

1. What is the difference between FM and AM radio waves. Using the cut-off frequencies between the AM to FM radio frequencies, estimate the number density of the ions in the ionosphere.
2. A fish looking straight up toward the smooth surface of a pond receives a cone of rays and sees a circle of light filled with *all* the images of the sky and whatever else is up there. This bright circular field is surrounded by darkness. Explain what is happening and compute the angle of the cone.
3. A polarizing goggle cuts out nearly 50% of natural light, by allowing either horizontally or vertically polarized light. In order to block *glare* from the twilight sun (*i.e.* when sun's rays reflect at an grazing angle) a specific polarization direction is blocked out. Analyze and determine which polarization state is blocked out (Horizontal or Vertical).
4. Consider the fiber given below. The Numerical Aperture of a fiber is defined as $n_i \sin(\theta_{max})$. Determine the maximum acceptance angle θ_{max} for which all the rays with $\theta < \theta_{max}$ will suffer total internal reflection and thus propagate through the fiber. ($n_{core} = 1.62$, $n_{cladding} = 1.52$, $D = 10 - 100\mu m$)
5. Draw the ray diagram for a water drop creating a Rainbow for a terrestrial observer. Utilizing *normal dispersion* determine the sequence of colors in the rainbow. Do different colors arise out of drops at the same angle? What happens in the secondary Rainbow? Can two observers see the same Rainbow?
6. **Discussion - Light in every day life**
 - a) Role of glass in a silvered mirror
 - b) Bright white colour of Talcum powder versus Grey colour of wet Talcum powder
 - c) Colour of Paints/Cloth - dyes
 - d) Colour in Carrots/leaves and other organic substances
 - e) Colour of Water vapour and Crumpled plastic
 - f) Colour in Soap bubbles, Peacock feather

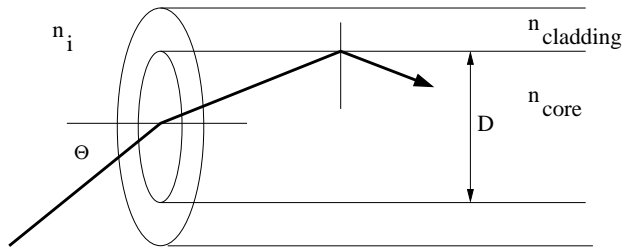


Figure 1: Figure for Problem 4