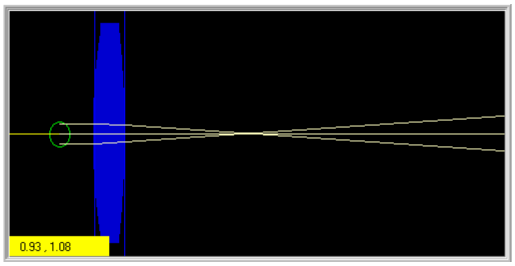
Worksheet for Exploration 35.5: Lens Maker's Equation



Light rays from a beam source, initially in air, are incident on a material of different index of refraction **(position is given in centimeters)**. You can change the curvature of the surface of the material as well as the index of refraction. Restart.

a. Build a plano-convex lens. Decrease the radius of curvature of the left side while keeping the right at 30 cm. As you decrease the radius of curvature, what happens to the beam?

When the curvature of the left side is 1 cm, where is the point where all the rays converge?

How far is the point where the rays converge from the center of the "lens" you are making? This is the focal point of the lens.

b. What happens if you keep the left side essentially flat (radius = 30 cm) and decrease the radius of curvature of the right side?

What is the focal point when this radius is 1 cm?

What happens to the focal point if you increase the index of refraction of the material?

What happens if you decrease it?

c. Build a double-convex lens. Decrease the radius of curvature of both sides of the lens. What is the focal point when the radius of curvature is 1 cm for both sides?

How does the focal point change with a different index of refraction?

d. Analytically, the focal length is described by the lens maker's equation: $1/f = (n-1)(1/R_1+1/R_2)$ where R_1 and R_2 are the radii of curvature, f is the focal length, and n is the index of refraction. Verify that your earlier measurements are consistent with this equation.

$f =$________

$n =$________

$R_1 =$________

$R_2 =$________

e. For lenses made from glass ($n = 1.5$), show that the radius of curvature of a double-convex lens (where the radii of both sides is the same) is equal to the focal length.