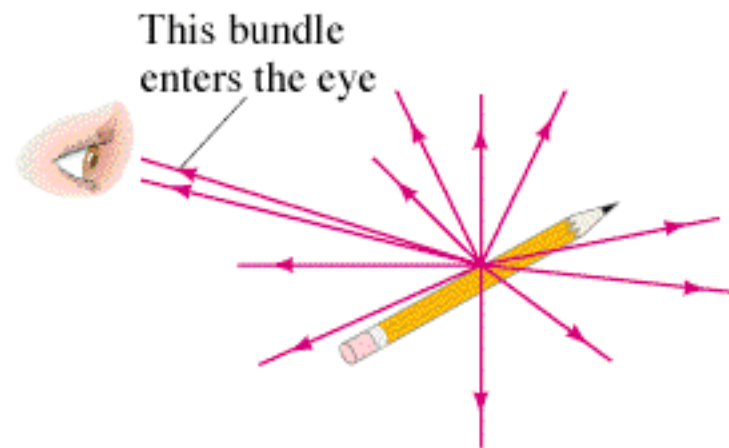


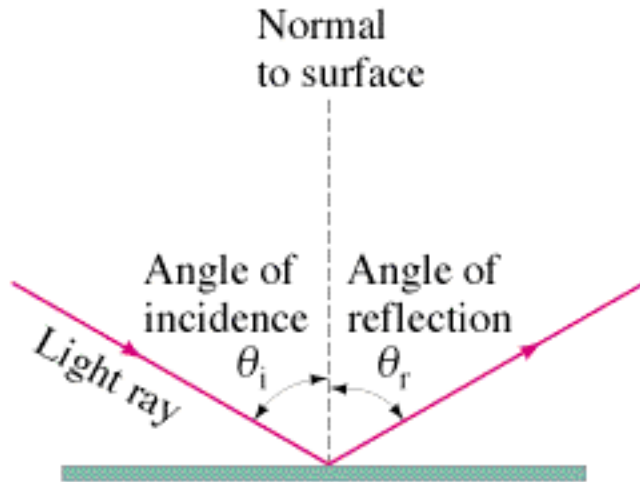
Ch 23. Geometric Optics

I. The Ray model of Light



Light travels in straight-line paths called **light rays**

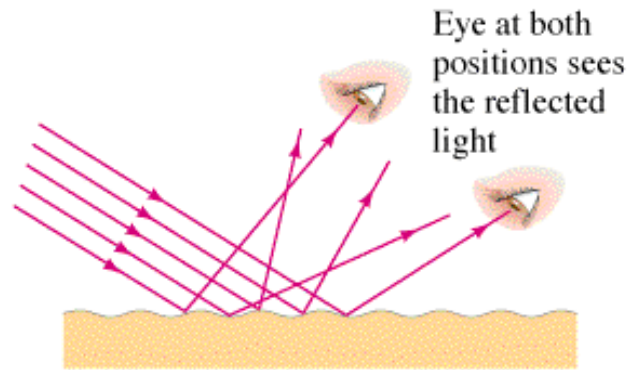
II. Mirror Reflection



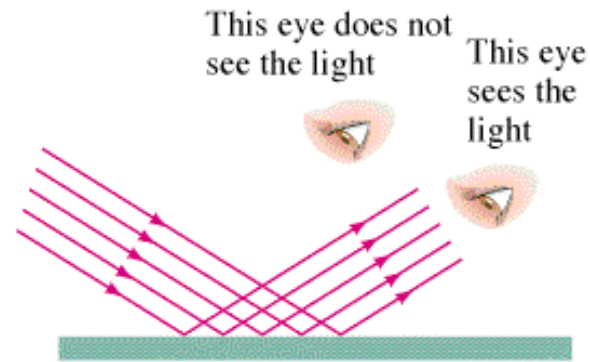
Angle of incidence θ_i
Angle of reflection θ_r

