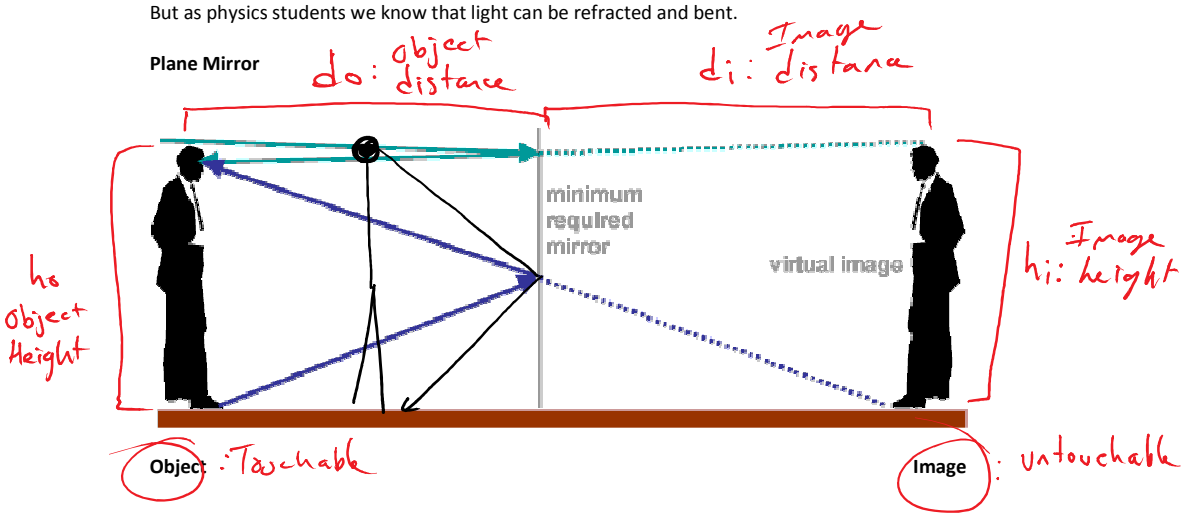
Ray Diagrams for Mirrors

September 8, 2015 1:24 PM

Light rays travel in straight lines and so when we see one we assume it is coming straight towards us.

But as physics students we know that light can be refracted and bent.

Plane Mirror



Plane mirrors form images at the same distance to the mirror as the object. This image is a virtual image as it is behind the mirror and impossible to project on a piece of paper in the real world.

Question: Do we see more of ourselves as we get closer to the mirror or less?

we see the same amount

Question: What size of mirror do we need to see all of ourselves?

half our height

Question: In a plane mirror is the images height larger, smaller or equal to the objects?

The same height

Plane Mirrors: Are flat reflective surfaces that create a virtual image with the same height as the object and at the same distance from the mirror as the object.

$h_o = h_i$

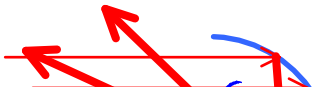
$d_o = -d_i$

Concave Mirrors Converging

Con Cave = happy bear

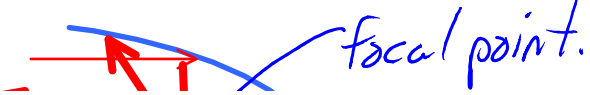
These are mirrors that are curved with their outer edges closer to you then their centers. Just like a parenthesis ")". They reflect light towards their focal points.

