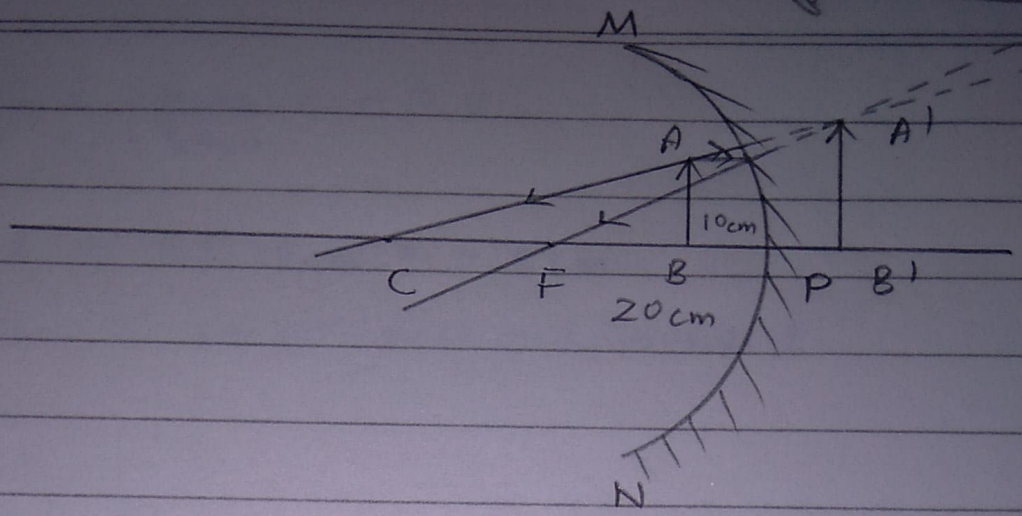
Q11) a)



b) $u = -10\,cm$

$f = -20\,cm$

So $\frac{1}{v} = \frac{1}{F} - \frac{1}{u} = \frac{-1}{20} - \frac{-1}{10} = \frac{-1+2}{20} = 1/20$

So $v = 20\,cm$.

c) The image is virtual and erect.

Q12) $h = 10\,cm$

$u = -36\,cm$

$f = -12\,cm$

So $\frac{1}{v} = \frac{1}{b} - \frac{1}{u} = \frac{-1}{12} - \frac{-1}{36} = \frac{-3+1}{36} = -1/18$

So $v = -18\,cm$

$$m = \frac{-v}{u} = \frac{-18cm}{-36cm} = -0.5$$

So $h' = -0.5 \times 10cm = -5cm$

So nature is small, real and inverted.

Q13) $h = 2cm$

$h' = 6cm$

So $m = \frac{h'}{h} = \frac{6cm}{2cm} = 3$

So let $u = -x\ cm$

So $v = +(3x)$

$f = -10cm$

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

$\Rightarrow +3x = +20 \Rightarrow x = 20/3 = 6.\bar{6}$

So $u = 6.\bar{6}\ cm$

Q14) $u = -15cm$

$v = -10cm$

So $\frac{1}{F} = \frac{1}{v} + \frac{1}{u} = \frac{-1}{15} + \frac{-1}{10} = \frac{-2-3}{30} = -1/6$

$\Rightarrow F = -6cm$

So focal length is $-6cm$.

Q15) $h = 3cm$

$u = -8cm$

$h' = 4.5cm$

So $\frac{h'}{h} = \frac{-v}{u} \Rightarrow \frac{4.5}{3} = \frac{+v}{+8} \Rightarrow 36 = 3v \Rightarrow v = 12$

