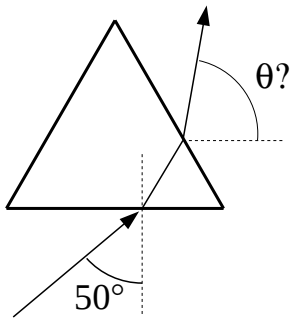
Answer **five** of the following six problems

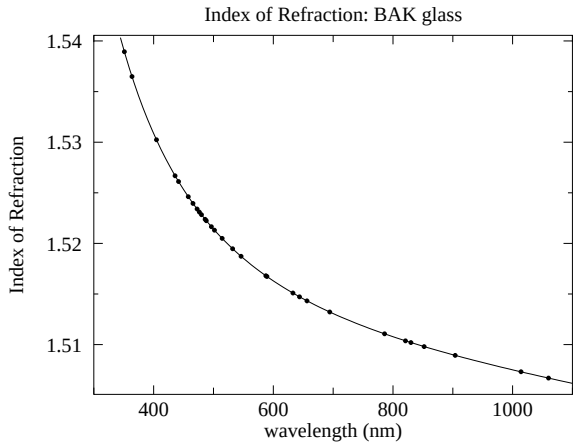
1. The intensity of sunlight outside the Earth's atmosphere is about 1367 W/m^2.

   (a) Find the corresponding maximum electric field for such intense light.

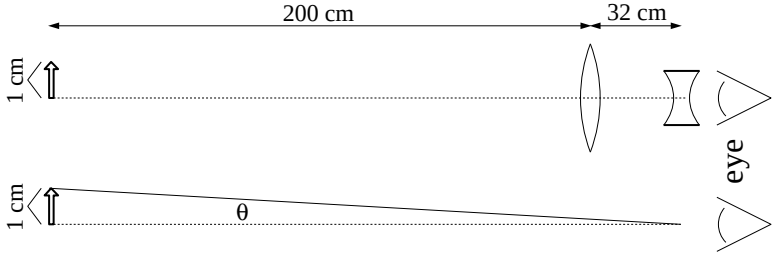
   (b) Find the radiation pressure resulting from 100% absorption of such light.

2. As shown in the following diagram, light is incident at an angle of 50° on a equilateral (all angles 60°) prism made of BAK glass. The light is a mixture of two wavelengths: 400 nm and 800 nm. The index of refraction of BAK glass as a function of wavelength is plotted below. Find the exit angles θ for the 400 nm and 800 nm light. (Retain 4 significant digits for this problem.)





3. A 1 cm high object is 200 cm to the left of a converging lens with focal length 30 cm. A diverging lens with focal length −3 cm is 32 cm to the right of the converging lens. Where is the image? What is the magnification? Is the image virtual? Upright? As viewed by an unaided eye 232 cm from the object (i.e., the same distance as an eye next to the diverging lens), what angle would the object subtend? What angle does the image subtend as viewed through the lenses?



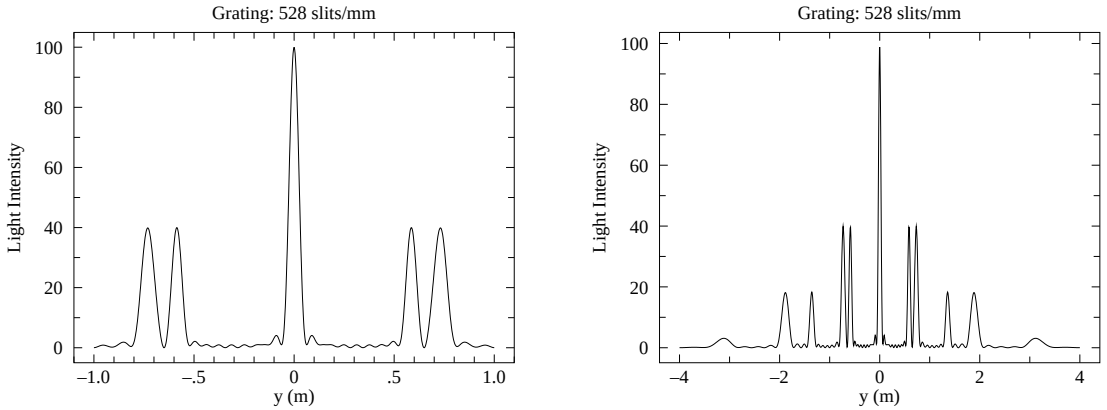
4. Consider normally incident light *exiting* anti-reflection coated glass. Assume that the coating has an index of refraction intermediate between that of glass and air.

   (a) As the light leaves the glass (i.e., at the glass-coating interface), is the reflected light in phase with the incident light? As the light leaves the coating (i.e., at the coating-air interface), is the reflected light in phase with the incident light?

   (b) If the glass-coating reflected light and the coating-air reflected light are to have the same amplitude, what condition must be met?

   (c) If the glass-coating reflected light and the coating-air reflected light are to destructively interfer, write down the equation that reports how thick should the coating be.

5. A beam of light, consisting of a mixture of two wavelengths, is normally incident on a diffraction grating with 528 slits/mm. The light intensity on a screen $D = 2$ m from the slit is recorded and plotted below. (A) What are the two wavelengths of light? Directly on the below plot label each peak with its correpsonding order m and wavelength. (B) Notice for $y > 0$ there are 5 big peaks—an odd number, so there must be a "missing" peak. Where is the partner of the rightmost peak? (C) Estimate the value of the slit width a. (The graphs are a bit ambiguous, so please carefully report the **basis** for your estimate. I expect I'll get varying answers, but I hope all will be based on proper methods!)



6. A object sits 6 units from a $f = +10$ unit lens. Calculate the location and magnification of the image. Directly on the below diagram, accurately draw (using a ruler) the three principal rays and use those rays to locate the image. Compare the ray-based image size and location to your calculated values.