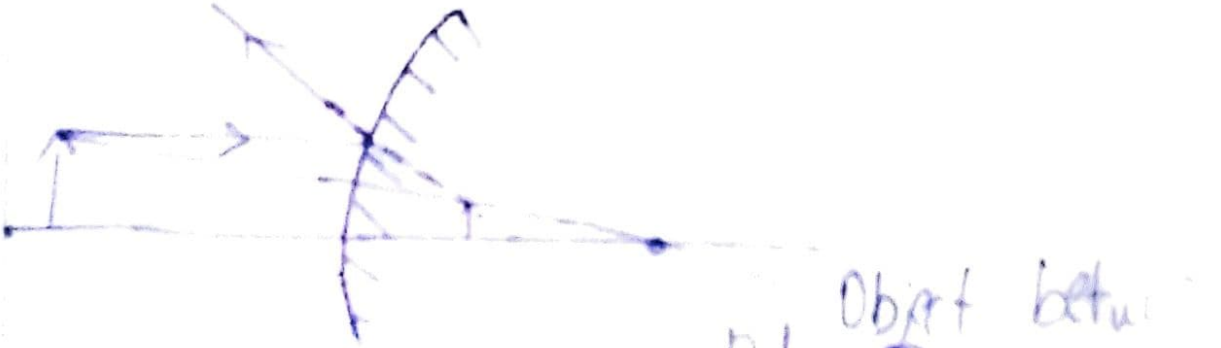
Object at F
image at ∞ (Real & inverted



Object Between F & P image B beyond mirror. [Erect & virtual]



Object at ∞
image at F (Virtual & Erect



Object betw
P & ∞ ∞
image between P &
(Virtual & Erect)

Date
Page

HOMEWOORK

11. b) ⊖ $F = -20$

$U = -10cm$

ATQ

$$\frac{1}{V} + \frac{1}{U} = \frac{1}{F}$$

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

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

$$V = 20\ cm$$

c) Characteristic of image :-

i) image is virtual and erect.

12. $h = 10cm,\ U = -36\ cm,\ f = -12cm$

ATQ

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

$$\frac{1}{V} + \frac{1}{-36} = \frac{1}{-12}$$

$$\frac{1}{V} \oplus = \frac{1}{36} - \frac{1}{12} = \frac{-9+3}{36} = \frac{-2}{36} = \frac{-1}{18}$$

$$V = -18cm$$

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

$$\therefore \frac{h'}{10} = -\frac{(+15)}{(-30)}$$

$$h' = -5\,(cm)$$

The image is real and inverted

14) $u = -15\,cm$, $v = -10\,cm$.

ATQ

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

$$\therefore \frac{1}{(-10)} + \frac{1}{(-15)} = \frac{1}{f}$$

$$\therefore \frac{1}{f} = \frac{-1}{10} - \frac{1}{15} = -\frac{3-2}{30} = \frac{-5}{30} = -$$

