Convex Mirrors

Mirror equation still holds, but:
\[ f \& R \text{ now negative} \]
Virtual image, always upright
Summary: Signs

Object height \( y \): 

\[ y \] 

Image height \( y' \):

\[ + \text{ upright } \rightarrow \text{ inverted } \]

Object distance \( s \) & Image distance \( s' \)

\[
+ \text{ on the reflecting side } \\
- \text{ behind the reflecting side }
\]

Concave mirror: \( R \) & \( f \) 

\[ + \]

Convex mirror: \( R \) & \( f \)

\[ - \]

Magnification \( m = \frac{y'}{y} = -\frac{s'}{s} \)

\[ |m| > 1, \text{ magnified} ; \ |m| < 1 \text{ shrunk} \]

\[ m: + \text{ upright} ; - \text{ inverted} \]
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

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

For plane surface, \( R = \infty \)

\[ \frac{n_a}{s} + \frac{n_b}{s'} = 0 \]

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

\( m = 1 \)

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 1 goes out from Q parallel to the axis & passes through F₂.

Ray 2 goes through the center of the lens unaffected

Ray 3 goes through F₁ and refracts parallel to the axis.
Lensmaker’s Equation

Object-image relation
\[
\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}. \quad m = \frac{y'}{y} = -\frac{s'}{s}
\]

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.