Name: _____ Date: _____ Period: **B**

Vocabulary and Notes

Ray Diagrams are drawings that trace rays of light so that you can figure out what an image (real or virtual) created by a lens or mirror will look like. In traditional ray diagrams, the object being considered is usually drawn as an arrow. It's simple, it's easy to draw, and it shows the important aspects of the images created: size, location, and orientation.

The **optical axis** (also known as the **principal axis**) is an imaginary line that runs perpendicular to the lens or mirror and runs through the center of it in both directions.

Any rays of light that enter a lens or strike a mirror parallel to the optical axis will refract or reflect towards the **focal point**, a point on the optical axis.

The **focal length** is the distance between the lens (or mirror) and the focal point.

Any time that one end of the object (arrow) rests ON the optical axis, the image created by the lens or mirror, whether real or virtual, will show that end of the object also on the optical axis.

A **real image** is an image created by the convergence of rays of light that are either reflected or refracted. Real images may be projected onto a screen.

A **virtual image** is an image created when the rays of light reflected or refracted do NOT converge. Virtual images cannot be projected onto a screen, and are only visible when looking through the lens or at the mirror. They are, effectively, optical illusions.

Plane mirror	Flat mirror, like in your bathroom.
Concave	Center is thinner than the edges. The lens or mirror is "caved in." Think of the front (hollow) of a spoon.
Convex	Center is thicker than the edges. Think of an M & M candy or a magnifying glass lens or the back of a spoon.
Converge	To come together
Diverge	To go apart

An interesting site that has a cool tool that you can play with that shows how ray diagrams work:
(thin lens demo by Fun-Kwun Hwang)

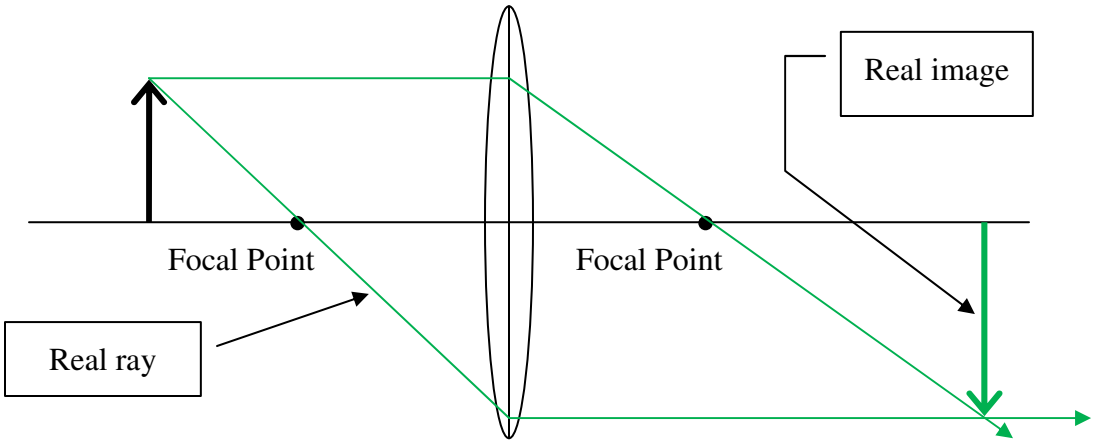
http://www.physics.metu.edu.tr/%7Ebucurgat/ntnujava/Lens/lens_e.html

Convergent Lenses and Mirrors

Both a convex lens and a concave mirror are considered "convergent" because light rays that hit them *can* converge after they are refracted/reflected. Convergent lenses or mirrors can create either real images or virtual images.

