

## 10.9: Summary

### Overview of Mirrors and Lenses

**Table 10.9.1: Summary of properties of mirrors and lenses**

focal length sign	image location and type	image distance sign	orientation	magnification
$f > 0$	<p>if <math>o &gt; f</math>: a real image front of the mirror or on the other side of the lens compared to the object</p> <p>if <math>o &lt; f</math>: a virtual images behind the mirror or on the same side of the lens as the object</p>	<p>if <math>o &gt; f</math>, then <math>i &gt; 0</math></p> <p>if <math>o &lt; f</math>, then <math>i &lt; 0</math></p>	<p>if <math>o &gt; f</math>, the image is inverted, <math>M &lt; 0</math></p> <p>if <math>o &lt; f</math>, the image is upright, <math>M &gt; 0</math></p>	<p>if <math>f &lt; o &lt; 2f</math>, the image is magnified, <math> M  &gt; 1</math></p> <p>if <math>o &gt; 2f</math>, the image is de-magnified, <math> M  &lt; 1</math></p> <p>if <math>o &lt; f</math>, the image is magnified, <math> M  &gt; 1</math></p>

b e h i n s r o r a n d b o t h s i d e s o f t h e l e n s				
$d_o < 0$ v e r t u a l i m a g e b e h i n d	virtual image behind the mirror or on the same side of the lens as the object for all object distances	$i < 0$ for all o's	the image is upright, $M > 0$ for all o's	all images are de-magnified, $ M  < 1$

g  
l  
h  
n  
sn  
i  
r  
r  
o  
r  
a  
n  
d  
b  
o  
t  
h  
s  
i  
d  
e  
s  
o  
f  
t  
h  
e  
l  
e  
n  
s

## Ray Tracing

Concave mirror: object further(closer) than focal point:

- Principle ray #1: incoming ray parallel to the optical axis will reflect through the focal point.
- Principle ray #2: incoming ray that goes through (away from) the focal point will reflect parallel to the optical axis.
- Principle ray #3: incoming rays that goes through (away from) the center of curvature will reflect straight back.

Conex Mirror:

- Principle ray #1: incoming ray parallel to the optical axis will reflect away from the focal point.
- Principle ray #2: incoming ray moving toward the focal point will reflect parallel to the optical axis.
- Principle ray #3: incoming ray moving toward center of curvature will reflect straight back.

Converging Lens: object further(closer) than focal point:

- Principle ray #1: incoming ray parallel to the optical axis will refract through the far focal point.
- Principle ray #2: incoming ray that goes through (away from) the near focal point will refract parallel to the optical axis.
- Principle ray #3: incoming ray that goes through the center of curvature will follow a straight path as it goes through the lens.

Diverging Lens:

- Principle ray #1: incoming ray parallel to the optical axis will refract away from the near focal point.

- Principle ray #2: incoming ray that goes toward the far focal point will refract parallel to the optical axis.
- Principle ray #3: incoming ray that goes through the center of curvature will follow a straight path as it goes through the lens.

---

This page titled [10.9: Summary](#) is shared under a [not declared](#) license and was authored, remixed, and/or curated by [Dina Zhabinskaya](#).