Law of reflection:

$$\theta_i = \theta_r$$

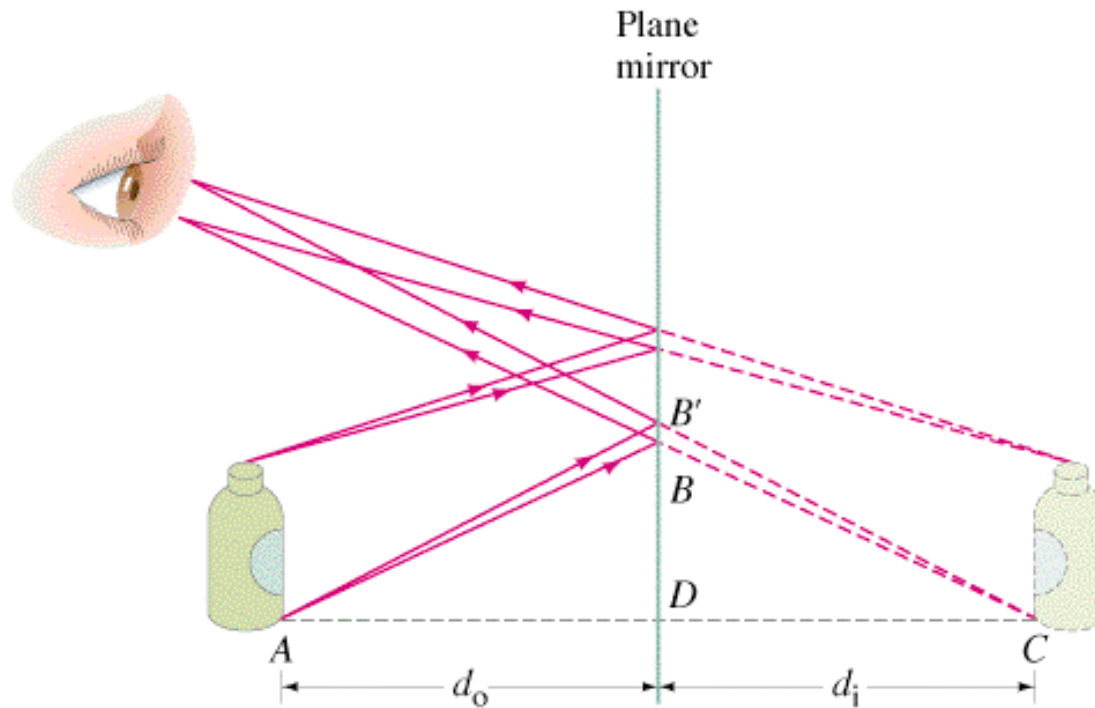


Diffusive reflection



Specular reflection

Image



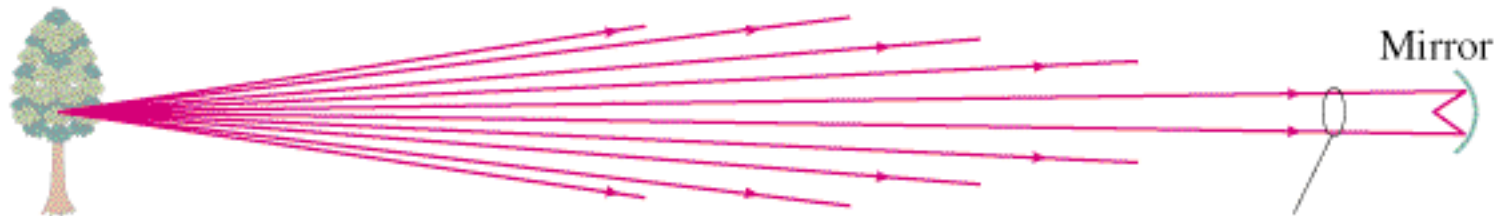
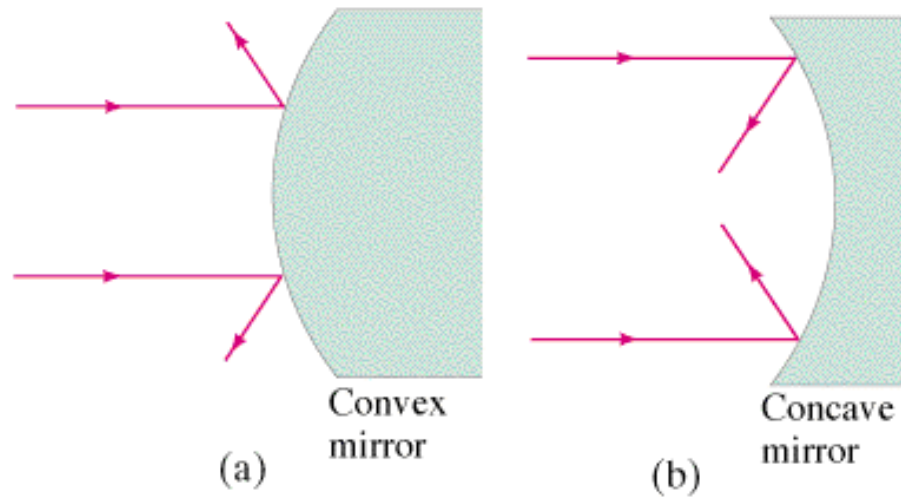
d_i : image distance

d_o : object distance

Virtual Image: not real, can't form on a screen

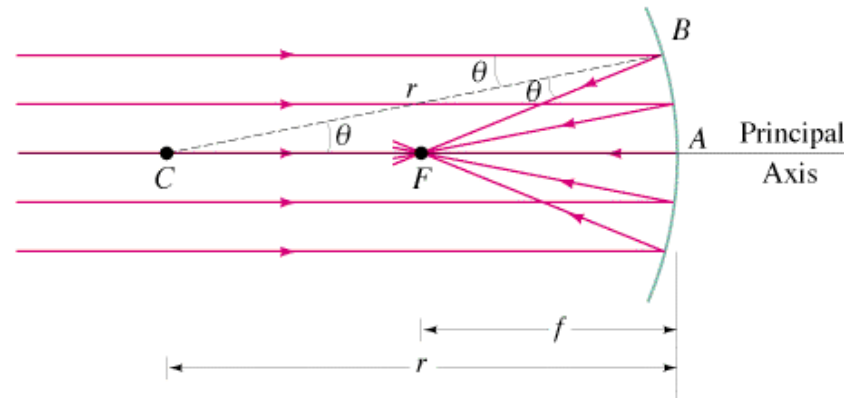
Real Image: can form on a screen

III. Spherical Mirrors



These rays are the only ones shown that will strike the mirror, and they are essentially parallel.

Concave Mirrors: Parallel Rays



CA: Principle axis

C: Center of curvature of the mirror

Radius of sphere CA: r

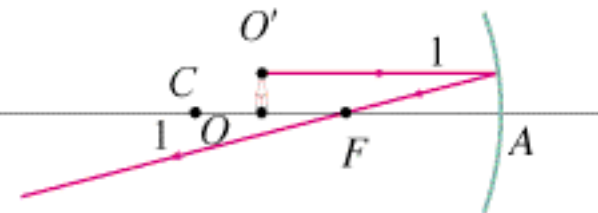
Focus: Focal point

Focal length FA : $f=r/2$

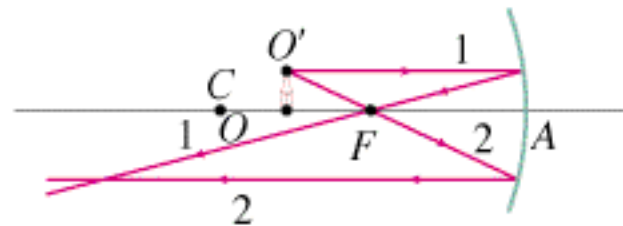


Ray Diagram

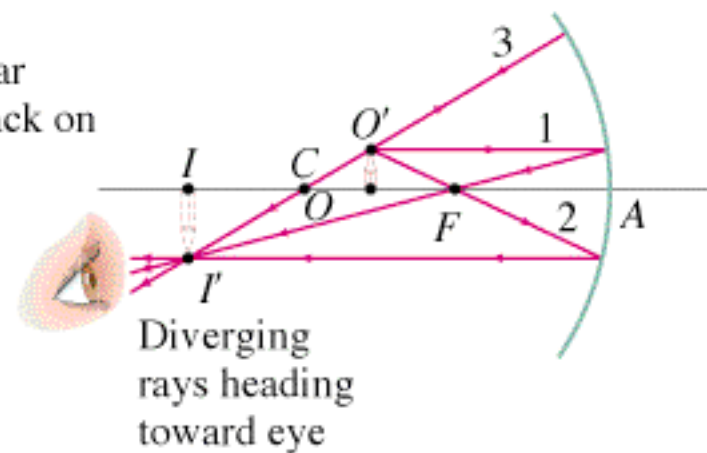
- (a) Ray 1 goes out from O' parallel to the axis and reflects through F .



