1 Fiber optics: problem 1

The incidence plane of a ray SI propagating into the air and then to the fiber is shown in Fig.1
(1) Show that if the angle θ_i is inferior to the angle θ_a, then a ray can be guided into the core. We call the numerical aperture the quantity $\sin(\theta_a)$. Express such a quantity in function of n_1 and Δ, ans evaluated. umerically for the value $\Delta = 10^{-2}$ and $n_1 = 1.5$.
(2) A light pulse arrives at $t = 0$ to the point O (r=0) under the conical convergence (faisceau), of half-angle $\theta_i < \theta_a$. For an optical fiber of length l, calculated the temporal broadening Δt of this pulse at the output of the fiber. Express Δt with respect to l, n_1, c and θ_i. Calculated Δt for $l = 10$ km, $\theta_i = 8$ and $n_1 = 1.5$.
(3) We send to the input of the fober ultra short pulses of duration δt and with period T. What is the minimal value of T so that the pulses are separated at the output of the fiber?

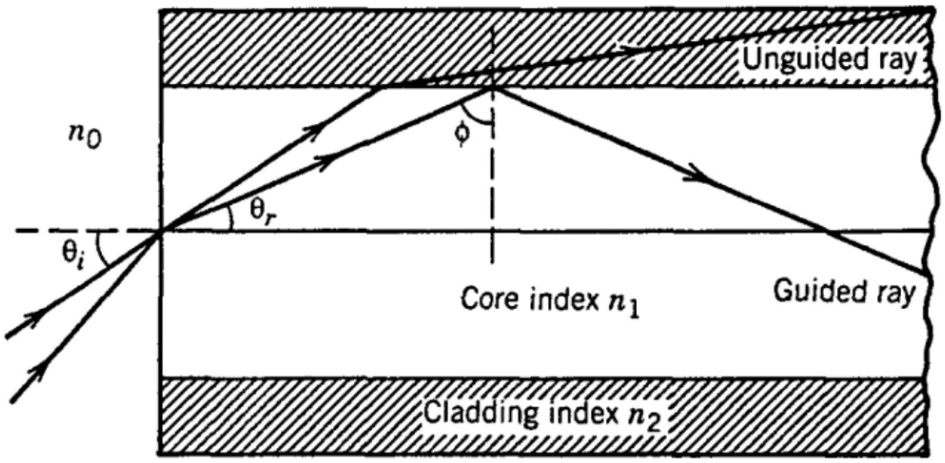

Figure 1: Fiber optics.