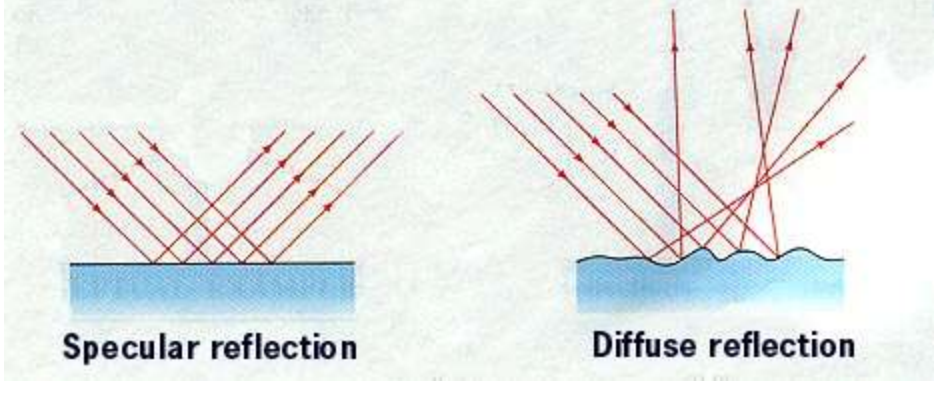
Physics Honors: Mirrors and Reflection

Reflection

Reflection is the change in direction of an electromagnetic wave at a surface that causes it to move away from that surface

