

13. (a) We use Eq. 35-8 and note that $n_1 = n_{\text{air}} = 1.00$, $n_2 = n$, $p = \infty$, and $i = 2r$:

$$\frac{1.00}{\infty} + \frac{n}{2r} = \frac{n-1}{r} .$$

We solve for the unknown index: $n = 2.00$.

- (b) Now $i = r$ so Eq. 35-8 becomes

$$\frac{n}{r} = \frac{n-1}{r} ,$$

which is not valid unless $n \rightarrow \infty$ or $r \rightarrow \infty$. It is impossible to focus at the center of the sphere.