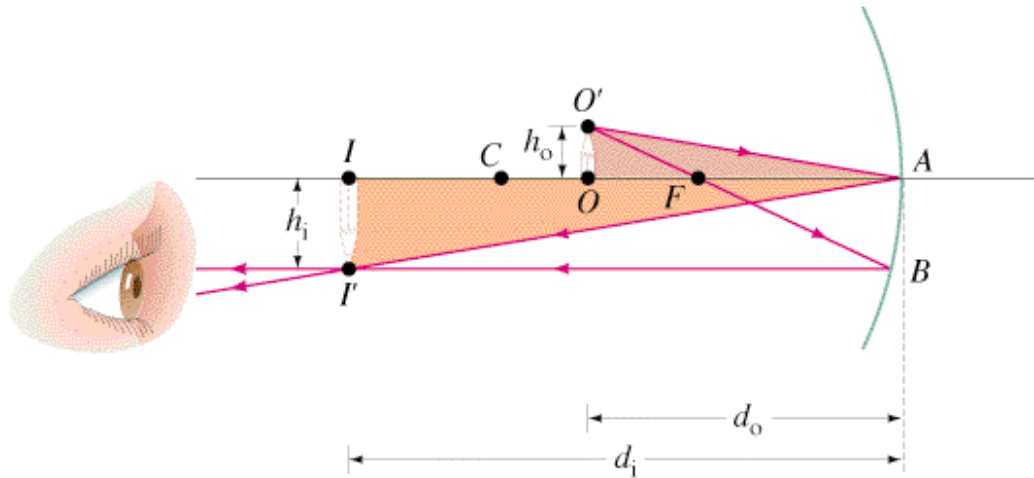
- (b) Ray 2 goes through F and then reflects back parallel to the axis.



- (c) Ray 3 heads out perpendicular to mirror and then reflects back on itself and goes through C (center of curvature)



Mirror Equation



Object height: h_o ;
Image height: h_i
Object distance: d_o ;
Image distance: d_i

$$\frac{h_o}{h_i} = \frac{d_o}{d_i}.$$

$$\frac{h_o}{h_i} = \frac{OF}{FA} = \frac{d_o - f}{f}.$$

$$\frac{d_o}{d_i} = \frac{d_o - f}{f}.$$

$$\underline{\underline{\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}}}$$

Signs

Object height h_o : + ↑

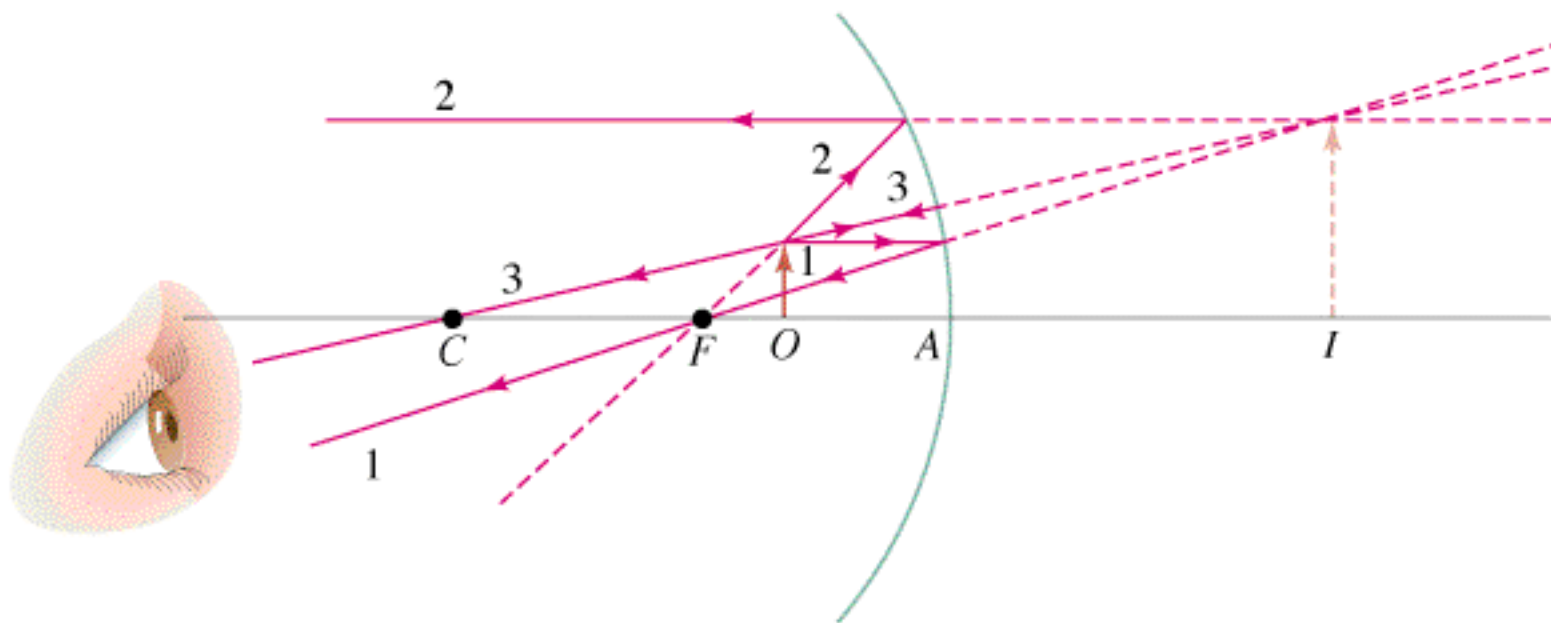
Image height h_i : + upright ↑ - inverted ↓