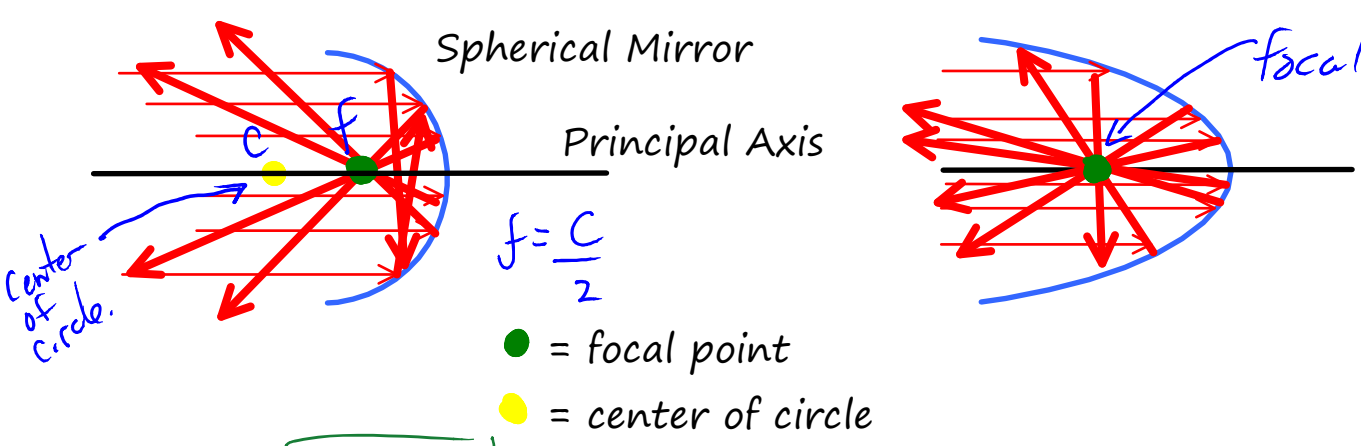
The most ideal curved mirror is a Parabolic Mirror but these are extremely difficult to produce accurately. Most Parabolic Mirrors are approximations created from taking a small portion of a spherical mirror.



Spherical Mirror

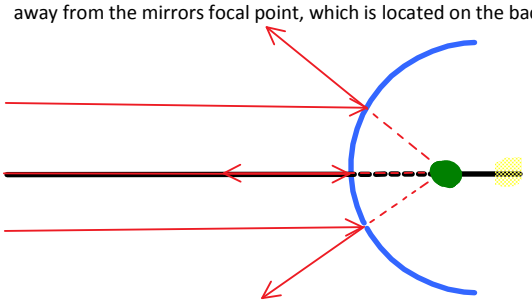
Parabolic Mirror





Convex Mirrors Diverging

Convex Mirrors are just the opposite of a concave mirror. They are like a backwards parenthesis "(". They reflect light away from the mirrors focal point, which is located on the back side of the mirror.



3 Rules are used to find the images formed by mirrors.

1) Light rays that are parallel to the principal axis of a mirror are reflected through the focal point.
2) Light rays that pass through the focal point are reflected parallel to the principal axis.
3) Light rays passing through (or appearing to pass through) the center are reflected back as if hitting a plane mirror. $\theta_i = \theta_r$

Real Image - the actual rays pass through the focal point and the image can be projected onto a screen. inverted
Virtual Image - The rays do not pass through the focal point and the image cannot be projected onto a screen (you can see the image in the mirror). right side up

Formulas

$$\frac{1}{d_i}+\frac{1}{d_0}=\frac{1}{f}$$

$$M=-\frac{d_i}{d_0}=\frac{h_i}{h_0}$$

d_i = distance to image
d_o = distance to object
f = focal Point
h_i = height of image
h_o = height of object
M = Magnification

Converging
Diverging

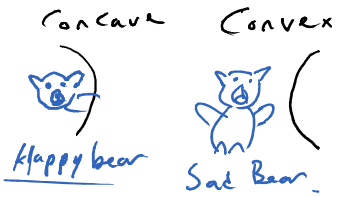
Sign Convention for Mirrors:
Concave mirror - both f and C are positive (f - focal point, C - radius of curvature)
Convex mirror - both f and C are negative.

