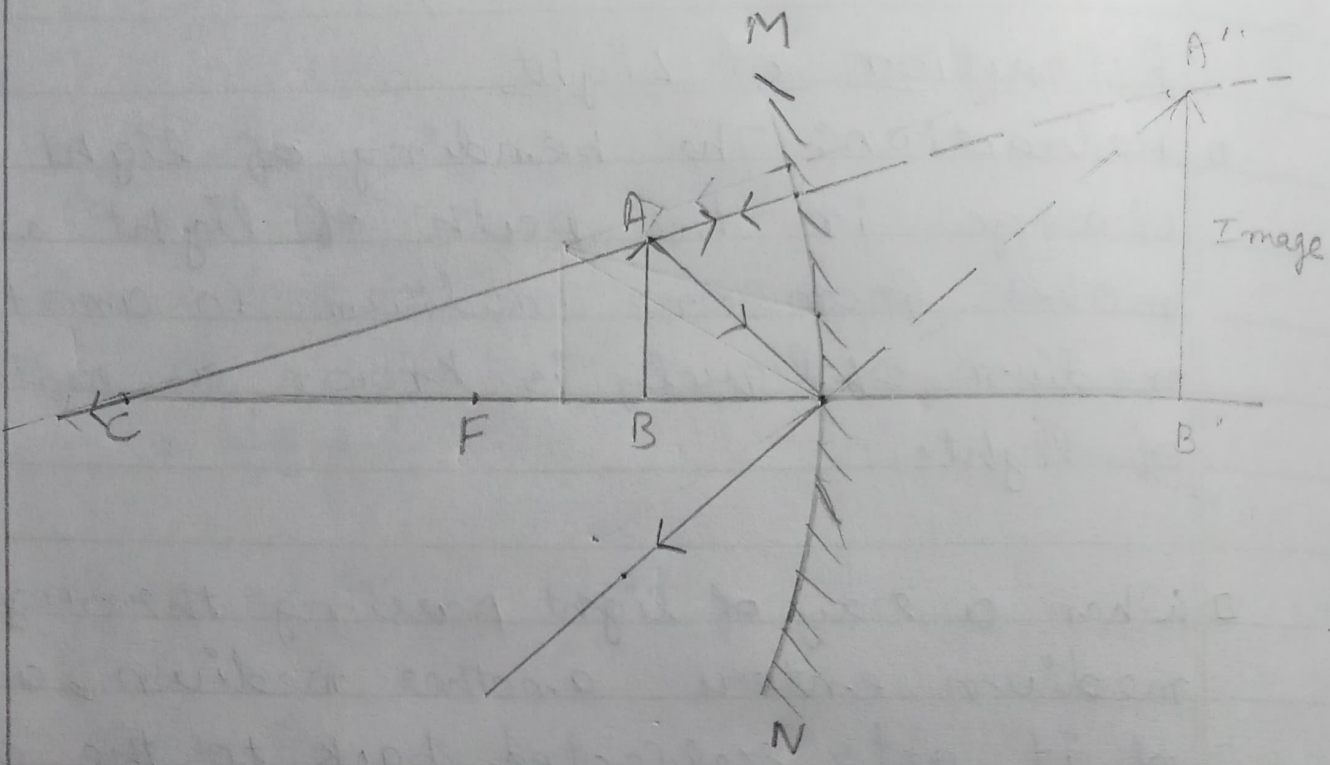


How  
15/5/21

Short Answer Type Questions

11.  
(a)



(b)  $f = -20\text{ cm}$ ,  $u = 10\text{ cm}$ ,  ~~$v = -20$~~   
we know that

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

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

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

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

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

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

(c) characteristics of image formed

(i) Image is virtual and enlarged.

(ii) Image is erect.

12. Given  $h_1 = 10 \text{ cm}$ ,  $u = -36 \text{ cm}$ ,  $f = -12 \text{ cm}$   
we know that

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

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

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

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

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

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

$$\Rightarrow v = -18 \text{ cm}$$

∴ The position of the image is 18 cm in front of the mirror.

