

Name:

KEY

ID Number:

a) Consider a thin lens with a focal length of 3cm and 2cm diameter. The lens is used to focus a collimated uniform beam of light having a diameter of 8mm . The wavelength of the beam equals $1.3\mu\text{m}$. Calculate the diameter of the focused beam.

b) The velocity of light in the core of an optical fiber is $2 \times 10^8 [\text{m/s}]$ and the critical angle at the core-cladding interface is 70° . Calculate the acceptance angle of the optical fiber in air.

a)

$$d = \frac{2.44 \lambda f}{D} = \frac{2.44 \times (1.3 \times 10^{-6} \text{m}) (3 \times 10^{-2} \text{m})}{8 \times 10^{-3} \text{m}} = 11.9 \mu\text{m}$$

$$b) \quad n_1 = \frac{c}{v} = \frac{3 \times 10^8}{2 \times 10^8} = 1.5$$

$$\sin \theta_c = \frac{n_2}{n_1} \Rightarrow n_2 = n_1 \sin \theta_c = 1.5 \sin 70^\circ = 1.4095$$

$$NA = \sqrt{n_1^2 - n_2^2} = \sqrt{(1.5)^2 - (1.4095)^2} = 0.513$$

$$n_0 \sin \theta = NA$$

$$(1) \sin \theta = 0.513 \Rightarrow \theta = 30.87^\circ$$