H.W

Q1) If the magnification of a body of size 1m is 2, what is the size of the image?

A Size of image = 2m

Q2) What is the position of the image when an object is placed at a distance of 20cm from a concave mirror of focal length 20cm?

A $u = -20cm \quad f = -20cm$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-20} + \frac{1}{20} = \frac{0}{20}$$

So v = at infinity

Q3) What is the nature of image formed by a concave mirror if the magnification produced by mirror is

(a) +4 – virtual & erect

b) −2 – Real & inverted

Q4) State the relationship between object & image distance & focal ~~&~~ length of a spherical mirror

A $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ where u = Object distance
v = image distance
f = focal length

Q5) Write the mirror formula. Give the meaning of each symbol which occurs in it.

A A formula which gives the relation between image distance (v), object distance (u) & focal length (f)

i.e., $$\boxed{\frac{1}{f} = \frac{1}{v} + \frac{1}{u}}$$

Q6) What is the ratio of heigh of image to the height an object known as?

A Lineare magnification

Q7) Define Lineare magnification produced by a mirror.

A It is the ratio of height of image to the height of an object.

Q8) Wrote down formula for magnification produced by a concave mirror.

a) in terms of height of object & image $\boxed{m = \frac{h_2}{h_1}}$

b) in terms of distance of object & image $\boxed{m = \frac{-v}{u}}$

Q9) Describe the nature of image formed when the object is placed at a distance of 20cm from a concave mirror of focal length 10 cm.

A $u = -20$ cm $\quad f = -10$ cm

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

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

so the nature of image = Real & inverted.

Q10 a) If the magnification has a (+) sign, then image is Virtual & erect

b) If the magnification has a (−) sign, then the image is real & inverted

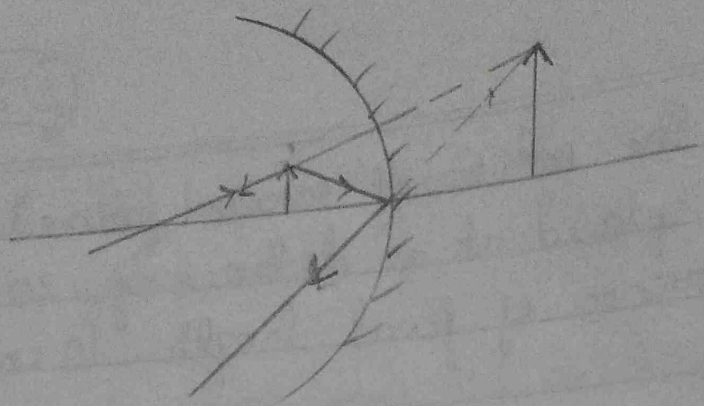
Q11) An object is placed at a distance of 10 cm from a concave mirror of focal length 20 cm.

a) Draw a ray diagram for the formation of image.

b) Calculate the image distance.

c) state two characteristics of image formed.

a)



b) $u = -10\ cm \qquad f = -20\ cm$

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

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

c) Virtual & erect

Q12) If an object of 10 cm height is placed at a distance of 36 cm from a concave mirror of focal length 12 cm, find the position, nature & height of image.

A $h_1 = 10\ cm \qquad u = -36\ cm \qquad f = -12\ cm$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-12} + \frac{1}{36} = \frac{-2}{36_{18}} = \frac{-1}{18}$$

$$\boxed{v = -18\ cm}$$ Real & inverted image is formed.

Now $\frac{h_2}{h_1} = \frac{-v}{u} \Rightarrow \frac{h_2}{10} = \frac{18}{36_2} \Rightarrow \frac{h_2}{10} = \frac{1}{2}$

$$\boxed{h_2 = 5\ cm}$$

Q13) At what distance from a concave mirror of focal length 10 cm should an object 2 cm long be placed in order to get an erect image 6 cm tall.

A $f = -10\ cm \qquad h_1 = 2\ cm \qquad h_2 = 6\ cm$

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

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

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

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

$$\Rightarrow 3u = -20$$

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

So $\boxed{u = -6.66\ cm}$

Q14) When an object is placed at a distance of 15 cm from a concave mirror, its image is formed at 10 cm in front of the mirror. Calculate the focal length of the mirror.

