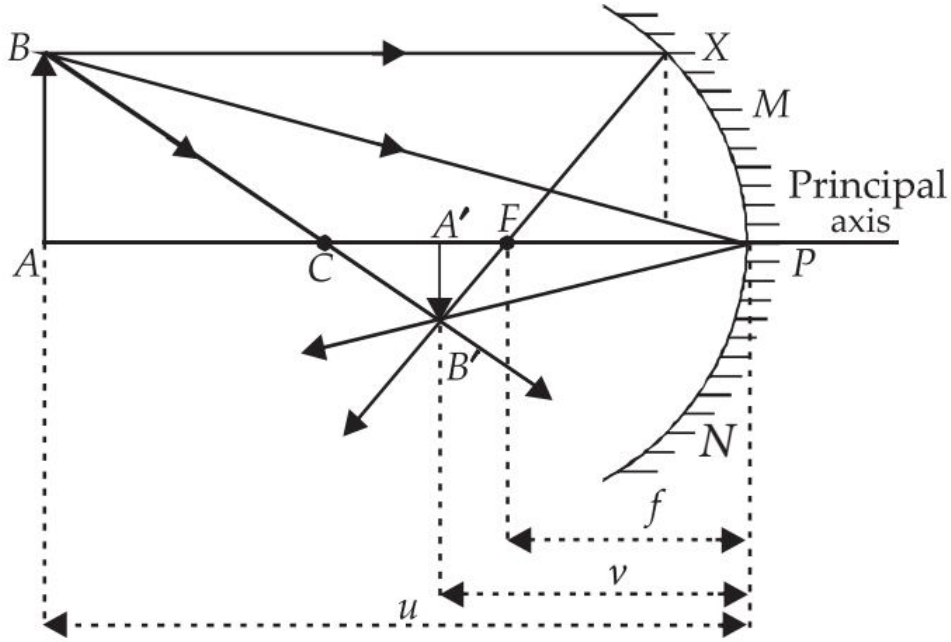
CASE STUDY QUESTION 45

Read the following and answer any four questions from (i) to (v)

Mirror formula is a relation between object distance (u), image distance (v) and focal length (f) of a spherical mirror.
It can be written as 1/u + 1/v = 1/f = 2/R where R is the radius of curvature of the mirror.
This formula is valid in all situations for all spherical mirrors for all positions of the object. Consider the case, in which a mirror forms a real image of height 4 cm of an object of height 1 cm placed 20 cm away from the mirror.



Consider the case, in which a mirror forms a real image of height 4 cm of an object of height 1 cm placed 20 cm away from the mirror.

(i) The distance from the object to its image is
(a) 20 cm (b) 80 cm (c) 60 cm (d) 70 cm

Here $h_1 = 1$ cm, $h_2 = -4$ cm, $u = -20$ cm

We have, $m = \frac{h_2}{h_1} = -\frac{v}{u}$ *i.e.*, $\frac{-4}{1} = \frac{-v}{-20}$

or $v = -80$ cm

So, $|v - u| = |(-80) - (-20)| = 60$ cm

(ii) The focal length of mirror is
(a) -16 cm (b) 12 cm (c) -15 cm (d) 10 cm

Here, we have $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ *i.e.*, $\frac{1}{f} = \frac{1}{-20} + \frac{1}{-80} = \frac{-4-1}{80} = \frac{-5}{80}$

$\therefore \quad f = \frac{-80}{5} = -16$ cm

Consider the case, in which a mirror forms a real image of height 4 cm of an object of height 1 cm placed 20 cm away from the mirror.

(iii) The radius of curvature of the mirror is
(a) -16 cm (b) -14 cm (c) -30 cm (d) -32 cm

Radius of curvature, $R = 2f$

$= -2(16) = -32$ cm.

(iv) The magnification of the image is
(a) 3 (b) -6 (c) -4 (d) 8

$$m = \frac{-v}{u} = -\frac{-80}{-20} = -4$$

(v) At what distance must an object be placed from mirror in order that a real image double its size may be obtained?
(a) -24 cm (b) 32 cm (c) -40 cm (d) 45 cm

$$m = -\frac{v}{u} = -2 \quad \Rightarrow v = 2u$$

$$\text{So, } \frac{1}{v} + \frac{1}{u} = \frac{1}{f} \quad \Rightarrow \frac{1}{u} + \frac{1}{2u} = \frac{1}{f}$$

$$\Rightarrow u = \frac{3}{2} f = \frac{3}{2}(-16) = -24 \text{ cm}$$