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Q1.

$$u = -5\text{cm}, f = 10\text{cm}$$

We know that

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

$$\Rightarrow \frac{1}{v} + \frac{1}{-5} = \frac{1}{10}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{10} + \frac{1}{5} = \frac{3}{10}$$

$$\therefore v = \frac{10}{3}\text{cm} = 3.33\text{cm}$$

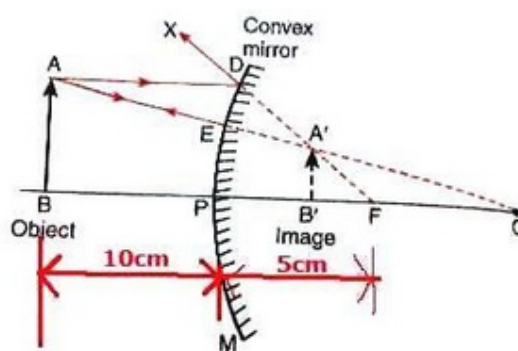
The position of the image is 3.33 cm behind the convex mirror.

Magnification, $m = -v/u = -3.33/-5 = 0.66$

The image is virtual and erect.

Q2.

(i)



(ii) The image formed is diminished and erect.

(iii) $u = -10\text{cm}, f = 5\text{cm}$

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

$$\Rightarrow \frac{1}{v} + \frac{1}{-10} = \frac{1}{5}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{10} + \frac{1}{5} = \frac{3}{10}$$

$$\therefore v = \frac{10}{3}\text{cm} = 3.33\text{cm}$$

Q3.

$$u = -6\text{cm}, f = 12\text{cm}, v = ?$$

We know that

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

$$\Rightarrow \frac{1}{v} + \frac{1}{-6} = \frac{1}{12}$$

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

$$\therefore v = 4\text{cm}$$

Image will be formed 4 cm behind the mirror.

Since the image is formed behind the convex mirror, it is virtual and erect.

Q4.

$$(a) u = -20\text{cm}, v = -15\text{cm}$$

We know that

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

$$\Rightarrow \frac{1}{-15} + \frac{1}{-20} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = -\frac{1}{15} - \frac{1}{20} = \frac{-4-3}{60} = -\frac{7}{60}$$

$$\therefore f = -\frac{60}{7}\text{cm}$$

The mirror is a concave mirror.

$$(b) u = -20\text{cm}, v = 15\text{cm}$$

We know that

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

$$\Rightarrow \frac{1}{15} + \frac{1}{-20} = \frac{1}{f}$$

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

$$\therefore f = 60\text{cm}$$

The mirror is a convex mirror.

Q5.

$$h_1=2.5\text{cm}, u=-25\text{cm}, f=20\text{cm}$$

We know that

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

$$\Rightarrow \frac{1}{v} + \frac{1}{-25} = \frac{1}{20}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{25} + \frac{1}{20} = \frac{4+5}{100} = \frac{9}{100}$$

$$\therefore v = \frac{100}{9} \text{ cm} = 11.1 \text{ cm}$$

The image is formed 11.1 cm behind the convex mirror.

Now,

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

$$\Rightarrow -\frac{11.1}{(-25)} = \frac{h_2}{2.5}$$

$$\Rightarrow h_2 = \frac{11.1 \times 2.5}{25} = 1.11 \text{ cm}$$

The image is virtual, erect and 1.11 cm tall.

Q6.

$$R=3\text{m}, u=-5\text{m},$$

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

We know that

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

$$\Rightarrow \frac{1}{v} + \frac{1}{-5} = \frac{1}{1.5}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{5} + \frac{2}{3} = \frac{3+10}{15} = \frac{13}{15}$$

$$\therefore v = \frac{15}{13} \text{ m} = 1.15\text{m}$$

The image is formed 1.15 m behind the mirror.

The image is virtual and erect.

Q7.

$$R=40\text{cm}$$

$$f=R/2=40/2=20\text{cm}$$

Image is half the height of the object.

$$\text{i.e. } m = -\frac{v}{u} = \frac{h_2}{h_1} = \frac{1}{2}$$

$$\Rightarrow u = -2v$$

$$\text{Now, } \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

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

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

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

$$\therefore v = 10\text{cm}$$

$$u = -2v = -2 \times 10 = -20\text{cm}$$

So, the object is placed 20 cm in front of the mirror and the image is formed 10 cm behind the mirror.