A $u = -15\,cm$ $\quad v = -10\,cm$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-10} + \frac{1}{-15} = \frac{-5}{30} = \frac{-1}{6}$$

$$\boxed{f = -6\,cm}$$

Q15) An object 3 cm high is placed at a distance of 8 cm from a concave mirror which produces a virtual image of 4.5 cm high

a) What is the focal length of the mirror?
b) What is the position of the image?
c) Draw the ray diagram to show the formation of image

$h_1 = 3cm \quad u = -8cm \quad h_2 = 4.5cm$

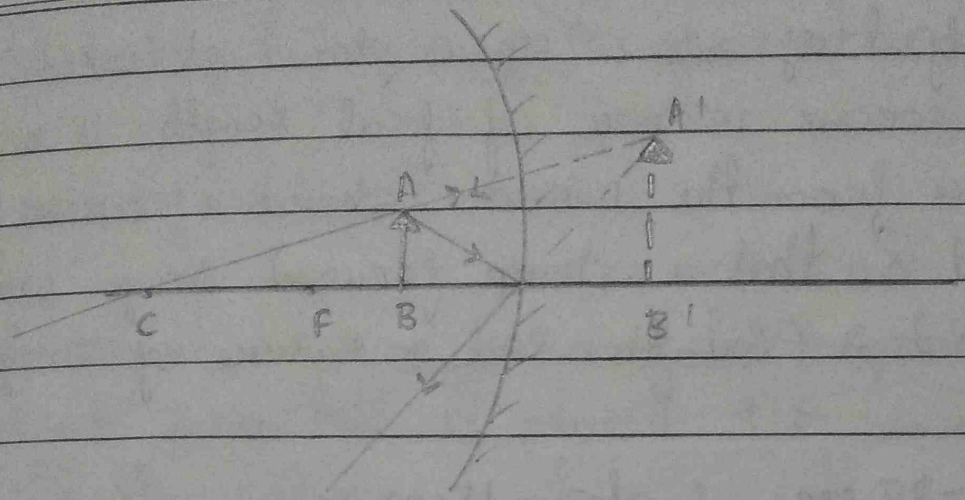
(ii) $\frac{h_2}{h_1} = \frac{-v}{u} \Rightarrow \frac{4.5}{3} = \frac{v}{8} \rightarrow 3v = 36$

$\boxed{v = 12cm}$ behind the concave mirror

(i) Now $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{12} + \frac{1}{-8} = \frac{-1}{24}$

$$\boxed{f = -24\,cm}$$

(iii)



Q16) A converging mirror forms a real image of height 4cm of an object of height 1cm placed 20cm away from the mirror.

a) Calculate the image distance

b) What is the focal length of the mirror?

$h_2 = -4\text{cm} \quad h_1 = 1\text{cm} \quad u = -20\text{cm}$

a) $\frac{h_2}{h_1} = \frac{-v}{u} \Rightarrow -4 = \frac{v}{20}$

$\boxed{v = -80\text{ cm}}$ infront of the concave mirror

b) $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-80} + \frac{1}{20} = \frac{-8}{80_{16}} = \frac{-1}{16}$

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

Q17) An object of size 7cm is placed at 27cm infront of a concave mirror of focal length 18cm. At what distance from the mirror should a screen be placed so that a sharp focussed image can be obtained? Find the size & nature of image.

A $u = -27$ cm $\quad f = -18$ cm

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-18} + \frac{1}{27} = \frac{-1}{54}$$

$\boxed{v = -54 \text{ cm}}$ Real & inverted image is formed

Size of image = 14 cm.

Q18) An object 3cm high is placed at a distance of 10cm infront of a converging mirror of focal length 20cm. Find the position, nature & size of the image formed.

A- $h_1 = 3$cm $\quad u = -10$ cm $\quad f = -20$ cm

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

$\boxed{v = 20 \text{ cm}}$ behind the converging mirror

Virtual & erect image is formed.

size of image = 6cm

Q19) A concave mirror has a focal length of 4cm & an object 2cm tall is placed 9cm away from it. Find the nature, position & size of image formed.

A $f = -4cm$ $\quad h_1 = 2cm$ $\quad u = -9cm$

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

$\boxed{v = -7.2\ cm}$ infront of the mirror

Nature ⇒ ~~Virtu~~ Real & inverted image

$$\frac{h_2}{h_1} = \frac{-v}{u} \Rightarrow \frac{h_2}{2} = \frac{7.2}{9} \Rightarrow 9h_2 = 14.4$$

$\boxed{h_2 = 1.6}$ size of image

Q20) When an object is placed 20cm from a concave mirror a real image magnified three times is formed. Find :-

a) focal length of the mirror

b) Where must the object be placed to get a virtual image three times the height of the object.

$u = -20\,cm \qquad m = -3$

$m = \frac{-v}{u} \Rightarrow -3 = \frac{v}{20} \Rightarrow \boxed{v = -60}$

a) Now $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-60} + \frac{1}{-20} = \frac{-4}{60} = \frac{-1}{15}$

$\boxed{f = -15\,cm}$

b) $m = 3$

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

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

$\Rightarrow \frac{2}{3u} = \frac{1}{-15}$

$\Rightarrow \boxed{u = -10\,cm}$

Q21) A dentist's mirror has a radius of curvature of 3 cm. How far must it be placed from a small dental cavity to give a virtual image of the cavity that is magnified 5 times.

