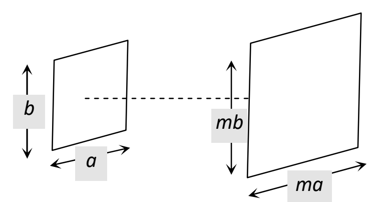
Mirror formula and magnification.

For a spherical mirror if u = Distance of object from pole, v = distance of image from pole, f = Focal length, R = Radius of curvature, O = Size of object, I = size of image, m = magnification (or linear magnification), ms = Areal magnification, A_o = Area of object, A_i = Area of image

Mirror formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$; (use sign convention while solving the problems).

Note: Newton's formula: If object distance (x1) and image distance (x2) are measured from focus instead of pole then $f^2 = x_1 x_2$

(2) Magnification: m = $\frac{\text{Size of object}}{\text{Size of image}}$

Linear magnification		Areal magnification
Transverse	Longitudinal	
When an object is placed perpendicular to the principle axis, then linear magnification is called lateral or transverse magnification. It is given by $m = \frac{I}{O} = -\frac{v}{u} = \frac{f}{f-u} = \frac{f-v}{f}$ (* Always use sign convention while solving the problems)	When object lies along the principle axis then its longitudinal magnification $m = \frac{I}{O} = \frac{-(v_2 - v_1)}{(u_2 - u_1)}$ If object is small; $m = -\frac{dv}{du} = \left(\frac{v}{u}\right)^2$ Also Length of image = $\left(\frac{v}{u}\right)^2 \times \text{Length of object } (L_0)$ $(L_i) = \left(\frac{f}{u-f}\right)^2 . L_o$	 If a 2D-object is placed with its plane perpendicular to principle axis It's A real magnification $M_s = \frac{\text{Area of image } (A_i)}{\text{Area of object } (A_o)} = \frac{ma \times mb}{ab} = m^2$ $\Rightarrow m_s = m^2 = \frac{A_i}{A_o}$

Note: Don't put the sign of quantity which is to be determined.

If a spherical mirror produces an image 'm' times the size of the object (m = magnification) then u, v and f are given by the followings

$$u=\left(\frac{m-1}{m}\right)f,\quad v=-(m-1)f\quad \text{and}\quad f=\left(\frac{m}{m-1)}\right)u$$ (Use sign convention)

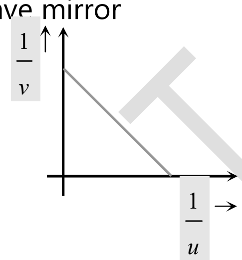
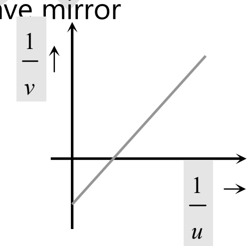
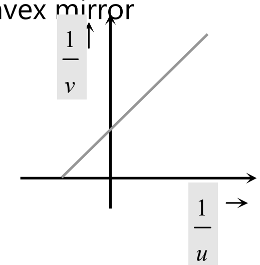
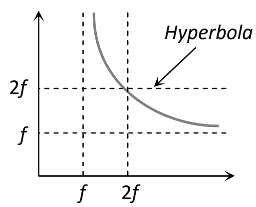
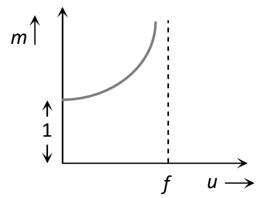
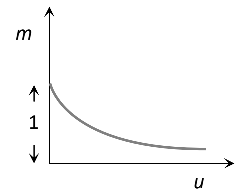
(3) Uses of mirrors

(i) Concave mirror: Used as a shaving mirror, in search light, in cinema projector, in telescope, by E.N.T. specialists etc.

(ii) Convex mirror: In road lamps, side mirror in vehicles etc.

Note: Field of view of convex mirror is more than that of concave mirror.

Different graphs

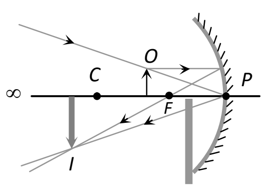
Graph between $\frac{1}{v}$ and $\frac{1}{u}$		
(a) Real image formed by concave mirror 	(b) Virtual image formed by concave mirror 	(c) Virtual image formed by convex mirror 
Graph between u and v for real image of concave mirror	Graph between u and m for virtual image by concave mirror	Graph between u and m for virtual image by convex mirror.
		

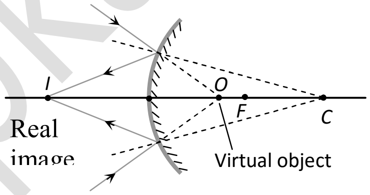
Concepts

Focal length of a mirror is independent of material of mirror, medium in which it is placed, wavelength of incident light

Divergence or Convergence power of a mirror does not change with the change in medium.

If an object is moving at a speed vo towards a spherical mirror along its axis then speed of image away from mirror is $v_i = -\left(\frac{f}{u-f}\right)^2 .v_o$ (use sign convention)





When object is moved from focus to infinity at constant speed, the image will move faster in the beginning and slower later on, towards the mirror.

As every part of mirror forms a complete image, if a part of the mirror is obstructed, full image will be formed but intensity will be reduced.

Can a convex mirror form real images?

yes if (distance of virtual object) u < f (focal length)