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

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

$$\Rightarrow \frac{h_2}{10} = \frac{-18}{36}$$

$$\Rightarrow \frac{h_2}{10} = -\frac{1}{2}$$

$$\Rightarrow h_2 = -5 \text{ cm}$$

The image formed is real and inverted.

13. Given: -  $f = -10 \text{ cm}$ ,  $h_1 = 2 \text{ cm}$ ,  $h_2 = 6 \text{ cm}$   
(erect image)

$$m = \frac{h_2}{h_1} = \frac{6}{2} = 3$$

and

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

$$\Rightarrow 3u = -v$$

$$\Rightarrow v = -3u \quad \text{--- (1)}$$

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

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

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

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

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

$$\Rightarrow u = \frac{-20}{3} = -6.66 \text{ cm.}$$

14. Given:-  $u = -15 \text{ cm}$ ,  $v = -10 \text{ cm}$

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

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

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

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

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

$$\Rightarrow \frac{1}{f} = \frac{-1}{6}$$

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

∴ The focal length of the concave mirror is 6 cm.

15. Given:  $h_1 = 3 \text{ cm}$ ,  $u = -8 \text{ cm}$ ,  $h_2 = 4.5$   
(virtual)

$$(i) m = \frac{h_2}{h_1} = \frac{4.5}{3} = 1.5$$

and

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

$$\Rightarrow 1.5 = \frac{-v}{(-8)}$$

$$\Rightarrow v = 1.5 \times 8$$

$$\Rightarrow v = 12 \text{ cm}$$

We have

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

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

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

$$\Rightarrow f = -24 \text{ cm}$$

(ii) So, the image is formed 12 cm behind the concave mirror.

16. Given :-  $h_2 = -4 \text{ cm}$  (real image)

$$h_1 = 1 \text{ cm}$$

$$u = -20 \text{ cm}$$

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

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

$$\Rightarrow v = -80 \text{ cm}$$

Image forms in front of the concave mirror.

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

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

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

$$\Rightarrow f = -16 \text{ cm.}$$

17. Given :-  $h_2 = 7 \text{ cm}$ ,  $u = -27 \text{ cm}$ ,  $f = -18 \text{ cm}$

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

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

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

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

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

$$\Rightarrow v = -54 \text{ cm.}$$

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

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

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

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

Image is 14 cm in size, real and inverted.

18. Given:  $h_1 = 3 \text{ cm}$ ,  $u = -10 \text{ cm}$ ,  $f = -20 \text{ cm}$

We know that

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

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

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

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

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

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

And

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

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

$$\Rightarrow \frac{h_2}{3} = \frac{2}{10}$$

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

Image is 6 cm in size, virtual and erect.

19. Given :-  $h_1 = 2 \text{ cm}$ ,  $u = -9 \text{ cm}$ ,  $f = -4 \text{ cm}$

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



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

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

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

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

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

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

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

$$m = \frac{h_2}{h_1} \Rightarrow -0.8 = \frac{h_2}{2}$$

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

So, image is 1.6 cm in size, real and inverted.

20. Given:-  $u = -20 \text{ cm}$ ,  $m = -3$ , (real image)

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

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

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

$$\Rightarrow v = -60 \text{ cm}$$

We have

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

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

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

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

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

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

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

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

$$\Rightarrow v = -3u$$

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

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

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

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

$$\Rightarrow u = -10 \text{ cm}$$

$\therefore$  So, Object should be placed 10 cm from the concave mirror.

21. Given:-  $R = -3 \text{ cm}$  (concave mirror)

$m = 5$  (virtual)

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

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

$$\rightarrow v = -5u$$

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

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

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

$$\Rightarrow u = \frac{-4 \times 1.5}{5} = -1.2 \text{ cm.}$$

∴ The mirrors should be placed 1.2 cm away from the dental cavity.

