2.4: Convergence

Figure II.5 shows a lens made of glass of refractive index 1.50. To the left of the lens is air (refractive index 1.00). To the right of the lens is water (refractive index 1.33). A converging beam of light is incident upon the lens directed toward a virtual object O that is 60 cm from the lens. After refraction through the lens, the light converges to a real image I that is 20 cm from the lens.

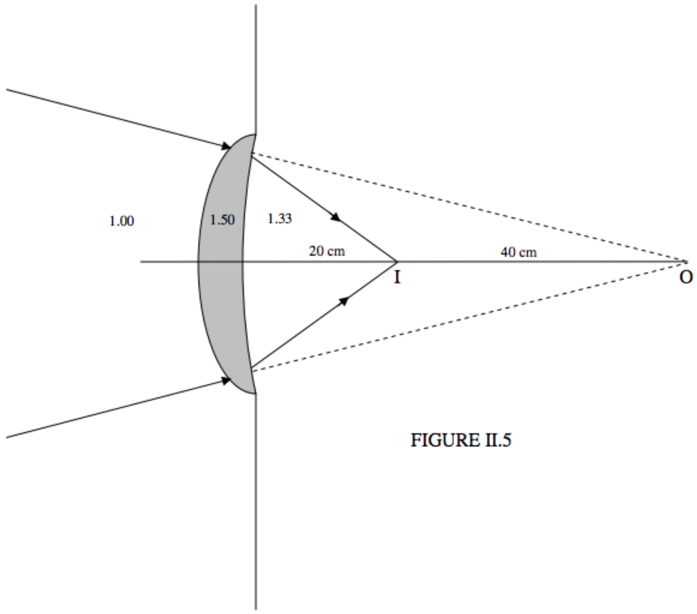

FIGURE II.5

I am not at this stage going to ask you to calculate the radii of curvature of the lens. (You can't – you need one more item of information.) I just want to use this diagram to define what I mean by *convergence*.

The convergence of the light at the moment when it is incident upon the lens is called the *initial convergence* C_1, and it is defined as follows:

$$initial\ convergence = \frac{Refractive\ index}{Object\ distance}. \tag{2.4.1}$$

The convergence of the light at the moment when it leaves the lens is called the *final convergence* C_2, and it is defined as follows:

$$final\ convergence = \frac{Refractive\ index}{Image\ distance}. \tag{2.4.2}$$

Sign convention

- Converging light has positive convergence;
- Diverging light has negative convergence.

Example 2.4.1

Initial convergence = $+\frac{1.00}{60} = +0.01667\ \text{cm}^{-1}$.

Final convergence = $+\frac{1.33}{20} = +0.06650\ \text{cm}^{-1}$.

Notice that, before the light enters the lens, it is in a medium of refractive index 1.00. Thus the relevant refractive index is 1.00, even though the virtual object is in the water.