$$f = -6\ cm$$

So the focal length of concave is -6 cm

15. H_1 (height of the object) $= 3cm$

$U = -8cm$

$H = 4.5cm$

i) Magnification $(m) \quad \frac{H}{H} = \frac{4.5}{3} = 1.5m$

ii) now $m = \frac{-V}{U} = \frac{-V}{-8}$

$\Rightarrow 1.5 = -V/-8$

$\Rightarrow +V = 1.5 \times -8 = 1-12$

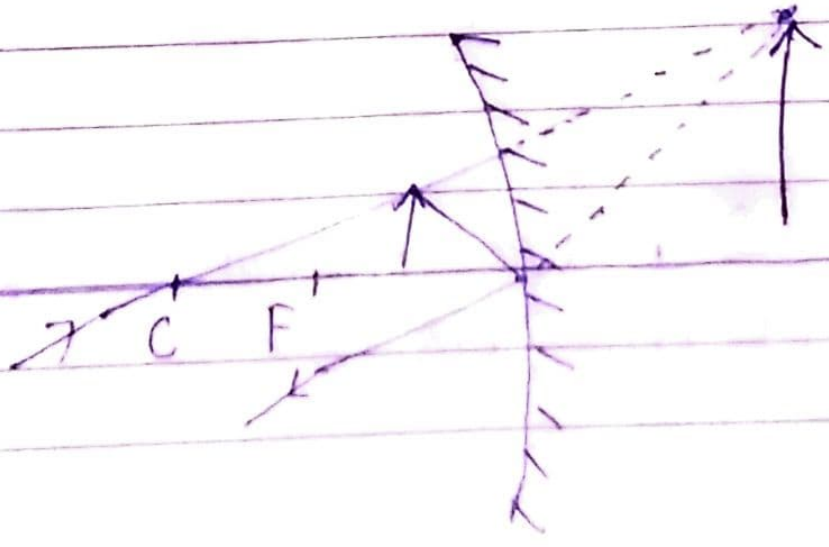
$V = 12cm$ cm

So the image formed is 12cm.

iii) $\frac{1}{f} = \frac{1}{V} + \frac{1}{U}$

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

$\Rightarrow F = -24cm$



13) $f = -10cm$
$h = 20m$
$h' = 6cm$
ATQ,
$m = \frac{h'}{h} = 6/2 = 3$
and,
$m = \frac{-V}{U} = 3$
$\Rightarrow 3U = -V$
$\Rightarrow V = -3U$ --- A

we have,
$\frac{1}{V} + \frac{1}{U} = \frac{1}{f}$
$\Rightarrow \frac{1}{-3U} + \frac{1}{U} = \frac{1}{-10}$
$\Rightarrow \frac{1}{U} - \frac{1}{3U} = -\frac{1}{10} \Rightarrow \frac{2}{3} = -\frac{1}{10}$
$\Rightarrow U = 6.66cm$

Ans

$\Rightarrow$ The object should be placed at a distance of 6.66cm.

16. $h_2 = -4cm$ (real image) $h_1 = 1cm$ $U = -20cm$

i) $V = ?$

magnification $= \frac{h_2}{h_1} = \frac{-V}{U}$

$\Rightarrow \frac{-4}{1} = \frac{-V}{-20} \Rightarrow V = -80cm$

So image formed in front of the concave mirror.

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

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

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

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

$\Rightarrow f = -16$

17. Given, $h = 7cm$ $U = -20$, $f = -18cm$

ATQ,

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

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

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

$V = -54cm$

So the screen should be placed at a distance of 54 cm in front of the concave mirror and,

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

$= \frac{h'}{7} \Rightarrow h' = -14cm$

So image is 14cm in size real & inverted

15 Given
$h = 3cm$
$U = -10cm$
$f = -20cm$

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

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

$= -\frac{1+2}{20} = \frac{1}{20} = 20cm$

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

now, $m = -\frac{v}{u} = \frac{h'}{h} \Rightarrow \frac{-20}{-10} = \frac{h'}{3} \Rightarrow h' = 6cm$

Image is 6 cm, virtual and erect.

19. $h_1 = 20cm \quad u = -9cm \quad f = -4cm$

Now

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

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

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

So the image formed at a distance 7.2 cm infront of concave mirror.

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

$m = \frac{h_2}{h} \Rightarrow -0.8 = \frac{h_2}{h_1}$

$h_2 = -1.6 cm$

Image is 1.6cm, real and inverted.

20. $V = -20\,cm$

$m = -3$

a) $m = \frac{V}{U}$

$\Rightarrow -3 = \frac{-V}{-20} \Rightarrow -V = -20 \times -3 = 60$

$V = -60\,cm.$

$\Rightarrow \frac{1}{V} + \frac{1}{U} = \frac{1}{f}$

$\frac{1}{-60} + \frac{1}{-20} = \frac{1}{60} - \frac{1}{20} = \frac{-1-3}{60} = \frac{-1}{15}$

$f = -15cm$

b) For virtual image $m = 3$, $F = -15cm$

now, $m = \frac{-V}{U}$, $m = 3 = \frac{-V}{U} \Rightarrow V = -3U$

$\frac{1}{V} + \frac{1}{U} = \frac{1}{f} \Rightarrow \frac{1}{-3U} + \frac{1}{U} = \frac{1}{-15}$

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

$\Rightarrow U = \frac{-2 \times 15}{3} = -10cm$

21- $R = -3cm$ $F = R/2 = -3/2 = -1.5cm$

$m = 5$ now

$m = -\frac{V}{U} \Rightarrow V = -5U$

Then, $\frac{1}{V} + \frac{1}{U} = \frac{1}{f} \Rightarrow \frac{1}{-5U} + \frac{1}{U} = \frac{1}{-1.5}$

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

$V = -\frac{4 \times 1.5}{5} = -1.2cm$

Then

The mirror should be placed 1.2cm away from the teeth.

