Homework (11.30)

(11) Given, Focal length of Concave mirror
$f = -20$ cm

distance of object from the mirror,
$u = -10$

we formula, $1/v + 1/u = 1/f$

or $1/v = 1/f - 1/u$

or $1/v = 1/-20 - 1/-10$

or $1/v = -1/20 + 1/10 = 1/20$

or, $v = \pm 20$ cm

(12) $h_0 = 10$ cm
$u = 36$ cm $= -36$ cm
$f = 12$ cm $= -12$ cm
$h_i = 6$ cm

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

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

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

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

$$= \frac{3+1}{36} = \frac{4}{36} = \frac{1}{9}$$

$$v = 9\text{ cm}$$

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

$$= \frac{-(9)}{-36} = \frac{10}{h_1}$$

$$= \frac{1}{4} = \frac{10}{h_1}$$

$$h_1 = 10 \times 4 = 40$$

$$h_1 = 40$$

P2 -18 cm towards the left

N = -Real and inverted

height = 5 cm

(15) Height of the object (h) = 3cm
Distance of object from concave mirror (u) = -8 cm

Height of the virtual image formed (h') = 4.5.

let's find 'v' first =

$-v/u = h'/h$

$v = -u \times h'/h$

$v = 12$ cm

(i) Focal length of minnor = ?

$1/F = 1/v + 1/u$

$1/F = 1/12 + 1/-8$

$1/F = -1/24$

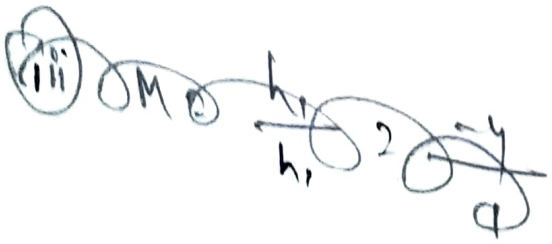
$1 \times 24 = -F$

$24 = -F$

$F = -24$ cm

(ii) Position of image (v) = 12 cm

(iii)



(16) $h_2 = -4\,cm$

$h_1 = 1\,cm$

$u = -20\,cm$

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

$v = -80\,cm$

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

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

$f = \frac{-5}{80}$

~~Focal~~ Focal length $= \frac{-80}{5}$

$= 16\,cm$

(2) $u = -27\,cm$, $f = -18\,cm$, $h = 7\,cm$

From mirror formula

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

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

$\therefore v = -54\,cm$. The screen must be placed at a distance of 54 cm from the mirror in front of it.

$$m = \frac{-v}{u} = \frac{-(-54)}{(-27)} = -2.$$

The image is real, inverted and enlarged. Size of the image $= m.h = (-2) \times 7\,cm = -14\,cm$. Thus, the image is of 14 cm length and is an inverted image i.e formed below principle axis.

(18) Given,

Height of the object = 3cm

Object distance = 10cm

Focal length = 20cm

Now,

According to minnor formula,

$1/f = 1/u + 1/v$

$1/v = -1/20 - (-1/10)$

$= -1/20 + 1/10$

$= (-1+2)/20$

$= 1/20$

$v = 20cm$

Now,

$-v/u = h(1)/h(0)$

$-20/-10 = h(1)/3$

$h(1) = 2 \times 3$

$h(1) = 6\ cm$

(19) Focal length $2f = -4\ cm$

height of Object $= +2\ cm$

Object distance $= u = -9\ cm$

Image distance : v

height of Image $=$ Ans $= h'$

Mirror Formula

$1/v + 1/u = 1/f$

$1/v = 1/f - 1/u$

$= -1/4 - (-1/9)$

$= -9 + 4/36$

$= -5/36$

76/9

- 2.1 cm

Hence,
the image is formed at a distance of 2.1 cm from the mirror.

Magnification = m

M = -v/u

2 -(-2.1)/-9

= -0.8

As the magnification is negative.
the image is real & inverted.

Also,

m = h'/h

-0.8 = h'/2 1.6 cm

h = 1.6 cm size of the image is

(20) magnification, $m = -3$

Object distance, $u = -20\,cm$

Using magnification formula

$m = -v/u$

$-3 = -v/-20$

$v = -60\,cm$

distance of the image from the mirror is 60

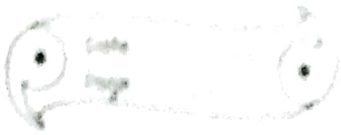
using mirror formula

$1/f = 1/v + 1/u$

$1/f = 1/-60 + 1/-20$

$f = -15\,cm$

the focal length of the mirror is -15.



to find the distance of the object from the mirror

using magnification formula

m = h (height of image) / h (height of object)

m = -v/u

As per the question "three times the height of the object"

v = -3u

using mirror formula

1/-3u + 1/u = 1/-15

u = -10cm

(2) R = -3cm (concave mirror)

m = 5 (virtual image)

f = R/2 = -(3/2) = 1.5cm

and

m = 5 = -(v/u) ⇒ v = -5u

we have

1/v + 1/u = 1/f

⇒ 1/(-5u) + 1/u = 1/(-1.5)

⇒ 4/5u = -(1/1.5)

⇒ u = -(4 × 1.5)/5 = 1.2cm

The mirror should be placed 1.2cm away from dental cavity.

