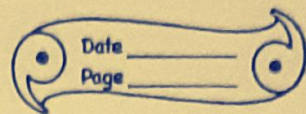
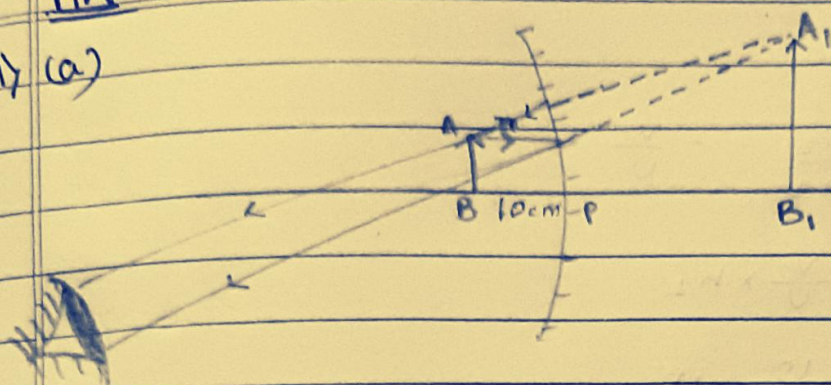


14/9/20



HW

Q11) (a)



$$(b) \quad f = -20 \text{ cm}, \quad u = -10 \text{ cm}$$

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

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

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

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

- 11) (i) Image is virtual
(ii) Image is erect

$$12) \quad h_1 = 10 \text{ cm}$$

$$-u = -36 \text{ cm}$$

$$f = -12 \text{ cm}$$

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

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

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

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

Magnification

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

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

$$h_2 = \frac{-19}{-36} \times 10$$

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

The image formed is real and inverted.

Q13) $f = -10 \text{ cm}$

$$h_1 = 2 \text{ cm}$$

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

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

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

$$3u = -v \Rightarrow v = -3u$$

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

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

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

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

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

Q14) $u = -15 \text{ cm}$, $v = -10 \text{ cm}$

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

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

$$\frac{1}{f} = -\frac{1}{10} - \frac{1}{15} = \frac{-3-2}{30} = \frac{-5}{30} = -\frac{1}{6}$$

The focal length of concave mirror is 6cm.

Q15) $h_1 = 3 \text{ cm}$, $v = -8 \text{ cm}$, $h_2 = 4.5 \text{ cm}$

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

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

$$v = 1.5 \times 8 = 12 \text{ cm}$$

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

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

$$\frac{2+3}{24} = \frac{1}{f}$$

$$-\frac{1}{24} = \frac{1}{f} \quad \therefore f = -24 \text{ cm}$$

$$\begin{aligned} 10) \quad h_2 &= -4 \text{ cm} \\ h_1 &= 1 \text{ cm} \\ u &= -20 \text{ cm} \end{aligned}$$

$$(i) \quad v = ?$$

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

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

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

Image formed
in front of concave mirror

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

$$-\frac{1}{80} + \left(-\frac{1}{20}\right) = \frac{1}{f}$$

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

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

Q17) $h_1 = 18 \text{ cm}$, $u = -27 \text{ cm}$, $f = -18 \text{ cm}$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \quad , \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \left(\frac{1}{-18}\right) - \left(\frac{1}{-27}\right)$$

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

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

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

$$= \left(\frac{-54}{-27}\right) = \frac{h_2}{18}$$

$$h_2 = -14 \text{ cm} \quad \text{Image is real inverted}$$

Q18) $h_1 = 3 \text{ cm}$, $u = 10 \text{ cm}$, $f = 20 \text{ cm}$

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

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

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

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

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

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

Image is 6cm in size
virtual and erect

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

Q19) $h_1 = 2 \text{ cm}$, $u = -9 \text{ cm}$, $f = -4 \text{ cm}$

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

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

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

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

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

$$m = \frac{h_2}{h_1} \Rightarrow 0.8 \text{ cm} = \frac{h_2}{2} \Rightarrow h_2 = 1.6 \text{ cm}$$

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

20) $U = -20 \text{ cm}$

$m = -3$

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

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

$v = -60 \text{ cm}$

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

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

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

$f = -15 \text{ cm}$

(b) $m = 3$, $f = -15 \text{ cm}$

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

$m = 3 = \frac{-v}{3} \Rightarrow v = -30$

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

$u = \frac{2 \times 15}{3} = 10$

$\left(\frac{1}{-30}\right) + \frac{1}{u} = \left(\frac{1}{-15}\right)$

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

$$Q21) R = -3 \text{ cm}$$

$$m = 5 \text{ (virtual image)}$$

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

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

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

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

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

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

$$Q22) R = -10.5 \text{ cm}$$

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

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

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

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

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

$$= \frac{1}{10} - \frac{4}{3} = \frac{3-40}{30}$$

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

Q23) $h_1 = 5 \text{ cm}$

$u = -20 \text{ cm}$

$f = -15 \text{ cm}$

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

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

$$\frac{1}{v} = \frac{-5}{300} \quad v = -60 \text{ cm}$$

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

$$h_2 = \frac{-60}{-20} \times 5$$

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

height of image = 15 cm

Q24)

$m = 3$

$u = -10 \text{ cm}$

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

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

$v = 30 \text{ cm}$

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

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

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

$f = -15 \text{ cm}$

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

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

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

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

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

$$\frac{1}{v} = \frac{-200}{30000}$$

$$\frac{1}{v} = \frac{-2}{300} = \frac{-1}{150} \text{ mm} \quad v = -150 \text{ mm}$$

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

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

$$- \left(\frac{-150}{-300} \right) \times 50 = 25 \text{ mm}$$

Image height = 25 mm

$$26) f = -20 \text{ cm} \Rightarrow m = \frac{1}{-4}$$

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

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

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

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

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

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

$$u = 4v$$

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

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

27) Case 1:

$$u = -50 \text{ cm}$$

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

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

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

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

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

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

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

Case 2:

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

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

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

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

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

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

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

$$u = \frac{600}{-3} = -200 \text{ cm}$$

28) (a) $u = -20 \text{ cm}$

$$f = -12 \text{ cm}$$

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

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

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

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

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

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

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

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

$v = 6 \text{ cm}$

The image is virtual and erect.

29) $h_2 = 1 \text{ cm} = 10 \text{ mm}$, $h_1 = 2.5 \text{ mm}$
 $u = -5 \text{ cm} = -50 \text{ mm}$

$$m = \frac{h_2}{h_1} = \frac{-10}{2.5} = -4$$

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

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

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

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

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

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

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

Q30) Radius of curvature, $R = -60 \text{ cm}$
 $f = -30$, $u = -15 \text{ cm}$

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

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

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

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

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

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

$$m = 2$$

So the image is formed 30 cm behind the mirror and the magnification is +2.