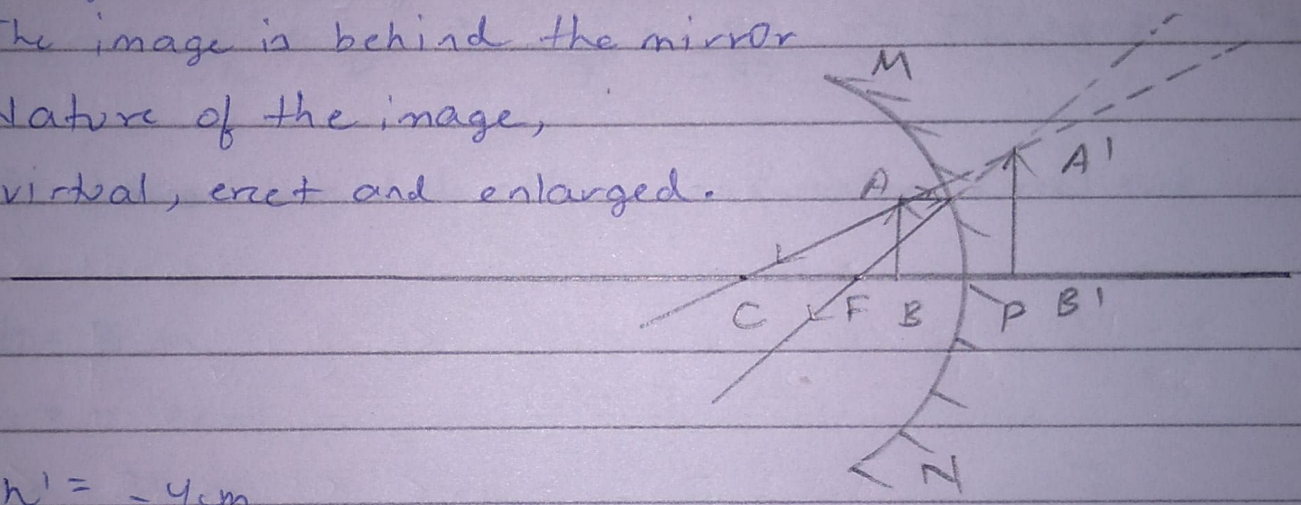
So $v = 12cm$

So $1/focal\ length = \frac{1}{12} + \frac{-1}{8} = \frac{2-3}{24} = -1/24$

i) So focal length $= -24cm$

ii) The image is behind the mirror

iii) Nature of the image,
virtual, erect and enlarged.



Q16) $h' = -4cm$

$h = 1cm$

$u = -20cm$

So $\frac{h'}{h} = \frac{-v}{u} \Rightarrow \frac{-4}{1} = \frac{+v}{+20} \Rightarrow v = -80\ cm$

i) So image distance $= -80cm$

ii) $\frac{1}{F} = \frac{-1}{20} + \frac{-1}{80} = \frac{-4-1}{80} = -5/80 = -1/16$

So $F = -16cm$.

So focal length $= -16cm$.

Q17) $h = 7cm$

$u = -27cm$

$f = -18cm$

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

So $v = -54$ cm

1) So at 54cm infront of the mirror a screen should be placed for an sharp image formation.

So $m = \frac{h'}{h} = \frac{-v}{u} \Rightarrow \frac{h'}{7} = \frac{54}{-27} \Rightarrow 27h' = 378 \Rightarrow h' = -14$

So image height is $-14cm$. and nature is real and inverted

Q18) $h = 3cm$

$u = -10cm$

$f = -20cm$

So $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{-1}{20} - \frac{-1}{10} = \frac{-1+2}{20} = 1/20$

So $v = 20cm$

So $\frac{h'}{h} = \frac{-v}{u} \Rightarrow \frac{h'}{3} = \frac{+20}{+10} \Rightarrow 10h' = 60 \Rightarrow h' = 6cm$

So height = 6cm, nature is erect, virtual and large.

Q19) $f = -4cm$

$h = 2cm$

$u = -9cm$

So $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{-1}{4} - \frac{-1}{9} = \frac{-9+4}{36} = -5/36$

$\Rightarrow v = -36/5\ cm$

So $\frac{h'}{h} = \frac{-v}{u} \Rightarrow \frac{h'}{2} = \frac{36}{5} \times \frac{-1}{9} \Rightarrow -72 = 45h'$

$\Rightarrow h' = 1.6\ cm$

So nature is real inverted and diminished.

Q20) $u = -20\ cm$

So $m = -3$

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

So $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{-1}{20} + \frac{-1}{60} = \frac{-3-1}{60} = -1/15$

$\Rightarrow f = -15cm.$

ii) Now $m = 3$

Let $u = u$

So $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = u+f/uf \Rightarrow v = \frac{uf}{u+f} = \frac{-15u}{u-15}$

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

$\Rightarrow 3 = -\left(\frac{-15u}{u-15}\right) \div u = \frac{15u}{u-15} \times \frac{1}{u} = \frac{15u}{u^2-15u}$

$\Rightarrow 3(u^2-15u) = 15u \Rightarrow 3u^2 - 45u - 15u = 0$

$\Rightarrow 3u^2 - 60u = 0 \Rightarrow u^2 - 20u = 0 \Rightarrow u^2 - 20u + 0 = 0$

So $a = 1, b = -20, c = 0$

So $b^2 - 4ac = 400 - 4 \times 1 \times 0 = 400$

So $u = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{20 \pm \sqrt{400}}{2}$

$\Rightarrow u = \frac{20 + 20}{2}$ or $\frac{20 - 20}{2}$ $\Rightarrow u = 20$ or $u = 0$

So the object should be placed 20 cm beyond pole to have a magnification of 3.