Q8.

$$R=2\text{m},$$

$$f = \frac{R}{2} = 1 \text{ m}$$

$$u=-3.5\text{m}$$

We know that

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

$$\Rightarrow \frac{1}{v} + \frac{1}{(-3.5)} = \frac{1}{1}$$

$$\Rightarrow \frac{1}{v} = 1 + \frac{1}{3.5} = 1 + \frac{10}{35} = 1 + \frac{2}{7} = \frac{9}{7}$$

$$\therefore v = \frac{7}{9} = 0.77 \text{ m}$$

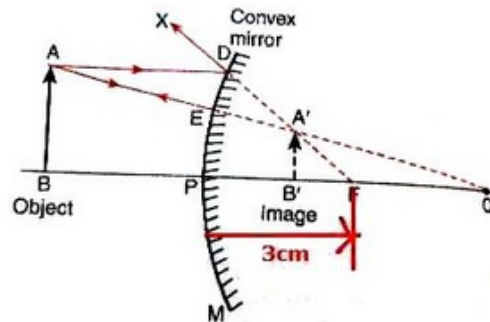
So, the image is formed 0.77m behind the mirror.

$$(b) \text{ Now, } m = -\frac{v}{u} = -\frac{0.77}{(-3.5)} = \frac{7/9}{3.5} = \frac{1}{4.5}$$

As m is positive, so image formed is virtual and erect

Q9.

(a)



(b) $h_1=1\text{cm}, u=-30\text{cm}, f=20\text{cm}, h_2=?, v=?$

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

$$\frac{1}{v} + \frac{1}{-30} = \frac{1}{20}$$

$$\frac{1}{v} = \frac{1}{30} + \frac{1}{20}$$

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

The image is formed 12 cm behind the mirror.

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

$$m = -\frac{12}{-30} = \frac{h_2}{1}$$

$$h_2 = 0.4\text{cm}$$

Q10.

(a) The mirror is of convex type.

(b) $u = -5\text{cm}$, $m = 1/10$

We have

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

$$\Rightarrow \frac{1}{10} = -\frac{v}{(-5)}$$

$$\Rightarrow v = \frac{5}{10} = \frac{1}{2}\text{m}$$

Therefore,

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

$$\Rightarrow \frac{1}{\frac{1}{2}} + \frac{1}{(-5)} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = 2 - \frac{1}{5} = \frac{9}{5}$$

$$\therefore f = \frac{5}{9}\text{ m}$$

$$\text{So, radius of curvature} = 2f = \frac{10}{9}\text{ m}$$

(a)

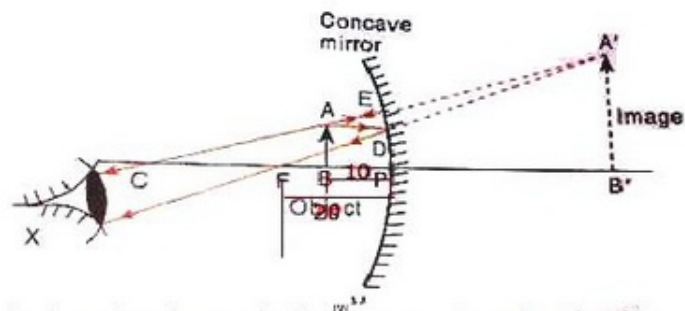


fig. formation of image by the concave mirror when the object is placed between its pole and focus.

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

We know that

$$\begin{aligned} \frac{1}{v} + \frac{1}{u} &= \frac{1}{f} \\ \Rightarrow \frac{1}{v} + \frac{1}{(-10)} &= \frac{1}{(-20)} \\ \Rightarrow \frac{1}{v} &= -\frac{1}{20} + \frac{1}{10} = \frac{1}{20} \\ \therefore v &= 20\text{ cm} \end{aligned}$$

(c) Characteristics of image formed

(i) Image is virtual.

(ii) Image is erect.

Q12.

$u = -20\text{cm}$

$v = 15\text{cm}$ (virtual image)

We know that

$$m = -\frac{v}{u} = -\frac{15}{(-20)} = 0.75$$

The mirror used is of convex type.

***** END *****