PHY152 PRACTICE PROBLEMs FOR WEEK 10 PRACTICALS

Q1 Consider a light source emitting a light beam horizontally with wavelength $\lambda = 400.0$nm, and the light goes along the horizontal direction through the center of a diffraction grating of length 2.00 cm with 10,000 evenly distributed (or spaced) slits oriented perpendicular to the light beam. A screen is set 10.0 cm away from the grating and also oriented perpendicular to the light beam. What is the distance between central maximum and 1st order maximum on the screen?

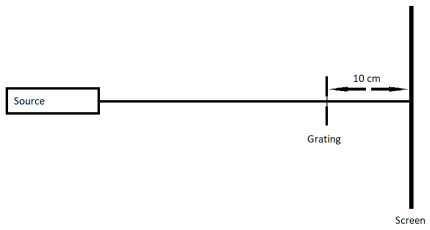

FIGURE 1. Figure for Q1

Q2 Now a block made of transparent material A with $h = 2$ cm thickness is placed between the light source and the grating with an angle of 45 degree with respect to the light's direction. The material A is known to have a index of refraction of 1.2. How far do you need to move the grating in the vertical so the light beam is centred on the grating again? Treat index of refraction of air to be 1 here.

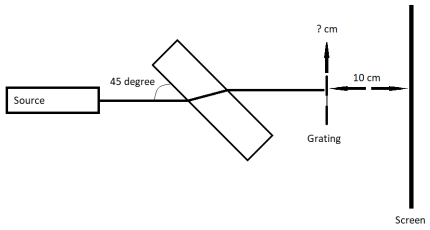

FIGURE 2. Figure for Q2

Q3 The placement of the block has made the experiment space dusty, so instead of air now a tank of transparent liquid B is placed between the light source and the grating, with the block at the same position. B is known to have an index of refraction of 1.8. How far does the grating need to shift in the vertical direction from its position in Q1 so the light beam is centred on the grating again? Here assume the tank will have no effect on the light's

path since light going in/out of it is normal to the tank's surface.

Q4 Now a new light source with a different wavelength is used, which effectively increases the index of refraction for A and B by 0.3 each. Where should the grating be shifted vertically from its position in Q1 now in order for the light beam to be centred on the grating again?