Physics 206b

Homework Assignment XIII
Due November 16 (Friday), 2007

1. Place the following in order of either increasing or decreasing wavelength (be sure to state which way you're going). In each case, give an approximate wavelength in vacuum ***and*** frequency for the entity:
   a) Yellow light
   b) Blue light
   c) Radio waves
   d) Ultraviolet
   e) X-Rays
   f) Green light
   g) Infrared
   h) Gamma rays
   i) Microwaves
2. When light enters a piece of glass, it slows down. Since we know that $\lambda \times f = \mathrm{v}$, where v is the speed of light inside the glass, either the wavelength or the frequency (or both!) must change, since v is always smaller than c. Explain why it is that the wavelength changes and not the frequency.

3. A ray of light enters a sheet of glass, like a windowpane. The two faces of the piece of glass are flat and parallel to each other. The angle of incidence of the ray is 30°. The piece of glass is 5 millimeters thick. Neglect the reflected portion of this ray in this problem. Take the refractive index of the glass to be n=1.5

   a) Make a sketch showing the incident ray and the refracted ray. Also, show the ray striking the far side of the glass on its way out and the ray leaving the sheet of glass.

   b) What is the angle the refracted ray makes with the sheet of glass? Be sure to indicate this on the sketch you made in (a).

   c) What angle will the ray make with the far side of the sheet? Again, indicate this on your sketch.

   d) What angle will the ray make with the glass upon leaving it? Once again, indicate this clearly on your sketch.

4. A ray of light enters a glass fiber (n=1.5). The fiber is cylindrical and the end is exactly perpendicular to the axis. The fiber is "clad" with a material with an index of refraction of n_{clad}=1.47. (The cladding completely surrounds the fiber except for the ends.) What is the "acceptance angle" of this fiber? The "acceptance angle" is the maximum angle of incidence for which rays will remain trapped in the fiber.
5. An object is placed 14 cm away from a lens with a focal length of 9 cm. Determine the location of the image using the thin lens formula. Also, determine the magnification of the system.
6. For the object and lens described above, at the separation stated above, Use ray tracing to determine, qualitatively, the location of the image. (I.e., you needn't be ultra-precise in this, but do keep the distances as close to proportional as you can.)