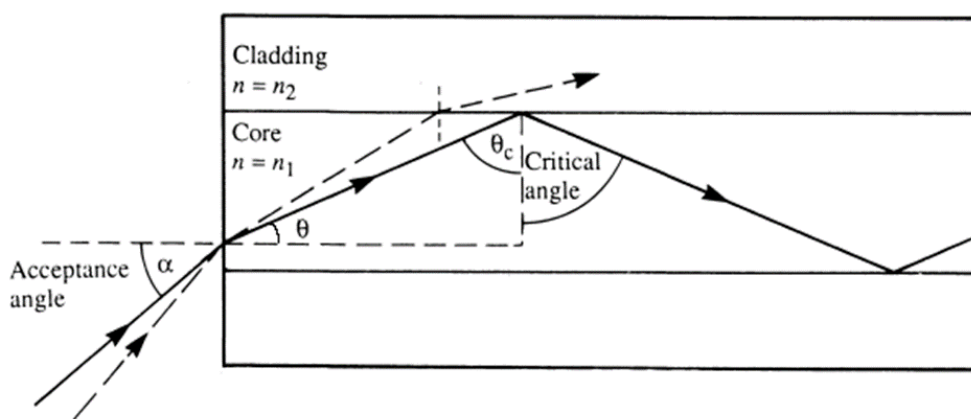# Answer on Question #60471, Physics / Optics

Define numerical aperture and angle of acceptance. An optical fiber has a numerical aperture of 0.20 and cladding refractive index of 1.59. Calculate the refractive index of the core material and the acceptance angle of the fibre in water whose refractive index is 1.33.

Solution:

Given:
NA = 0.2
n_2 =1.59

The Numerical Aperture (NA) is a measure of how much light can be collected by an optical system such as an optical fibre or a microscope lens.
The NA of any glass combination may be calculated as follows:
$$NA = \sqrt{n_1{}^2 - n_2{}^2}$$
where n_1= the index of refraction of the core glass, and n_2=the index of refraction of the cladding glass.
Thus,
$$n_1 = \sqrt{NA^2 + n_2^2} = \sqrt{0.2^2 + 1.59^2} = 1.602 \approx 1.60$$

The NA is related to the acceptance angle α, which indicates the size of a cone of light that can be accepted by the fibre.
$$NA = n_0 \sin \alpha$$
where n_0 is refractive index of medium outside the fiber. For water n_0 =1.33.

Thus,
$$\alpha = \sin^{-1}\left(\frac{NA}{n_0}\right) = \sin^{-1}\left(\frac{0.2}{1.33}\right) = 8.649° \approx 8.65°$$

Output: $n_1 = 1.60; \alpha = 8.65°$.