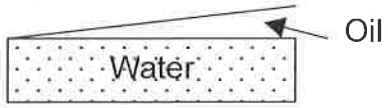
Big Exam #4 Name Pete

1. We've looked at the rainbow in two similar systems: a bubble of soap film that gets thicker near the bottom, and an oil slick on top of some water that has variable thickness. Consider that the edge of the oil slick and the top of the soap film have a thickness of one molecule, around a nanometer…
   a) how does the thickness of the thinnest layer compare with the wavelength of light?
   b) Consider the light reflected from the surface of the films. At the point where it is thinnest, would you find that there is no light reflected? All wavelengths are reflected? Or is it different for the two different systems? Please explain.

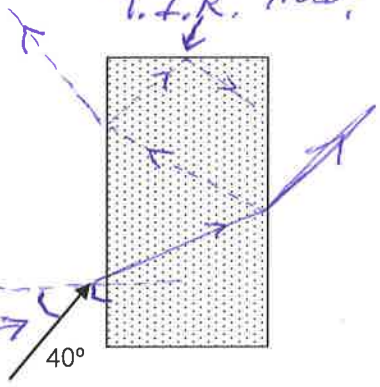


a) $\ell_{molecule} \ll \lambda_{visible}$

b) when $\Delta x \to 0$, Slick has ~~dark~~ bright spot, no color
Soap film has dark spot, no color
in reflected light.

2. Below, you see a rectangular piece of glass, (n=1.4).
   a. Find the angle of refraction and ***carefully*** finish the drawing of the ray through the rectangle.

Critical & T.I.R. How?



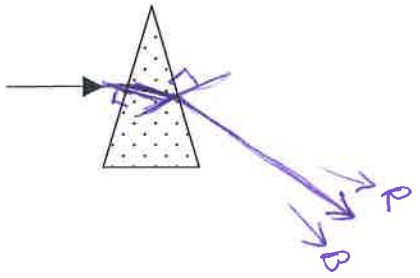
for Snell's law must use this angle

   b. (1 pt) Calculate the critical angle in this medium showing work

$\theta_2 = 90°$ ... use Snell's law.

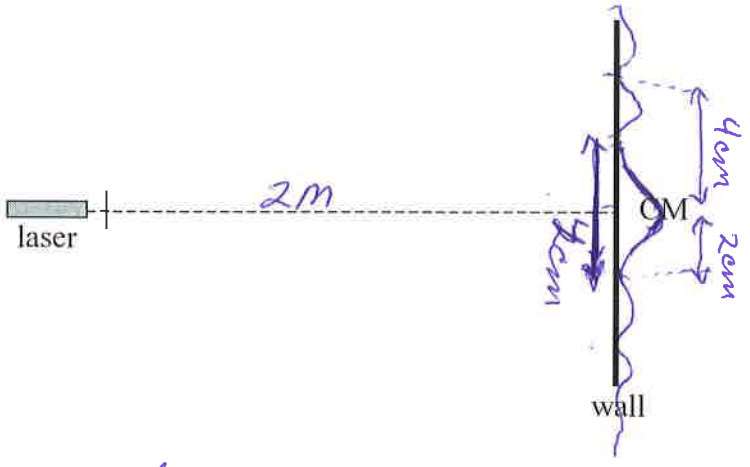
   c. (1 pt) Find a way to draw a ray that will experience total internal reflection. Add this ray to the diagram above. Angles should be approximately correct.

   d. (1 pt) Continue the ray through the glass object at right (no math necessary).



I start here

3. I do an experiment with ***one single slit*** (thickness = 50 um) in front of a tunable green laser (500 nm). At a distance of 2 m from the slits, there is a wall
   a. Draw the resulting pattern on the wall
   b. Label the relevant distances between bright spots in your drawing
   c. How is this pattern different from that of a two slit or many slit experiment?



~~fro~~

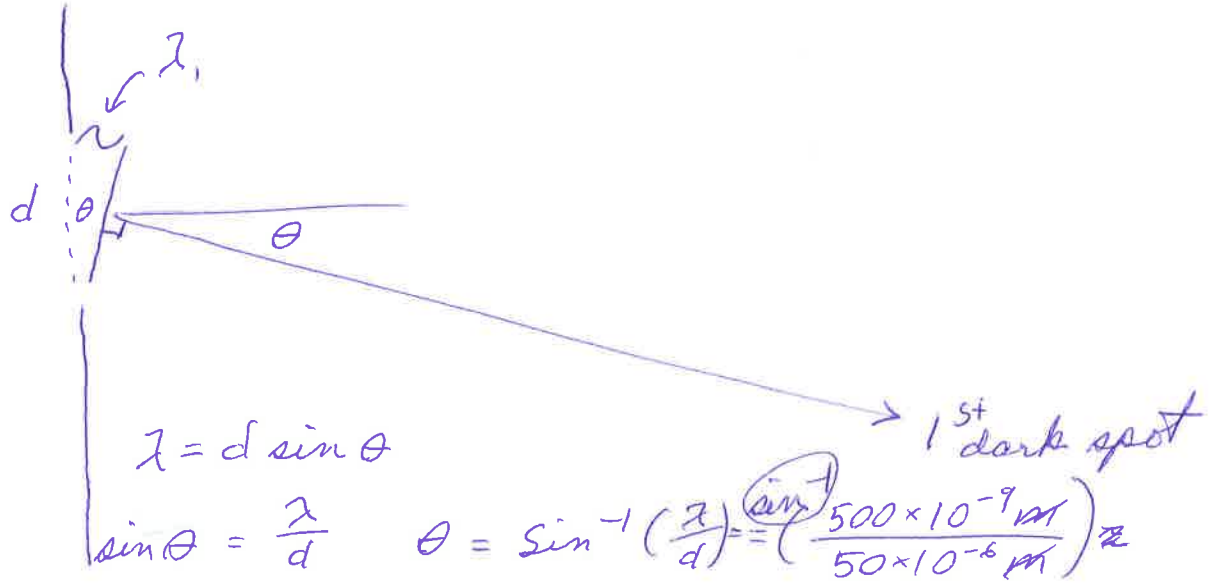
for small θ approx:

$\theta \approx \sin\theta \approx \tan\theta \approx 0.01$

So, the distance between central max + dark #1 spot is 2cm, making central max 4cm wide. ~~the~~ diffraction peaks are only 2cm wide!

$\Rightarrow$ in a 2 slit experiment

   d. Explain with a drawing why there should be this pattern. *Should you have done this part of the question first?*



$\lambda = d \sin\theta$

$\sin\theta = \frac{\lambda}{d}$ $\quad \theta = \sin^{-1}\left(\frac{\lambda}{d}\right) = \left(\frac{500\times10^{-9}\,m}{50\times10^{-6}\,m}\right) \approx$

$= \sin^{-1}\left(\frac{1}{100}\right) \approx \frac{1}{100}$ rad for small $\angle$ approximation