Q21) $R = -3\,cm$

$f = -1.5\,cm$

$m = 5$

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

So $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{-1}{5u} + \frac{1}{u} = \frac{-1}{1.5} \Rightarrow 4/5u = -1/1.5$

$\Rightarrow u = 1.2\,cm$

So the minimum distance is 1.2 cm.

Q22) $R = -1.5\,m$ So $F = -0.75\,m$

$u = -10\,m$

So $\frac{1}{v} = \frac{1}{F} - \frac{1}{u} = \frac{-1}{0.75} - \frac{-1}{10} = \frac{-40 + 3}{30} = -37/30$

So $v = -30/37 = 0.81$

So image distance is 0.81 m.

Q23) $h = 5\,cm$

$u = -20\,cm$

$f = -15\,cm$

So $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{-1}{15} - \frac{-1}{20} = \frac{-4+3}{60} = -1/60 \Rightarrow v = -60$

So image distance $= -60\,cm$

So $\frac{h'}{h} = \frac{-v}{u} = \frac{h'}{5} = \frac{+60}{-20} \Rightarrow -20h' = 300 \Rightarrow h' = -15$

So height $= 15\,cm$.

Q24) $u = -10\,cm$

$m = 3$

So $m = \frac{-v}{u} \Rightarrow 3 = \frac{+v}{+10} \Rightarrow v = 30\,cm$

So $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{30} - \frac{1}{10} = \frac{1-3}{30} = -2/30 = -1/15$

$\Rightarrow f = -15\,cm$

So $R = 2x - 15\,cm = -30\,cm$.

Q25) $h = -50\,mm$

$f = -100\,mm$

$u = -300\,mm$

So $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{-1}{100} - \frac{-1}{300} = \frac{-3+1}{300} = -1/150$

So $v = -150\,mm$

So $\frac{h'}{h} = \frac{-v}{u} = \frac{h'}{50} = \frac{150\,mm}{-300\,mm} \Rightarrow -300h' = 7500 \Rightarrow h' = -25$

So $h' = -25\,mm$.

Q26) $F = -20cm$

$m = 0.25 = \frac{-v}{u} \Rightarrow v = -0.25u$

So $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{-1}{20} = \frac{-1}{0.25u} + \frac{1}{u} = \frac{-1 + 0.25}{0.25u}$

$\Rightarrow \frac{-1}{20} = \frac{-0.75}{0.25u} = \frac{-3}{u} \Rightarrow -u = 60 \Rightarrow u = -60cm$

So u is $-60cm$.

Q27) $f = ?$

$u = -50cm$

So $m = \frac{-v}{u} = -0.5 = \frac{+v}{+50} \Rightarrow v = -25cm$

So $\frac{1}{f} = \frac{-1}{25} + \frac{-1}{50} = \frac{-2-1}{50} = -3/50$ so $f = -50/3$

now $m = -1/5$

so $m = \frac{-v}{u} = +0.2 = \frac{+v}{u} \Rightarrow v = 0.2u$

$so \frac{-3}{50} = \frac{1}{0.2u} + \frac{1}{u} = \frac{1+0.2}{0.2u} = \frac{1.2}{0.2u} = \frac{6}{u}$

$\Rightarrow -3u = 300 \Rightarrow u = -100cm$

So u is $-100cm$.

Q28) $u = -20cm$

$f = -12cm$

a) So $\frac{1}{v} = \frac{-1}{12} - \frac{-1}{20} = \frac{-5+3}{60} = -1/30$ so $v = -30cm$.

b) $u = -4cm$

$f = -12cm$

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

$h' = -1cm = -100mm$

Q29) $h = 2.5mm$

$u = -500mm$

so $\frac{h'}{h} = \frac{-v}{u} = \frac{-100}{2.5} = \frac{+v}{+500} \Rightarrow 2.5v = -50000 \Rightarrow v = -20000$

so $v = -200cm$

so $u = 5cm$

so $\frac{1}{f} = \frac{1}{5} - \frac{1}{200} = \frac{40-1}{200} = 39/200 \Rightarrow f = 200/39$

so $f = 200/39\ cm.$

Q30) $R = -60cm$

so $F = -30cm$

$u = -15cm$

so $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{-1}{30} - \frac{-1}{15} = \frac{-1+2}{30} = 1/30$

$\Rightarrow v = 30cm$

so the image is formed behind the mirror.

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