22. Given:  $R = -1.5 \text{ m}$  (concave)

$$u = -10 \text{ m}$$

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

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

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

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

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

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

$$\Rightarrow v = -\frac{30}{37} = -0.81 \text{ m}$$

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

23. Given:  $h_1 = 5.0 \text{ cm}$ ,  $u = -20 \text{ cm}$ ,  $f = -15 \text{ cm}$ .

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

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

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

$$\Rightarrow \frac{1}{v} = \frac{-5}{300}$$

$$\Rightarrow v = -60 \text{ cm}$$

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

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

$$\Rightarrow \frac{h_2}{5} = \frac{-(-60)}{-20}$$

$$\Rightarrow \frac{h_2}{5} = -3$$

$$\Rightarrow h_2 = -15 \text{ cm}$$

height of image = -15 cm.

24. Given:-  $m = 3$  (virtual)

$$u = -10 \text{ cm}$$

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

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

$$\Rightarrow v = 30 \text{ cm}$$

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

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

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

$$\Rightarrow \frac{-20}{300} = \frac{1}{f}$$

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

Radius of curvature =  $R = 2f$   
 $= 2 \times (-15) = -30 \text{ cm}$

25. Given:  $h_1 = 50 \text{ mm}$ ,  $f = -100 \text{ mm}$ ,  $u = -300 \text{ mm}$

Req

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

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

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

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

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

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

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

$$\frac{-(-150)}{-300} = \frac{h_2}{50}$$

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

$$\Rightarrow h_2 = -25 \text{ mm}$$

∴ The image will be 25 mm high.

26. Given:  $f = -20 \text{ cm}$ ,  $m = \frac{-1}{4}$  (real image)

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

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

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

$$\Rightarrow u = 4v$$

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

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

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

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

$$\Rightarrow -4v = 100$$

$$\Rightarrow v = \frac{-100}{4}$$

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

$$u = 4v$$

$$\Rightarrow u = 4 \times (-25)$$

$$\Rightarrow u = -100 \text{ cm}$$

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

27. Case-1

Given:-  $u = -50 \text{ cm}$ ,  $m = \frac{-1}{2}$ ,

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

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



$$\Rightarrow 50 = -2v$$

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

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

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

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

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

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

### Case-2

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

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

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

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

$$\Rightarrow \frac{5}{40} + \frac{1}{u} = \frac{-3}{50}$$

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

$$\Rightarrow u = \frac{100}{-6} = \frac{300}{-6} = -100 \text{ cm}$$

$$\Rightarrow u = -100 \text{ cm}$$

28. (a)

(a) Given :-  $u = -20 \text{ cm}$ ,  $f = -12 \text{ cm}$

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

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

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

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

The image is formed at a distance of 30 cm in front of the mirror.  
The image is real and inverted.

(b) Given :-  $u = -4 \text{ cm}$ ,  $f = -12 \text{ cm}$

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

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

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

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

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the image is formed at a distance of 6 cm behind the mirror. The image is virtual and erect.

29. Given :-  $h_2 = 1 \text{ cm} = 10 \text{ mm}$  (real image)  
 $h_1 = 2.5 \text{ mm}$ ,  $u = -5 \text{ cm} = -50 \text{ mm}$

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

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

$$\Rightarrow m = -4$$

and we know that

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

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

$$\Rightarrow v = -200 \text{ mm}$$

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

The image is formed 20 cm in front of the mirror.

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

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

$$\Rightarrow \frac{1}{f} = \frac{-25}{100}$$

$$\Rightarrow f = -4 \text{ cm.}$$

30. Given,  $R = -60 \text{ cm}$  (concave),  $f = -30 \text{ cm}$ ,  
 $u = -15 \text{ cm}$

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

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

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

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

$$\Rightarrow v = 30 \text{ cm}$$

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

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

$$\Rightarrow m = 2$$

∴ So, the image is formed  $30 \text{ cm}$

behind the mirror and the magnification  
is  $+2$ .