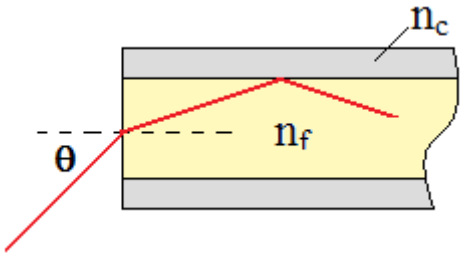
# Optics

## Fiber Optics

**Problem 1.-** A model of an optical fiber is shown in the figure below. The optical fiber has an index of refraction $n_f$, and is surrounded by cladding with index of refraction $n_c$, which is smaller that $n_f$, but larger than 1.
What is the maximum angle of incidence Θ that will result in the light staying in the optical fiber?




A) $\theta_{max} = \sin^{-1}\left(\sqrt{n_f^{\,2} - n_c^{\,2}}\right)$

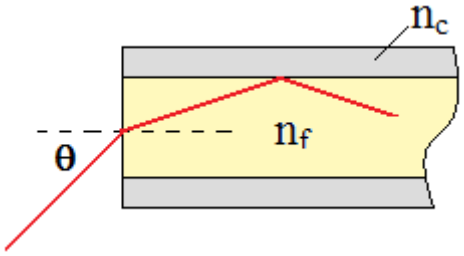
B) $\theta_{max} = \sin^{-1}\left(\sqrt{n_f^{\,2} + n_c^{\,2}}\right)$

C) $\theta_{max} = \sin^{-1}\left(\sqrt{n_c^{\,2} - n_f^{\,2}}\right)$

D) $\theta_{max} = \cos^{-1}\left(\sqrt{n_f^{\,2} - n_c^{\,2}}\right)$

E) $\theta_{max} = \cos^{-1}\left(\sqrt{n_f^{\,2} + n_c^{\,2}}\right)$

**Problem 2.-** A model of an optical fiber is shown in the figure below. The optical fiber has an index of refraction $n_f = 1.52$ and is surrounded by cladding with index of refraction $n_c = 1.3$
What is the maximum angle of incidence Θ that will result in the light staying in the optical fiber?




A) $\theta_{max} = 45^\circ$ B) $\theta_{max} = 48^\circ$ C) $\theta_{max} = 50^\circ$

D) $\theta_{max} = 52^\circ$ E) $\theta_{max} = 54^\circ$

**Solution:** The maximum angle is

$$\theta_{max} = \sin^{-1}\left(\sqrt{n_f^{\,2} - n_c^{\,2}}\right) = \sin^{-1}\left(\sqrt{1.52^2 - 1.3^2}\right) = 52^\circ$$ Answer: **D**