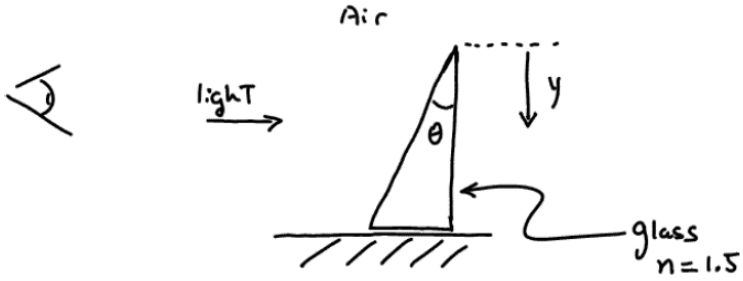
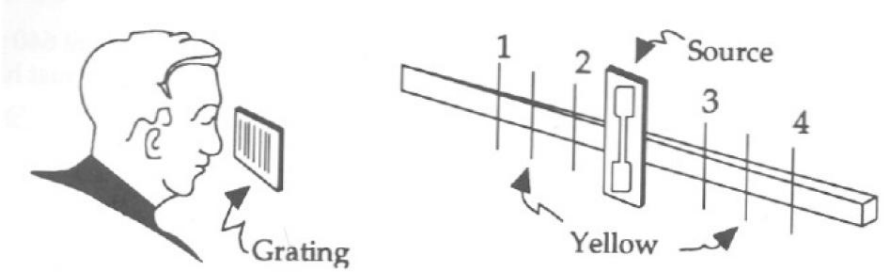
Workshop module 8 - Physics 123, Spring 2013

1. A two-slit interference experiment is set up, and the fringes are displayed on a screen. Then the whole apparatus is immersed in a swimming pool. How does the fringe pattern change?
2. Monochromatic light is directed at normal incidence on a thin film. There is destructive interference for the reflected light, so its intensity is very low. What happened to the energy of the incident light? How does this relate to the need for coatings on a camera lens?
3. The human ear is especially sensitive to sounds at frequencies around 3500 Hz. Show that this can be understood by regarding the ear's auditory canal, which extends about 2.5 cm from the outside ear to the eardrum, as a "nonreflecting coating" for sound.
4. A plane transmission grating has 4000 slits/cm. Assume normal incidence. The α and δ lines emitted by atomic hydrogen have wavelengths 656 nm and 410 nm, respectively. Compute the angular separation in degrees between these lines in a) the first order spectrum and b) the second order spectrum.

5. A triangular piece of glass is illuminated from the front as shown in the sketch. The light has a wavelength of 500×10^{-9} m. The index of refraction of the glass is 1.5. If the angle theta (as shown in the graph) is 0.2 degrees, what is the distance between dark fringes along the direction y as seen by the observer in the sketch?



6. A student looks through a transmission grating at the light from a helium light source. He sees the red, yellow, and green light from the source superimposed on a meterstick. If the yellow lines are the ones indicated in the figure, then



a) 1 and 2 are green; 3 and 4 are red.
b) 1 and 4 are red; 2 and 3 are green.
c) 1 and 4 are green; 2 and 3 are red.
d) 1 and 3 are red; 2 and 4 are green.
e) 1 and 3 are green; 2 and 4 are red.

7. Plane light waves are incident on a single slit of width 2 cm. The second dark fringe is observed at 43 degrees from the central axis. What is the wavelength of the light?

8. Two bright point sources of light (at a wavelength of 450 nm) separated by the width of a dime could be resolved at what maximum distance by the Hubble Space Telescope? For simplicity, let the dime be 1 cm wide. Assume the Hubble has an aperture diameter of 2.4 m.

9. What size object would you estimate a spy satellite (e.g., similar to the Hubble) could image on earth?