A $c = -3\,cm$

$f = -1.5\,cm$

$m = 5$

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

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-5u} + \frac{1}{u} = \frac{4}{5u}$$

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

$$\Rightarrow 5u = -6$$

$$\Rightarrow \boxed{u = -1.2\ cm}$$

(Q22) A large concave mirrore has a radius of curvature of 1.5 m. A person stands 10 m in front of the mirrore. where is the person's image?

A $C = -1.5\ cm \qquad f = -0.75\ cm \qquad u = -10\ m$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-0.75} + \frac{1}{10} = \frac{-4}{3} + \frac{1}{10}$$

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

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

So $\boxed{v = -0.81\ m}$

Q 23) An object of 5 cm size is placed at a distance of 20 cm from a converging mirror of focal length 15 cm. At what distance from the mirror should a screen be placed to get the sharp image? Also calculate the size of image.

$u = -20\,cm \qquad f = -15\,cm$

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

$$\boxed{v = -60\,cm}$$

Size of the image = 15 cm

Q 24) A concave mirror produces three times enlarged image (virtual) of an object placed at 10 cm in front of it. Calculate the radius of curvature of mirror.

A $u = -10\,cm \qquad m = +3$

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

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{30} + \frac{1}{-10} = \frac{-1}{15}$$

$$\boxed{f = -15\,cm} \quad \& \quad \boxed{C = -30\,cm}$$

(Q25) A bright object 50mm high stands on the axis of a concave mirror of focal length 100mm. & at a distance of 300mm from the concave mirror. How big will the image be?

A $f = -100mm \quad u = -300mm \quad h_1 = 50mm$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-100} + \frac{1}{300} = \frac{-3+1}{300} = \frac{-2}{300} = \frac{-1}{150}$$

$$\boxed{V = -150\ mm}$$

$$\frac{h_2}{h_1} = \frac{-v}{u} \Rightarrow \frac{h_2}{50} = \frac{150}{300} \Rightarrow 300h_2 = 7500$$

$$\Rightarrow h_2 = \frac{7500}{300} = 25mm$$

$$\boxed{h_2 = 25mm}$$

(Q26) How far should an object be placed from the pole of a converging mirror of focal length 20cm to form a real image of size exactly $\frac{1}{4}$ th the size of object

$f = -20cm$

$m = \frac{-1}{4}$ (real image)

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

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

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

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

$$\boxed{u = 4v = -100 \text{ cm}}$$

(Q 27) When an object is placed at a distance of 50 cm from a concave mirror, the magnification produced is $-\frac{1}{2}$. Where should the object be placed to get a magnification of $\frac{-1}{5}$?

A $u = -50 \text{ cm} \qquad m = \frac{-1}{2}$

$$m = \frac{-v}{u} \Rightarrow \frac{-1}{2} = \frac{v}{50} \Rightarrow \boxed{v = -25 \text{ cm}}$$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-25} + \frac{1}{-50} = \frac{-3}{50}$$

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

For Case II

$$f = \frac{-50}{3} \qquad m = \frac{-1}{5}$$

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

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

$$\Rightarrow \frac{-3}{50} = \frac{6}{5v} \Rightarrow \boxed{v = -20\ cm}$$

$$\boxed{u = 5v = -100\ cm}$$

Q 28) An object is placed (a) 20 cm (b) 4 cm, infront of a concave mirror of focal length 12 cm. Find the nature & position of the image formed in each case

A- a) $u = -20\ cm \quad f = -12\ cm$

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

$\boxed{v = -30\ cm}$ infront of the mirror

Nature ⇒ Real & inverted

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

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-12} + \frac{1}{4} = \frac{2}{12}$$

$\boxed{v = 6\ cm}$

behind the mirror.

Nature ⇒ Virtual & erect

Q29) A concave mirror produces a real image 1 cm tall of an object 2.5 mm tall placed 5 cm from the mirror. Find the position of the image & the focal length of the mirror.

A- $u = -5\,cm \quad h_1 = 2.5\,mm \quad h_2 = -1\,cm$

$$m = \frac{-v}{u} = \frac{h_2}{h_1} \Rightarrow \frac{+v}{5} = \frac{-1}{2.5 \times 10^{-1}}$$

$$\Rightarrow \frac{-10}{5/2} = \frac{v}{5} \Rightarrow \frac{5v}{2} = -50$$

$$\Rightarrow \boxed{v = -20\,cm}$$ infront of the mirror

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-20} + \frac{1}{-5} = \frac{-5}{20_4} = -\frac{1}{4}$$

$$\boxed{f = -4\,cm}$$

Q30) A man holds a spherical shaving mirror of $C = 60$ & $f = 30\,cm$, at a distance of 15 cm from his nose. Find the position of image & calculate the magnification of the image formed.

A $u = -15\,cm$

$f = -30\,cm$

$C = -60\,cm$

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

$\boxed{v = 30 \text{ cm}}$ behind the mirror

virtual & erect image formed

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

$\boxed{m = 2}$