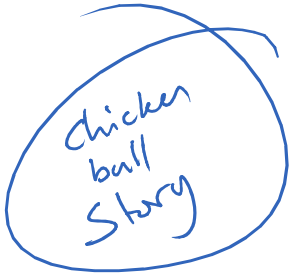
di is + if the image is in front of the mirror (real image)
di is - if the image is behind the mirror (virtual image)

If M (magnification) is +, the image is erect (right side up)
If M (magnification) is -, the image is inverted (upside down)
If M>1, the image is larger than object, if M<1, the image is smaller than object.
do is + if the object is in front of the mirror (real object)
The Mirror Equation:

do = distance from object to mirror.
di = distance from image to mirror.
f = focal point (half the distance to center)
(The units are any unit of length, just keep them the same)
The Magnification Equation:

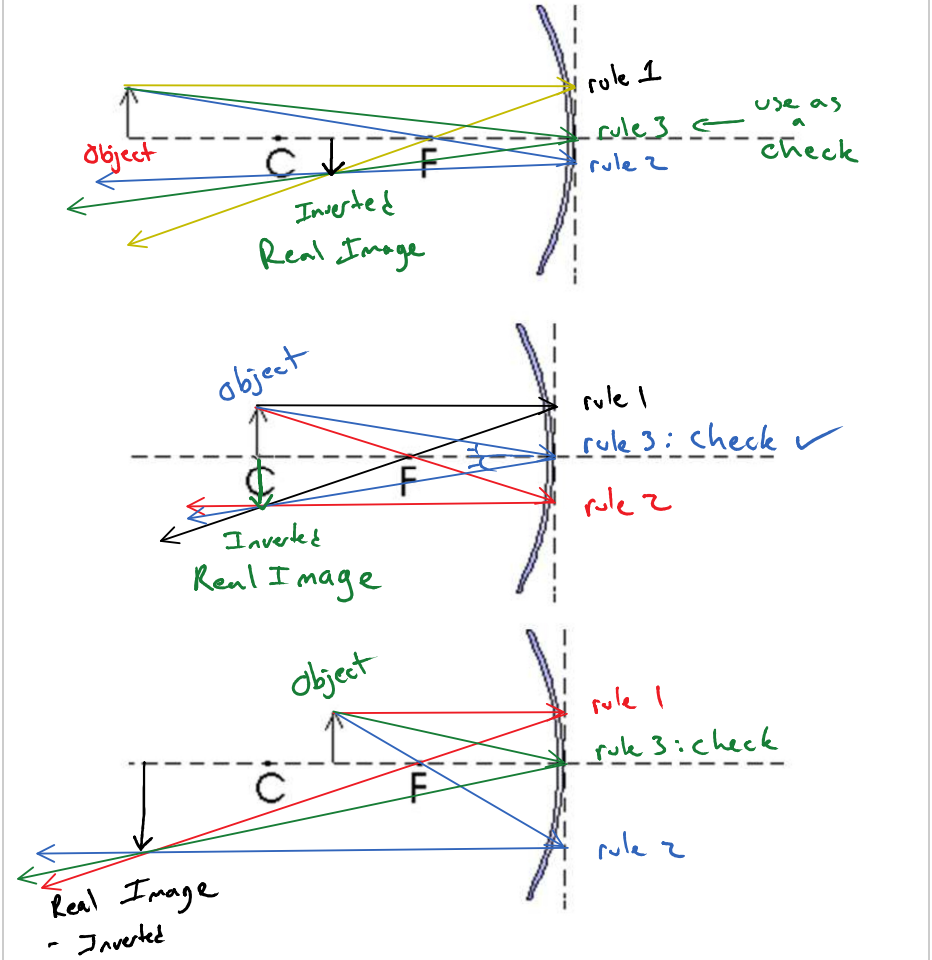
hi = height of image. di = distance to image