Diffuse reflection sends the rays in many directions

Specular reflection sends rays in the same forward direction



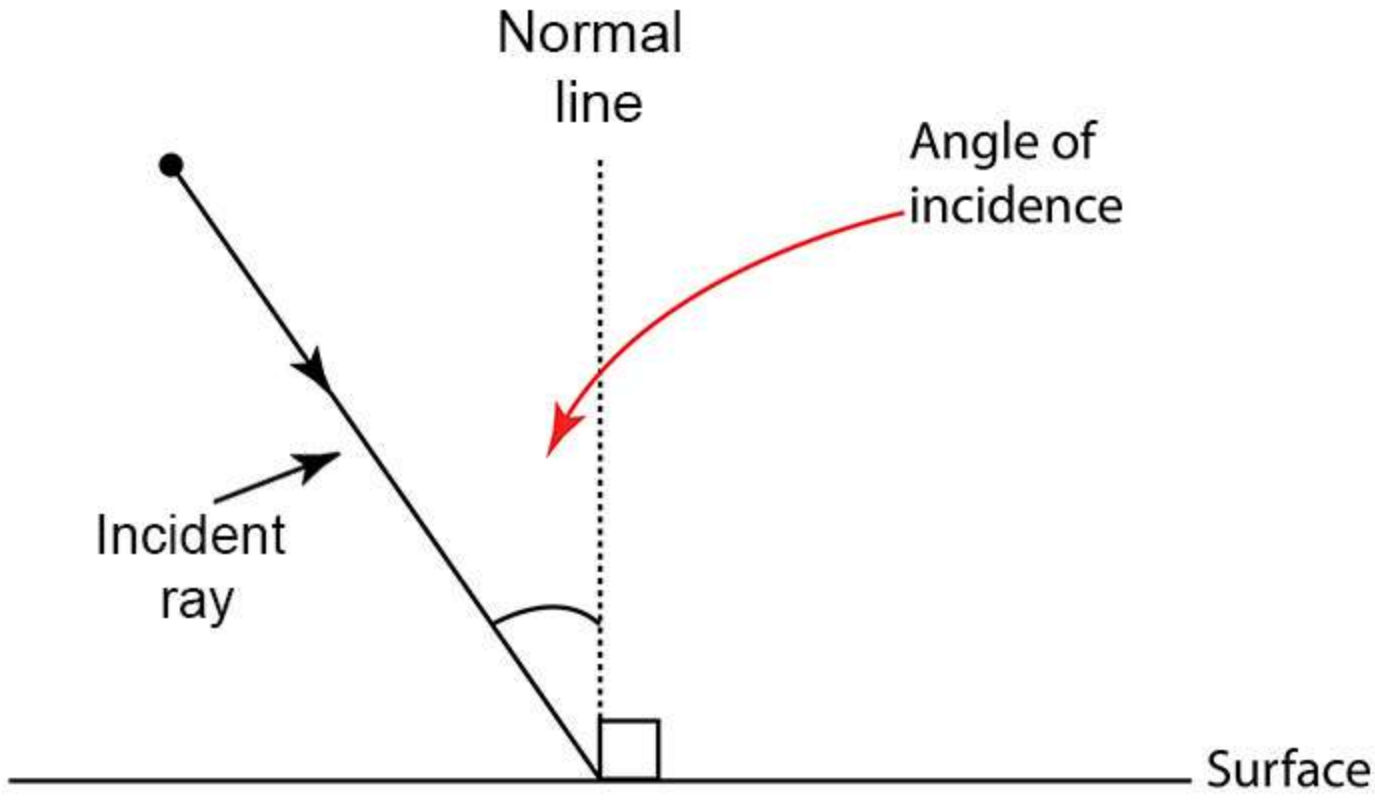
Law of Reflection

The law of reflection states that incoming and reflected angles are equal

$$= \ '$$

Angle of incidence - the angle between a ray that strikes a surface and the line perpendicular to that surface

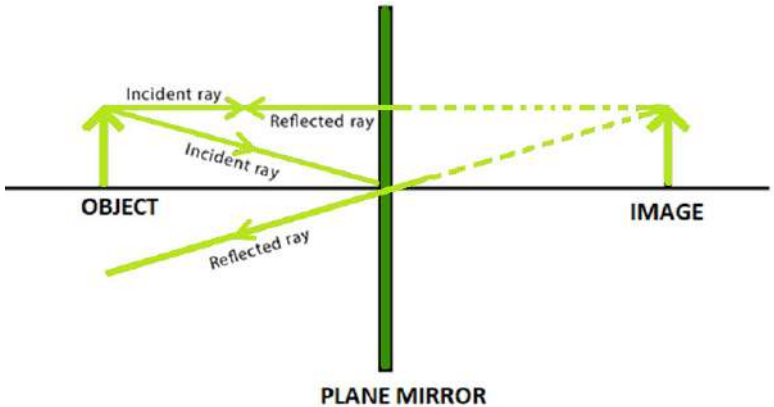
Angle of reflection - The angle formed by the line perpendicular to a surface and the direction a reflected ray moves


Normal
line
Angle of
incidence
Incident
ray
Surface

Objects and images

Object - a luminous source of light rays (like a light bulb) or an object that is illuminated by light rays, like a person

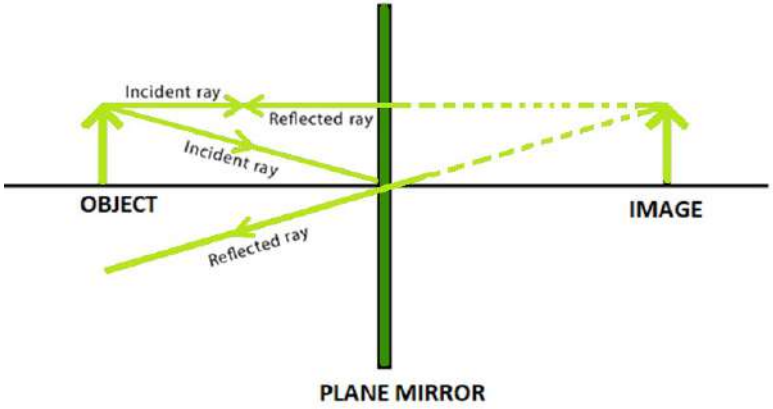
Image- An optical reproduction of an object formed by the combination of light rays reflected (or refracted) by a mirror (or lens)



Flat Mirrors (Plane Mirrors)

Most of the mirrors you've ever seen or looked into are flat mirrors, or plane mirrors.

