16.2.8: Double Concave Lenses

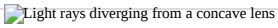

Figure 14.8.1

The three light rays traveling into the concave lens shown above travel away from each other. For this reason, concave lens are also called diverging lenses. As a result of this light divergence, concave lenses create only virtual images.

Images in Double Concave Lenses

Every **concave lens** causes all rays to diverge. Rays that approach the lens parallel to the principal axis refract as if they came from the focal point.

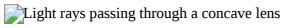

Figure 14.8.2

As you can see in the figure above, the light rays hit the lens and refract away from each other. Since none of these rays will intersect, a real image cannot exist. Instead, all images created by a double concave lens are virtual images. Like in all ray diagrams, images can be found using two rays.

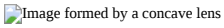

Figure 14.8.3

The first ray, shown above, begins from the tip of the image and travels to the lens parallel to the principal axis. Within the lens, this ray is refracted away from the principal axis such that the virtual ray (shown as a dotted line) travels back to the focal point. The second ray also leaves from the tip of the object, and travels straight through the center of the lens. The image will be where these two rays intersect - one real and one virtual. Since one ray is a virtual ray, the image will always be virtual, as well as upright and diminished.

Like for convex lenses, the lens equation and magnification equations can be used to calculate image size and distance for double concave lenses. When using the lens equation with a concave lens, however, the focal length must be assigned a negative value.

In the Contact Lens simulation below, the Lens Slider allows you to choose between a converging (convex) contact lens and a diverging (concave) contact lens. Try to view different objects at different distances using these two lenses and determine what is the best shape for the contact lens:

Summary

- A concave lens causes all rays to diverge.
- Concave lenses create only virtual images. After the rays are refracted, they never converge and so there will be no real images.
- All concave lens images will be upright, virtual, and diminished, and can be found between the *F* and the lens.
- When using the lens equation with a concave lens, the focal length must be assigned a negative value ($(1/d_i)+(1/d_o)=(1/-f)$).

Review

1. An object is placed 15.0 cm in front of a concave lens with a focal length of 8.00 cm. Find the image distance. Hint: $1di+1do=1-f$

2. An object is placed 3.00 cm in front of a concave lens with a focal length of 5.00 cm. Find the image distance. Hint: $\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{-f}$
3. What physical characteristic of a lens distinguishes a converging lens from a diverging lens?
4. An 2.00 cm tall object is placed 20.0 cm in front of a concave lens with a focal length of 5.00 cm. Find the image distance and the height of the image. Hint: $\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{-f}$ and $\frac{h_i}{h_o}=\frac{-d_i}{d_o}$

Explore More

Use this resource to answer the questions that follow.

1. Concave lenses are _____ (thicker or thinner) in the middle.
2. Concave lenses are also called _____ lenses.
3. All images from concave lenses are _____ (real or virtual).

Additional Resources

Study Guide: Geometric Optics Study Guide

Real World Application: A View Through a Lens

Video: