Homework 6

Last time we discussed how to calculate focal distance of a thin lens. It can be done with the expression below:

$$\frac{1}{f} \approx \left(\frac{n_{lens}}{n_{env}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

This expression is also called "lensmaker's equation". Here nlens and n env are the refractive indices of the lens material and of the environment. R_1 and R_2 are the radii of curvature of the front lens surface and back lens surface. "Front" and "back" are determined as the first and the second (last) surfaces the light "meet" as it passes through the lens. If the surface is convex, the curvature radius is positive; for concave surface the radius of curvature is negative.

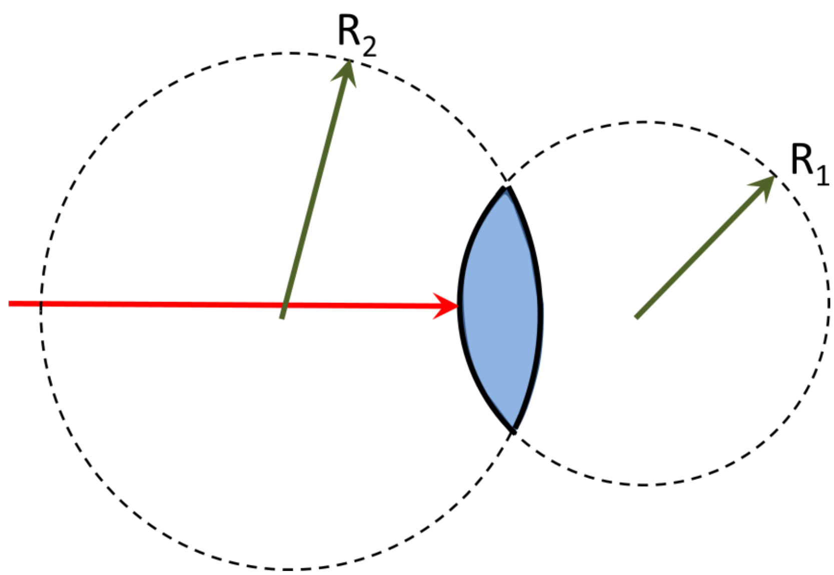

Figure 1 Biconvex lens

For the biconvex lens shown in Figure 1 light moving from left to right first "meets' the convex surface with radius of curvature R_1. Then, moving inside the lens, the light "meets" another surface, concave, with radius of curvature R_2. So in the lensmaker's equation for a biconvex lens R_2 has to be taken with "minus" sign.

Questions:
1. Does the focal distance of a lens change if we put the lens it in water?
2. Can same lens work as a converging or diverging lens depending on the substance it is placed in?
3. In a thick glass plate there is a hollow shaped as a convex lens. Will this "lens" work as converging or diverging? Prove your answer.

4. A convex-concave lens (see fig. below) has radii of curvature R=10cm and 3R. Find refractive index of the lens material if its focal length is 20 cm. (The lens is in air, n=1)