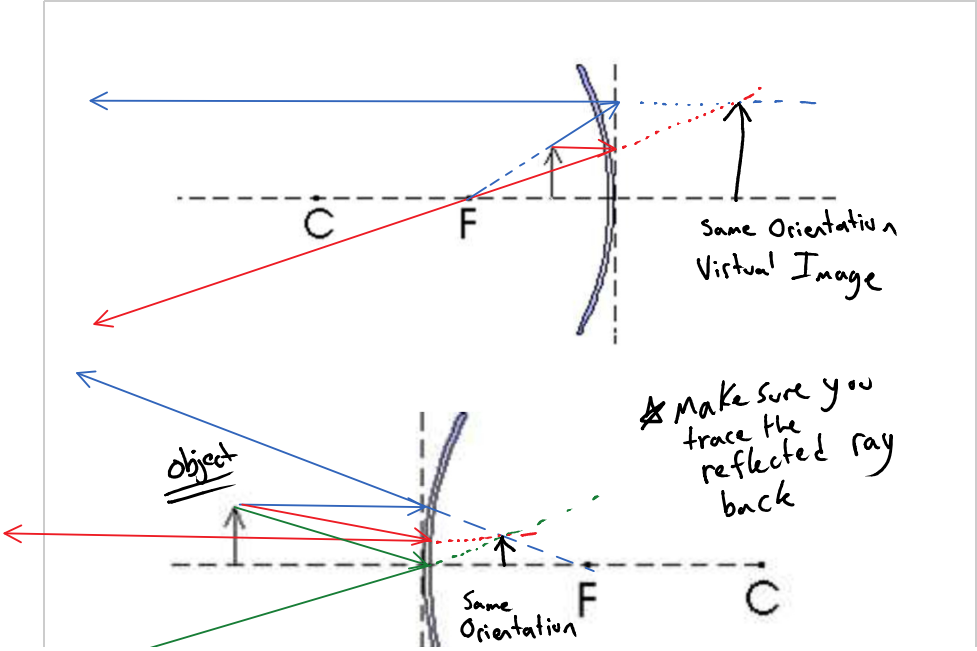


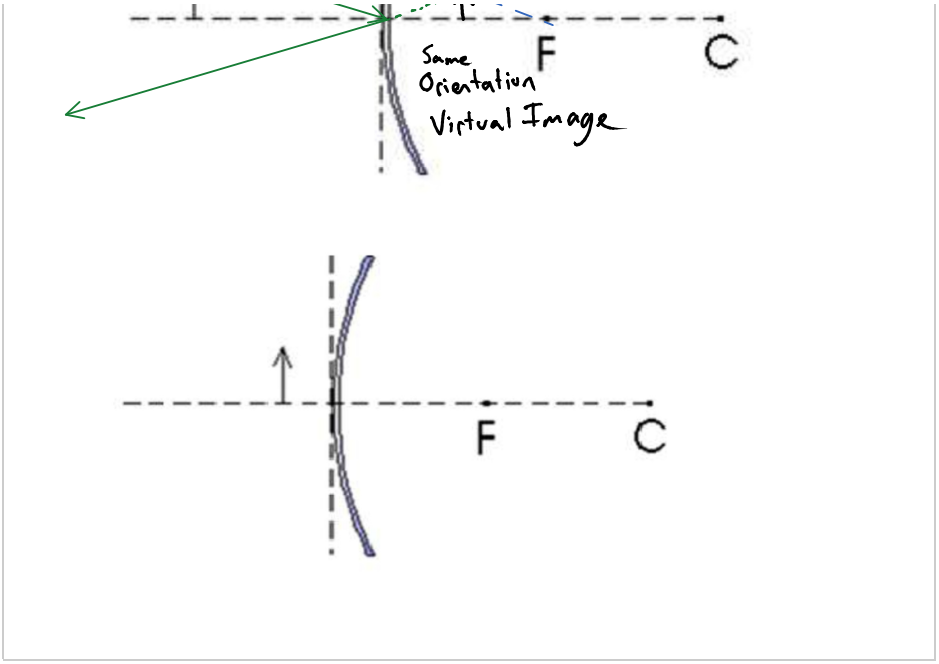


ho= height of object. do = distance to object

Mirror's Practice Sheet






F
C
Same
Orientation
Virtual Image

F
C