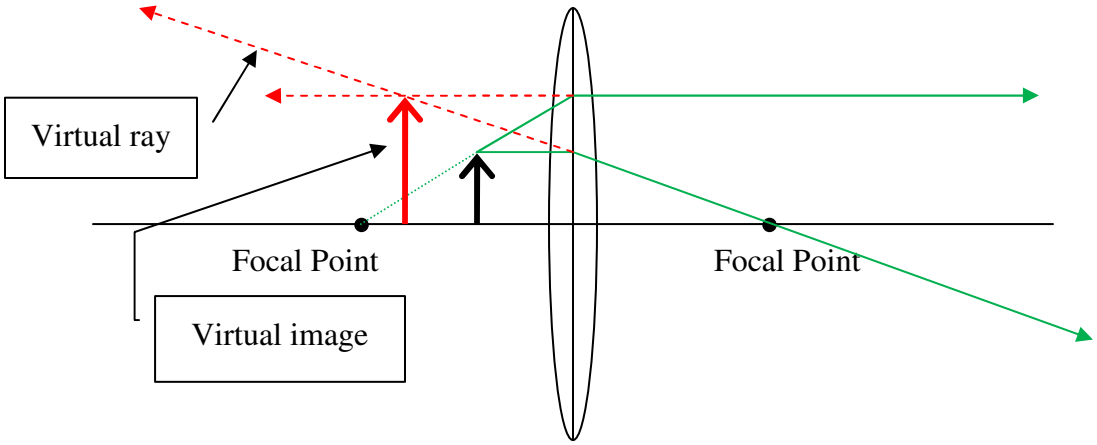
Convex Lens: Object is farther than focal length away from lens

You will see a real image, inverted, on the other side of the lens.



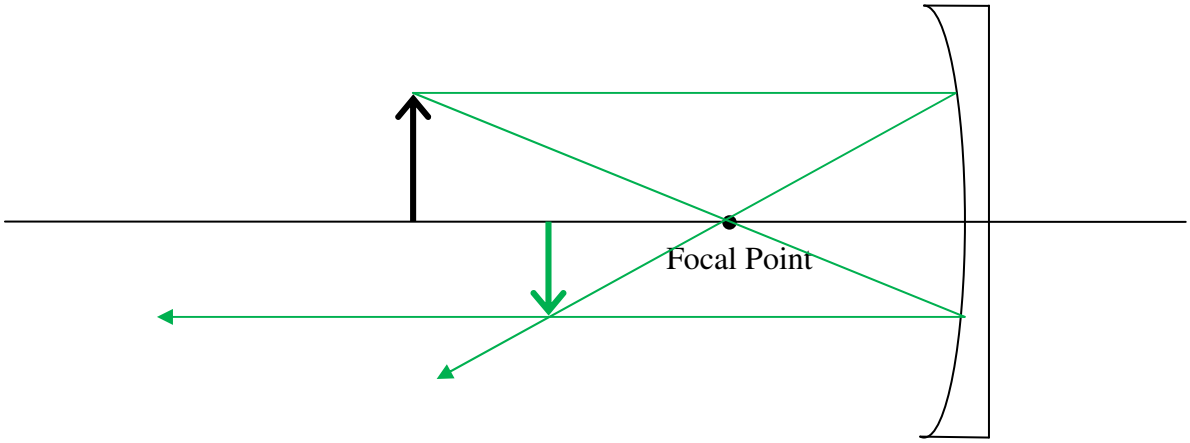
Convex Lens: Object is closer than focal length away from lens

You will see a virtual image, larger than the original image, and upright. The virtual image will appear on the same side as the actual object, and will be visibly only if you are looking through the lens at the virtual image. Here, the refracted waves actually diverge, so the formation of a real image is impossible.



