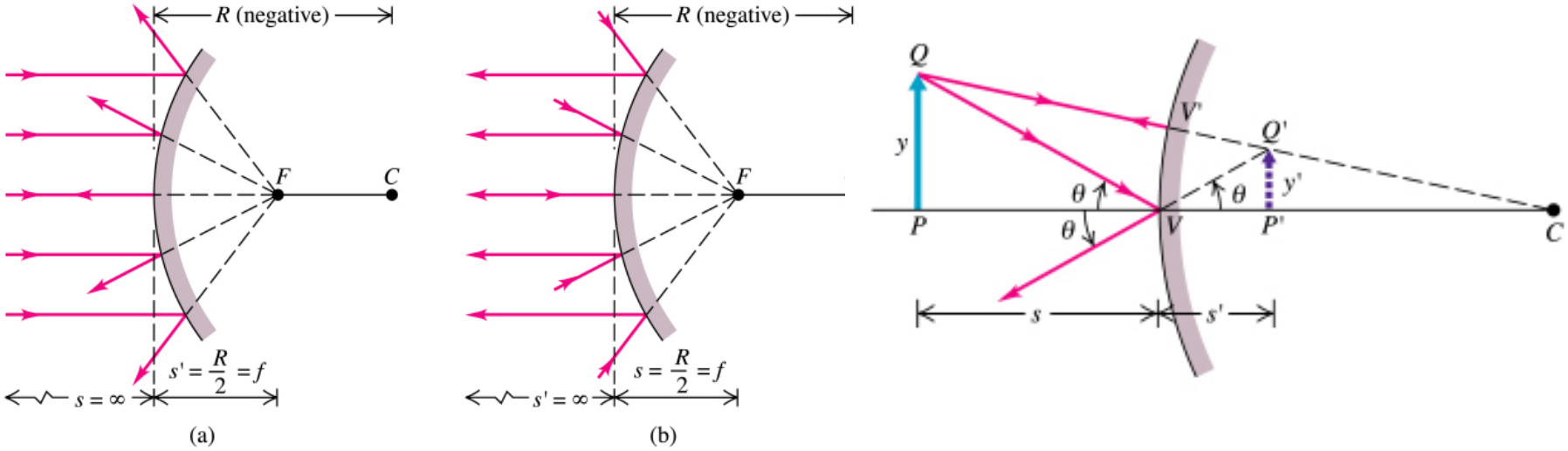
Convex Mirrors



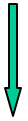
Mirror equation still holds, but:

f & *R* now negative

Virtual image, always upright

Summary: Signs

Object height *y*: + 

Image height *y'*: + upright  - inverted 

Object distance s & Image distance s'