Object distance d_o & Image distance d_i
+ on the reflecting side
- behind the reflecting side

Magnification $m = h_i/h_o = - d_i/d_o$

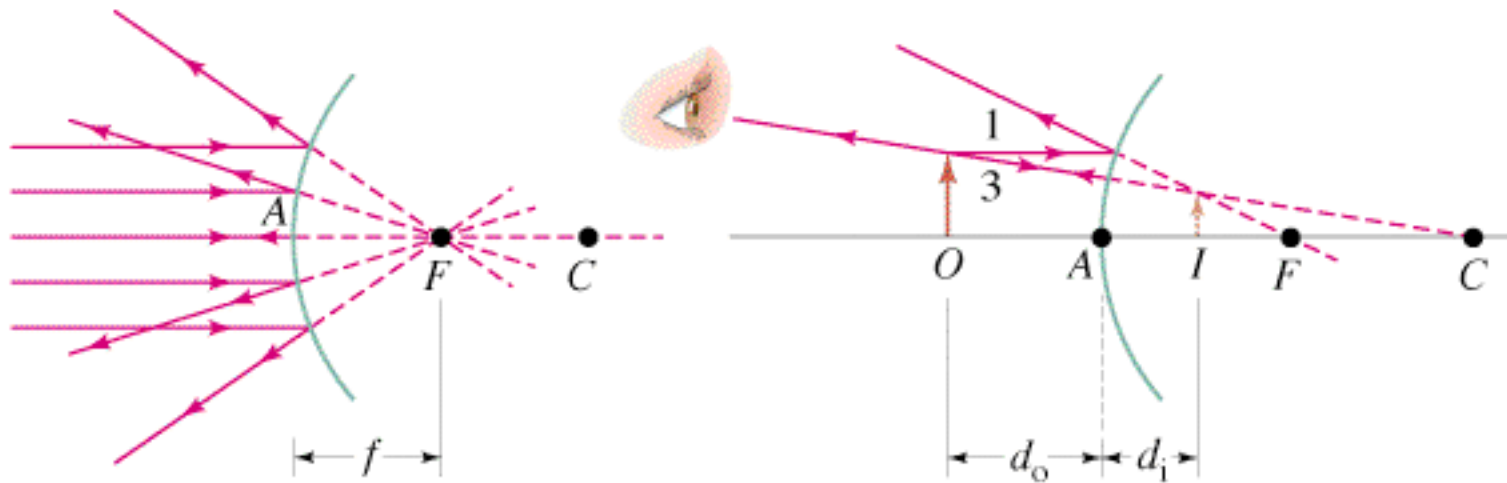
$|m| > 1$, magnified; $|m| < 1$ shrunk
 m : + upright; - inverted

Example



Always draw a ray diagram with 2 or 3 easy-to-draw rays
Keep track of signs in mirror equation
Compare & see if make sense

Convex Mirrors



Mirror equation still holds, but:

f & r now negative

Virtual image, always upright