

* For Numericals learn few terms $\rightarrow$

<u>For Concave mirror</u>	<u>For Convex mirror</u>
u - Object distance	$u = -ve$ (always)
v - Image distance	$v = +ve$ (always)
f - focal length	($\because$ Convex mirror always form Virtual image)
$u = -ve$ (always)	$f = +ve$ (always)
$v = -ve$ (for real image)	
$v = +ve$ (for virtual image)	
$f = -ve$ (always)	

Q1 At what distance from a Concave mirror of focal length 25cm should an object be placed so that size of image is equal to the size of the object

Ans: $\rightarrow$ Concave mirror so; $f = -ve$
 $f = -25cm$
 $I = O$ (both are equal)

I - Image Size
 O - Object Size

$$\text{as } m = \frac{v}{u} = \frac{I}{O} \quad \text{or } \frac{v}{u} = 1$$
$$\frac{I}{O} = 1$$

$v = u$

So by using mirror formula;

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

$f = -25\text{cm}$, $u = u$ So;

$$\frac{1}{u} + \frac{1}{u} = \frac{1}{-25}$$

$$\frac{2}{u} = -\frac{1}{25}$$

by cross-multiplication;

$$\boxed{u = -50\text{cm}}$$

_____ x _____ x _____ x _____

Q2 An Object 5cm high is placed at a distance 60cm in front of a Concave mirror of focal length 10cm. Find (i) the position and (ii) Size, of the image.

Ans Concave mirror; $f = -ve$

$$f = -10\text{cm}$$

$$\text{height of Object} = O = 5\text{cm}$$

$$u = -60\text{cm} \quad (\because u = -ve \text{ for concave mirror})$$

$$I = ?$$

$$v = ?$$

$$\text{So, } m = \frac{I}{O} = \frac{v}{u} \quad (\because u = -60\text{cm})$$

By using Mirror formula; $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{v} + \frac{1}{-60} = \frac{1}{-10} \Rightarrow \frac{1}{v} - \frac{1}{60} = -\frac{1}{10}$$

$$\text{or } \frac{1}{v} = \frac{1}{-10} + \frac{1}{60}$$

$$\frac{1}{v} = \frac{-6+1}{60} = \frac{-5}{60 \div 12}$$

$$\frac{1}{v} = -\frac{1}{12} \quad \text{So } \boxed{v = -12\text{cm}}$$

So image is in front of mirror because v is -ve.

$$\text{So, } m \Rightarrow \frac{v}{u} = \frac{I}{O}$$

$$\frac{-12}{-60} = \frac{I}{5}$$

$$\frac{12}{60} = \frac{I}{5}$$

$$\begin{cases} u = -60\text{cm} \\ v = -12\text{cm} \\ O = 5\text{cm} \end{cases}$$

After cross-multiplication; $60I = 60$
 $I = \frac{60}{60} = 1\text{cm}$

So Size of Image $\Rightarrow 1\text{cm}$

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Q3:→ An object of length 4cm is placed in front of a concave mirror at a distance 30cm. The focal length of a mirror is 15cm. (a) where will be the image form
 (b) what will be the length of image?

Ans:— Concave mirror; $u = -30\text{cm}$
 $O = 4\text{cm}$
 $f = -15\text{cm}$

$$m = \frac{I}{O} = \frac{v}{u}$$

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

$$\frac{1}{v} - \frac{1}{30} = -\frac{1}{15}$$

$$\frac{1}{v} = -\frac{1}{15} + \frac{1}{30} = \frac{-2+1}{30}$$

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

$$\text{So } \boxed{v = -30\text{cm}}$$

So image is formed in front of the mirror

$$\text{As } m = \frac{I}{O} = \frac{v}{u}$$

$$\Rightarrow \frac{I}{4} = \frac{-30}{-30} \quad \text{or} \quad \frac{I}{4} = 1 = \boxed{I = 4\text{cm}}$$

Q4 The image formed by a Convex mirror is of size one-third the size of Object. How are u and v related?

Ans

$$m = \frac{v}{u} = \frac{I}{O} \quad \text{--- (1)}$$

$$\frac{I}{O} = \frac{1}{3} O, \text{ using (1)}$$

$$\text{So } \frac{v}{u} = \frac{\frac{1}{3} O}{O}$$

$$\frac{v}{u} = \frac{1}{3}$$

$$\boxed{v = 3u}$$

Q5 A concave mirror forms a virtual image of size twice that of object placed at a distance 5cm from it. find (a) the focal length of the mirror. (b) Position of the image

Ans

Concave mirror, Virtual Image
 $u = -5\text{cm}$, $I \Rightarrow 2O$

$$m \Rightarrow \frac{v}{u} \Rightarrow \frac{I}{O}$$

$$\frac{v}{u} \Rightarrow \frac{2O}{O} \quad \text{or } \boxed{v \Rightarrow 2u}$$

$v = 2 \times -5 = -10\text{cm}$
as for virtual image
 v is +ve
 $\therefore v = 10\text{cm}$

$$\text{Using; } \frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{2u} + \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{10} + \frac{1}{-5}$$

$$\frac{1}{f} = \frac{1}{10} - \frac{1}{5}$$

$$\frac{1}{f} = \frac{1 - 2}{10}$$

$$\text{or } \boxed{f = -10\text{cm}}$$

as $v = 10\text{cm}$; so
Image is formed
behind the mirror
as v is +ve.

($u = -5\text{cm}$)

[$\therefore f$ is -ve for
Concave mirror