\+ on the reflecting side

\- behind the reflecting side

Concave mirror: *R* & *f* +

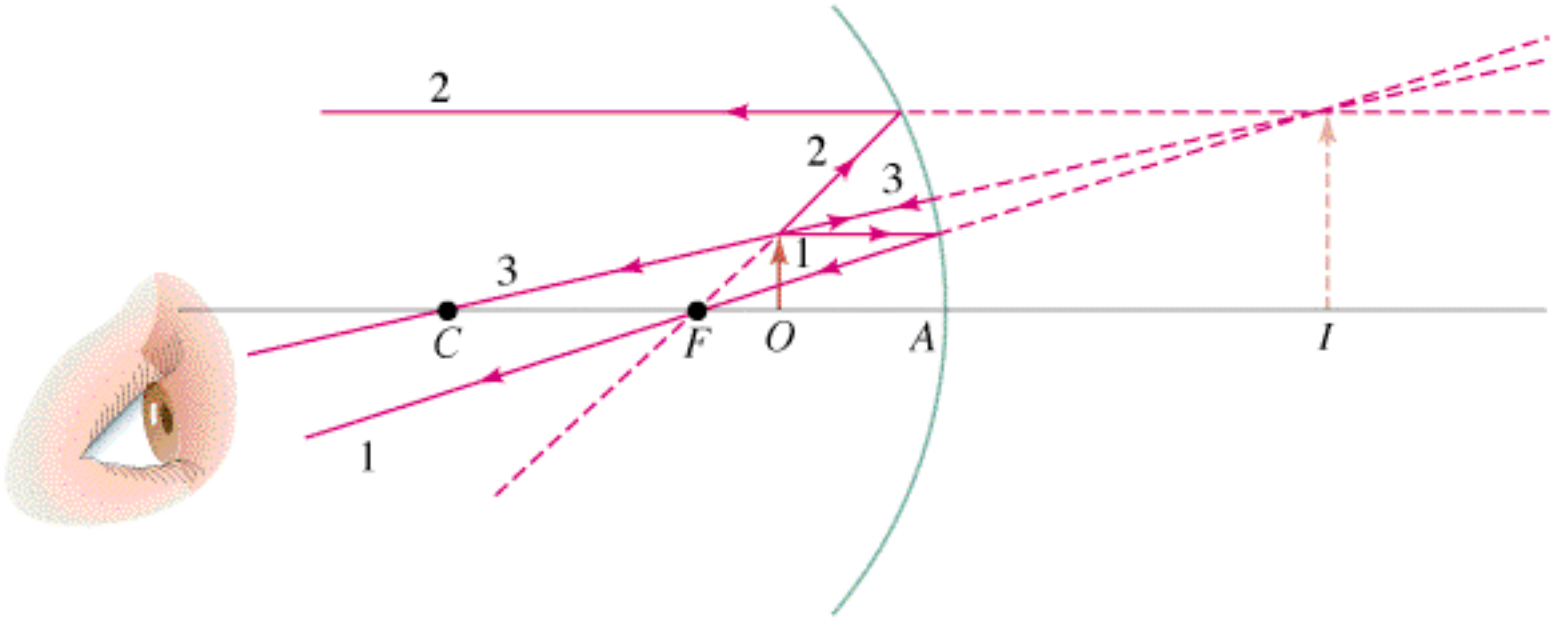
Convex mirror: *R* & *f* -

Magnification m= y'/y = - s'/s

|m| >1, magnified; |m|<1 shrunk

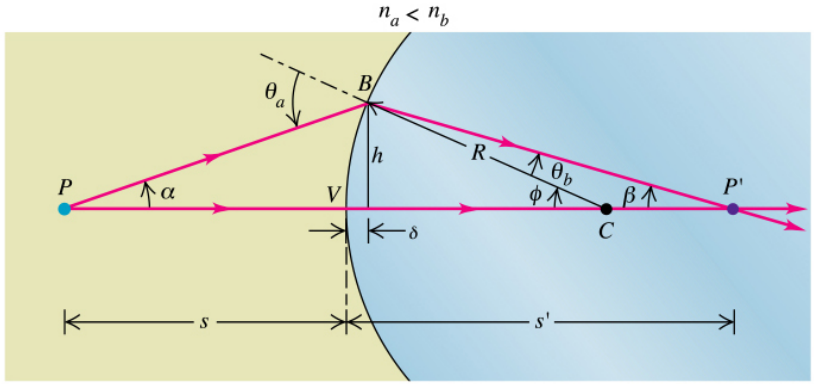
m: + upright; - inverted

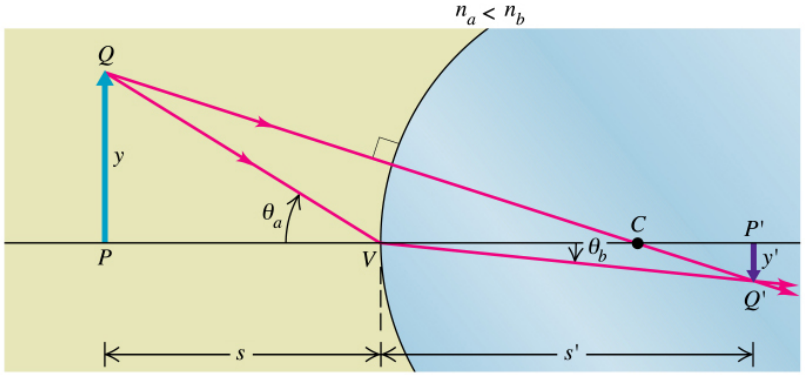
Example



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

34-3. Refraction at a Spherical Surface





$$\frac{n_a}{s} + \frac{n_b}{s'} = \frac{n_b - n_a}{R}$$

$$m = \frac{y'}{y} = -\frac{n_a s'}{n_b s}$$

For plane surface, R= ∞

$$\frac{n_a}{s} + \frac{n_b}{s'} = 0$$

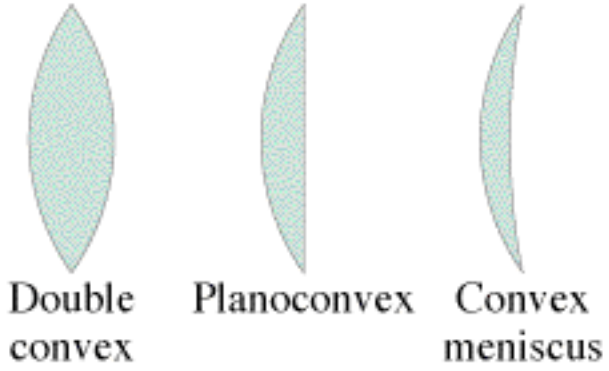
$$m = 1$$

s>0: when object is on the incoming side of the surface (real object)

s'>0: when image is on the outgoing side of the surface (real image)

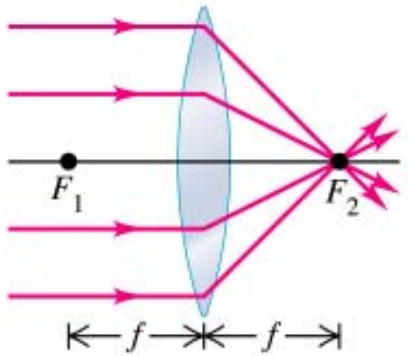
R>0: when center of curvature C is on the outgoing side of the surface

