

Answer on Question #52354, Physics, Optics

A double convex lens of focal length 20 cm is made of glass of refractive index 3/2. When placed completely in water ($\mu_w = 4/3$) its focal length will be..

1) 80cm. 2) 15cm. 3) 17.7cm. 4) 22.5cm_w

Solution:

The focal length of a lens can be calculated from the lensmaker's equation:

$$\frac{1}{f} = \frac{(\mu_2 - \mu_1)}{\mu_1} \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

In first case (lens in air)

$$\frac{1}{f_a} = \frac{(3/2 - 1)}{1} \left(\frac{1}{R} + \frac{1}{R} \right)$$

In first case (lens in water)

$$\frac{1}{f_w} = \frac{(3/2 - 4/3)}{4/3} \left(\frac{1}{R} + \frac{1}{R} \right)$$

$$\frac{f_w}{f_a} = \frac{\frac{3}{2} - 1}{\frac{3}{2} - \frac{4}{3}} * \frac{4}{3} = 4$$

$$f_w = 4 * f_a = 4 * 20 \text{ cm} = 80 \text{ cm}$$

Answer: 1) 80cm