Solving a case:

An extremely rich individual decides to gift his mother a convex lens made out of diamond. He orders for a lens of diameter of 1.2 m. The diamond merchant cheats the customer and makes the lens out of cubic zirconia, and claims innocence. You being the Physics investigator are called for to prove that the lens is not made of diamond.

Calculate the focal length for the two lenses

For diamond, $n = 2.419$, therefore

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$f = \frac{1}{(n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)} = \frac{1}{(2.419)\left(\frac{1}{60} - \frac{1}{60}\right)} = 21.1\text{ cm}$$

For CZ, $n=2.2$, therefore

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$f = \frac{1}{(n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)} = \frac{1}{(2.2)\left(\frac{1}{60} - \frac{1}{60}\right)} = 25\text{ cm}$$

For any given object distance, the corresponding image distance can be calculated using lens makers equation, and the nature of the image determined. As an example consider an object distance of 22 cm.

The diamond lens would form an image at

$$\frac{1}{0.211m} = \frac{1}{0.22cm} + \frac{1}{q}$$

$$q = 5.15m$$

And the image is real, inverted and magnified 23 times

For the same object distance of 22 cm, the CZ lens would form an image at

$$\frac{1}{0.25m} = \frac{1}{0.22m} + \frac{1}{q}$$

$$q = -1.8m$$

And the image is virtual, upright and would form on the same side as that of the object.