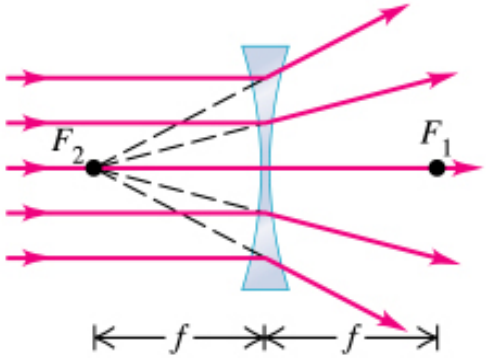
34-4. Thin Lenses



(a) Converging lenses

(b) Diverging lenses



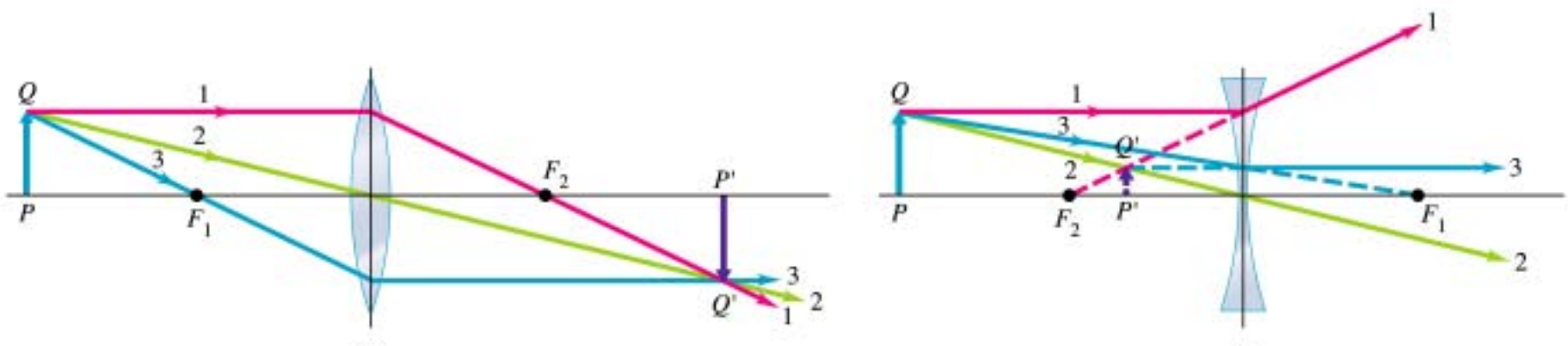


f same on both side

\+ for converging lenses

\- for diverging lenses

Ray Diagram for Thin Lenses

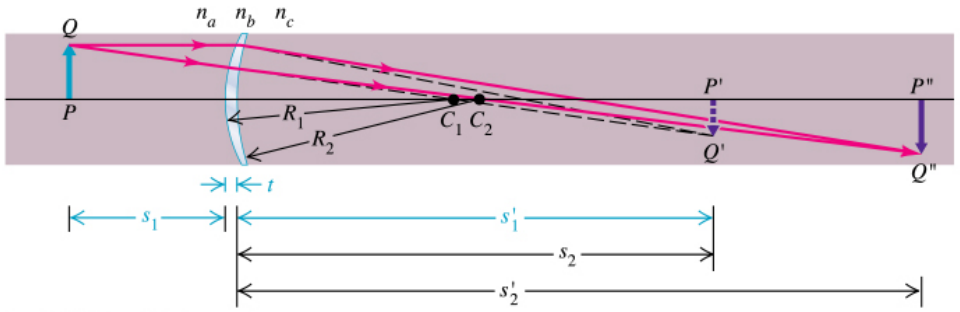


Ray 1 goes out from Q parallel to the axis & passes through F_2.

Ray 2 goes through the center of the lens unaffected

Ray 3 goes through F_1 and refracts parallel to the axis.

Lensmaker's Equation

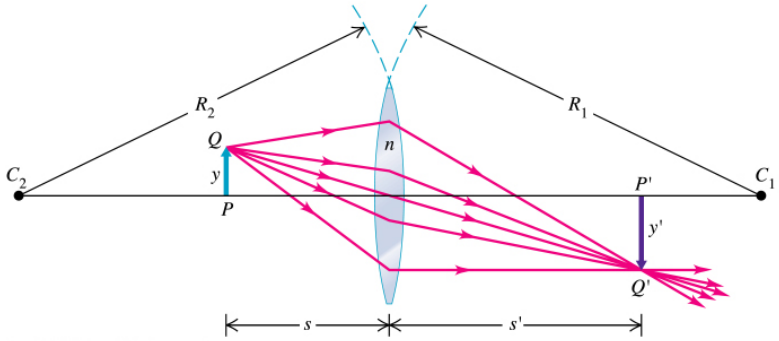


Object-image relation

$$\frac{1}{s}+\frac{1}{s'}=\frac{1}{f}. \qquad m=\frac{y'}{y}=-\frac{s'}{s}$$

Lensmaker's equation

$$\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$



Example: n=1.52
Double convex, radius is 20cm, *f*?
Double concave?

Ch 34-5 - 7. Optical Instruments

Please read text on your own.