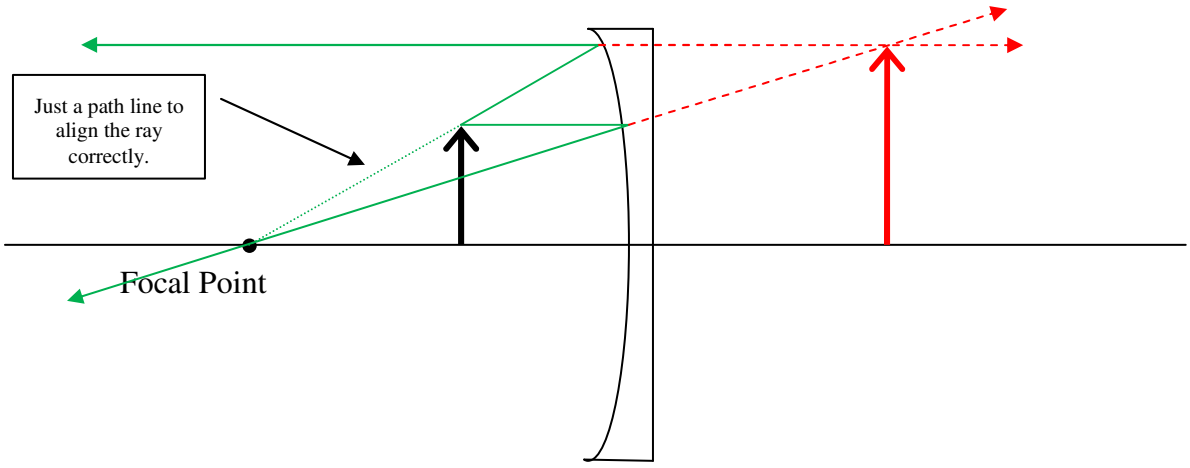
Concave Mirror: Object is farther than focal length away from mirror

You will see a real image, inverted, on the same side as the object.



Concave Mirror: Object is closer than focal length away from mirror

You will see a virtual image, upright, that appears on the other side of the mirror. You will be able to see the image only if you are looking at the mirror from the same side as the object. Here, the reflected rays diverge, so a real image is impossible.

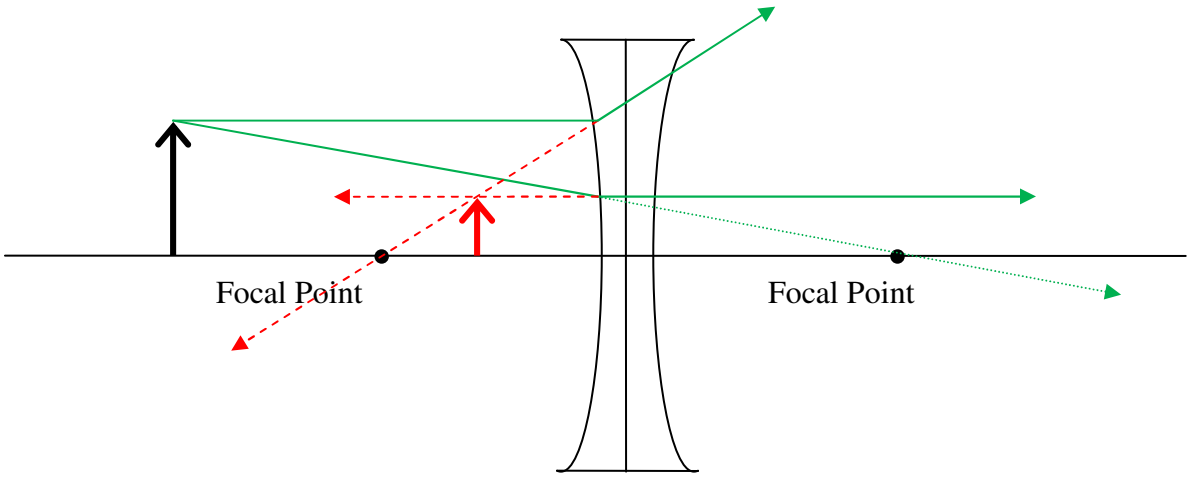


Divergent Lenses and Mirrors

Both concave lenses and convex mirrors are considered "divergent" because light rays that are reflected/refracted by them diverge. Divergent mirrors and lenses can form only virtual images.

Concave Lens

Regardless of where the object is, relative to the focal point, the virtual image will always appear smaller than the object, upright, and between the object and the lens. It is visible only through the lens.



Convex Mirror

Regardless of where the object is, relative to the focal point, the virtual image will always appear smaller than the object, upright, and on the other side of the mirror from the object. It is visible only when looking at the reflective face of the mirror.