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

Focal length of a convex mirror is taken as negative.

Focal length = (Radius of curvature)/(2

= 1.512 = 0.75

So,

F = -0.75

u = -10 (Person distance)

v =

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

By solving we get

$$\frac{1}{v} = \frac{-37}{30}$$

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

Hence

$$v = 0.81 \text{ m}$$

(Q3) Given $F = -15$ cm, $u = 20$ cm

a) Minnon equations, $\frac{1}{v} + \frac{1}{u} = \frac{1}{F}$

Re-writing to find v, $\frac{1}{v} = \frac{1}{F} - \frac{1}{u}$

Substituting for F and u,

$$\frac{1}{V} = \frac{1}{-15} - \frac{1}{-10}$$

$$\frac{1}{v} = \frac{(.20)-(.15)}{300} \times \frac{-5}{500} = \frac{-1}{60}$$

$$v = -60.0 \text{ cm}$$

As the image is formed at 60 cm to the left of the concave mirror, the screen is to be placed at distance 60.0 cm to the left of concave mirror.

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

$$m = \frac{h'}{h} = \left(\frac{-60}{-20}\right) = -3$$

As the sign of magnification is negative, the image is inverted. As the magnitude of magnification is 3, the image is enlarged three times, & the image is formed to the left of the concave mirror, the image is real.

(24) Magnification of mirror is given by $m = -v/u$

where v = Position of image, u = Position of object

$m = -3$, $u = -10$ cm

$m = -v/-10$

$-3 * (-10) = -v$

$v = -30$

we know, $R = 2uv/(u+v)$

$R = 2(-10)(-30)/(-40)$

$R = -15$

Radius of Curvature $= -15$ cm

(25) Firstly find the v

$1/f = 1/v + 1/u$

$1/v = 1/f - 1/u$

$1/v = 1/100 - 1/300$

$1/v = 3-1/300$

$1/v = 2/300$

$v = 150$ 150 mm

hence the is in front of mirror and in 150 mm

$00''/11'' = -v/u$

$50/11'' = 150/30$

$50/11'' = 1/2$

$11'' = 100$ m

(26) To obtain an image of the same size as the object the object must be placed on the centre of curvature of the concave mirror.

The rays after reflecting will meet at the point to form a 'real' and inverted image of the same size.

(27) Given when an object is placed at a distance of 50 cm from a concave spherical mirror the magnification produced is minus one by two

so we have $m = -v/u = -1/2$

$$-v = m \times u$$

Given $u = 50$ cm $\quad m = -1/2$

$$-v = -1/2 \times 50$$

$$v = 50/2 \text{ or } v = 25 \text{ cm}$$

$1/F = 1/u + 1/v$

$1/F = 1/50 + 1/25$

$F = 50/3 = 16.6\ cm$

Now coming to magnification we have $m = -v/u = -1/5$

$v/u = 1/5$

$v = u/5$ or $1/v = 5/u$

$1/F = 1/u + 1/v$

$3/50 = 1/u + 5/u$

$3/50 = 6/u$

$3u = 300$

$u = 300/3$

$u = 100\ cm$

(28) a) u = -20 cm , f = -12 cm

$1/v + 1/u = 1/f$

$1/v + 1/-20 = 1/-12$

$1/v = -1/12 + 1/20 = (-20+12)/240$

$= -8/240$

$v = -30\,cm$

The image is formed at a distance of 30 cm infront of the mirror.

The image is real and inverted

b) u = -4 cm, f = -12 cm

$1/v + 1/u = 1/f$

$1/v + 1/-4 = 1/-12$

$1/v = -1/12 + 1/4 = (-1+3)/12 = 2/12$

$v = 6\ cm$

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

The image is virtual and erect.

(29) $h_2 = 10\ mm$

$h_1 = 2.5\ mm$

$u = -50\ mm$

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

$$\frac{-v}{-50} = \frac{-10}{2.5}$$

$-v = 200\ mm$

$v = -200\ mm$

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

$$\frac{1}{200} + \frac{1}{-50} = \frac{1+4}{x-200} = \frac{5}{\frac{200}{40}} = \frac{1}{-40}$$

$$f = -40\ mm$$

Object will be placed in between focus and centre.

(30) Radius of curvature, $R = -60\ cm$

$f = -30\ cm$, $u = -15\ cm$

$$1/v + 1/-15 = 1/-30$$

$$1/v = 1/15 + 1/-30$$

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

$$v = 30\ cm$$

$$m = -(v/u)$$

$$m = -(30/-15)$$

Date
Page

$m = 2$

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