Plane mirrors form **Virtual Images,** which means the image is going to appear on the other side of the mirror



Plane mirror image position

With a plane mirror, the image position is equal to the negative of the object position. The negative sign indicates that the image is behind the mirror

$$-X_i = X_o$$

X_i = Image distance from mirror (meters)

X_o = Object distance from mirror (meters)

Image Height

With a plane mirror, image height is equal to object height

$$h_i = h_o$$

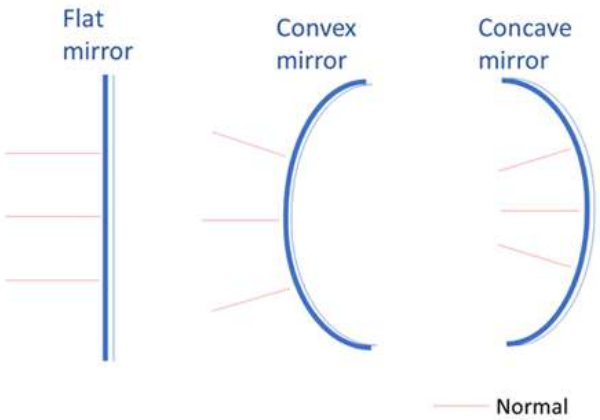
h_i = image height (m)

h_o = Object height (m)

Curved Mirrors

There are two main types of curved mirrors:

1. Concave mirrors, which curve inwards
2. Convex mirrors, which curve outward



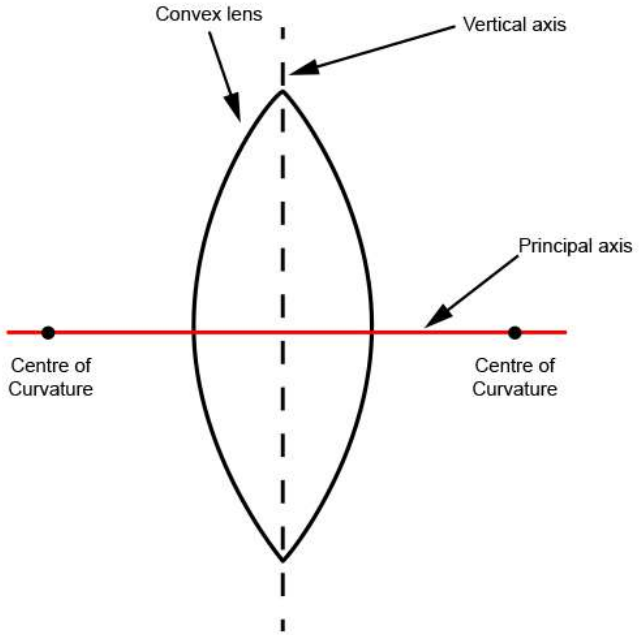
Parts of Curved Mirrors

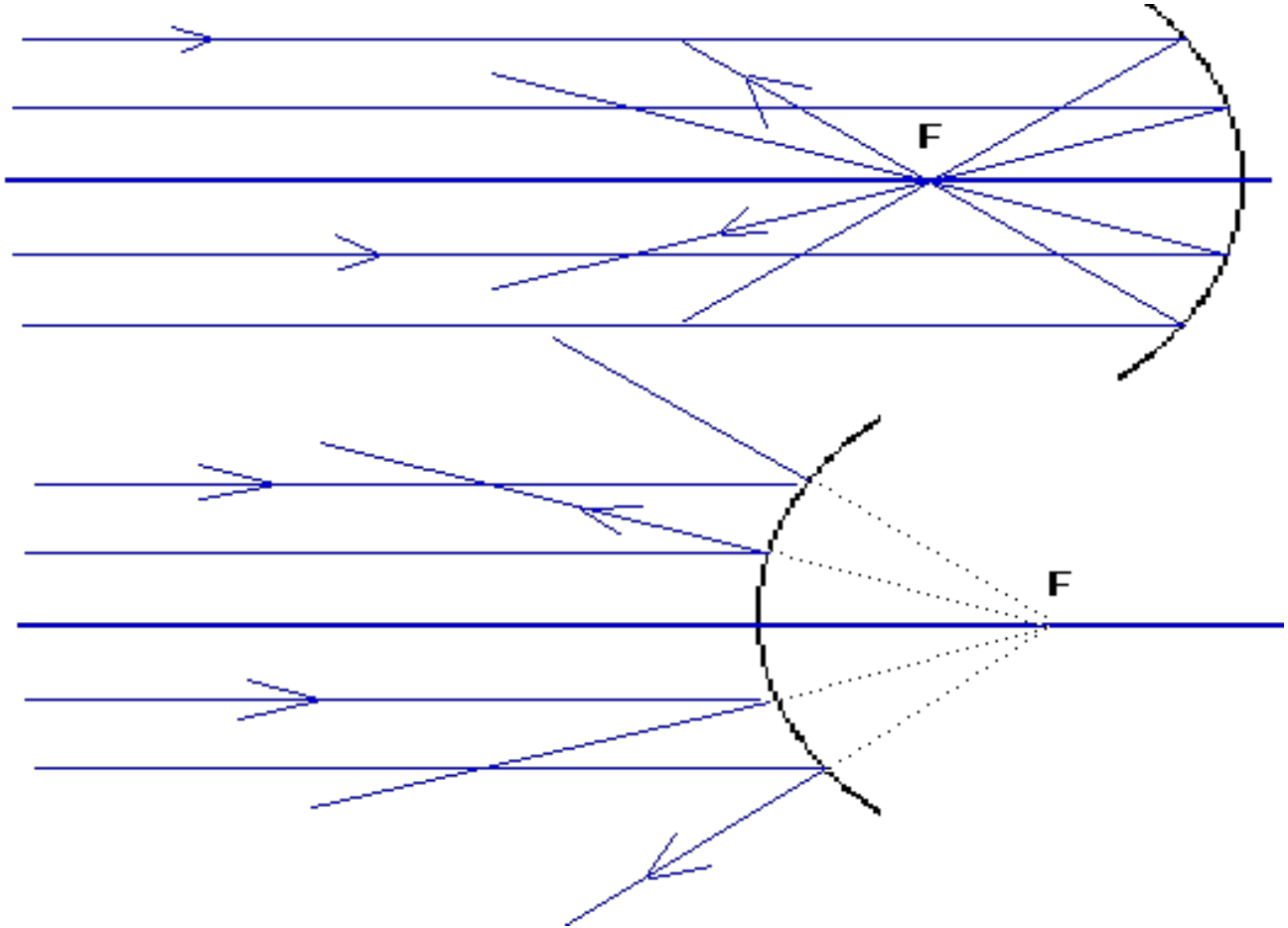
Principal axis: a line perpendicular to the mirror's surface that divides the mirror in half

Center of Curvature: If you extended the curve of the mirror into an entire circle, the center of curvature would be the middle point (on the principal axis).

Focal point: The point where incident rays that are parallel to the principal axis converge after reflecting from the mirror.

The focal length is ½ of the center of curvature





When the rays converge in front of the mirror, like in the case of concave mirror, we call the image a **Real Image**

When the rays converge behind the mirror, like in convex mirror or in plane mirrors, we call the image a **Virtual Image**

Calculating Image Position

$$\frac{1}{f} = \frac{1}{x_i} + \frac{1}{x_o}$$

f = focal length

X_i = image distance

X_o = object distance

Magnification

$$m \equiv \frac{h_i}{h_o} = -\frac{x_i}{x_o}$$

m = Magnification

h_i = image height

h_o = object height

X_i = image distance

X_o = object distance

Positives and Negatives

Positives	Negatives
Object distance in front of mirror	
Images distance in front of mirror (real)	Image distance behind mirror (virtual)
Upright magnification	Inverted magnification

Mirror Equation and Magnification Practice

You place an object 36cm in front of a concave mirror with a 16 cm focal length. Determine the image position.

A 1.8m tall person stands 2.4 m in front of a curved mirror. Her image appears 0.36 m tall.

a. What is the images distance?
b. What is the focal length of the mirror?

Mirror Equation and Magnification Practice

You place a 2.0 cm tall object in front of a concave mirror with a center of curvature of 20cm. What are the image position and the image height?