22. $R = -1.5cm$

$U = -10cm$

$F = R/2 = \frac{-1.5}{2} = -0.75cm$

ATQ, $\frac{1}{V} + \frac{1}{U} = \frac{1}{f}$

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

$\frac{1}{V} = \frac{1}{10} = \frac{-100}{75} = \frac{1}{10} - \frac{4}{3}$

$\Rightarrow \frac{1}{V} = \frac{3-40}{30} = \frac{-37}{30}$

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

23 $h_1 = 5cm \quad U = -20cm \quad f = -15cm$

ATQ, $\frac{1}{V} + \frac{1}{U} = \frac{1}{f}$

$\Rightarrow \frac{1}{V} = \frac{1}{f} - \frac{1}{U} = \frac{1}{-15} - \frac{1}{-20} = \frac{1}{15} + \frac{1}{20} = \frac{4+6}{60}$

$= \frac{-1}{60} \quad V = -60cm$

The screen should be ~~proreect~~ placed 60cm infront of the mirror

now,

$m = \frac{h_2}{h_1} = \frac{-V}{U}$

$m = \frac{h_2}{5} = \frac{-60}{-20} = \frac{h_2}{5} = -3 \Rightarrow h_2 = -3 \times 5 = -15$

height of image = 15cm

24) Given, $U = -10\,cm$
$m = 3$

now, $m = \frac{-V}{U} \Rightarrow 3 = \frac{-V}{-10}$

$\Rightarrow -V = 3 - 10 = -30$
$V = 30\,cm$

Then $\frac{1}{V} + \frac{1}{U} = \frac{1}{f}$

$\Rightarrow \frac{1}{30} + \frac{1}{-10} = \frac{1}{F}$

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

$F = \frac{-30}{2} = -15\,cm$

Radius of Curvature $(R) = 2F$
$R = 2 \times (-15) = 30\,cm$

25. $h = 50\,mm \quad f = -100\,m$
$U = -300\,m$
ATQ. $\frac{1}{V} + \frac{1}{U} = \frac{1}{f}$

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

$$\frac{1}{v} = \frac{-1}{100} + \frac{1}{300} = \frac{-3+1}{300} = \frac{-2}{300}$$

$$v = -150 \text{ mm}$$

Now,

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

$$\Rightarrow \frac{h'}{50} = -\left(\frac{-150}{-300}\right) = -\frac{1}{2}$$

$$h' = -\frac{1}{2} \times 50 = -25 \text{ mm}$$

The image will 25 mm high.

26. Given, $F = -20\text{cm}$

$m = -1/4$

ATQ,

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

So,

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

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

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

$\therefore v = 4u$

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

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

Case I

27. $v = -50\,cm$

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

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

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

$\Rightarrow v = -25\,cm$

now,

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

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

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

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

$\therefore f = -\frac{50}{3}\,m$

Case 2.

$m = -1$

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

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

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

now,

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

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

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

$-3u = 300$

$u = 300/-3 = -100$ cm

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

ATQ

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

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

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

$$\frac{1}{V} = \frac{-5+3}{60} = \frac{-2}{60}$$

$$\Rightarrow V = \frac{60}{-2} = -30\,cm$$

So the image is formed at distance of 30 cm infront of the mirror

b) $U = -4cm \quad f = -12cm$

ATQ

$$\frac{1}{V} + \frac{1}{U} = \frac{1}{f}$$

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

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

$V = 6\,cm$

So the image will be formed 6 cm behind the mirror.

The nature is virtual and erect

29. Given,

$h = -10cm = -10mm$

$h = 2.5m$

$u = -5cm = -50mm$

AIQ

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

now,

$$m = \frac{-v}{u} \Rightarrow -4 = \frac{-v}{(-50)mm}$$

$$\Rightarrow 200mm = -v$$

$$v = -200mm$$

$$v = 20cm$$

Ans 1,

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

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

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

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

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

30) $R = -60\,cm$ $\quad u = -15\,cm$

$f = -30\,cm$

ATQ

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

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

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

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

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

$$V = 300\,cm$$