Assignment 3; Phys 186 Name _____

Note: You can ask me for help; for example, have me check if an answer is correct. Talk to me: you'll learn some physics, and that's the point of the course.

1. (30 points) You pass white light through a prism, and see the ray of light split into a rainbow pattern. Choose between four possible explanations:

(a) The prism is a diffraction grating, with the spaces between atoms acting as slits.

(b) The prism is a double slit, with the spaces between atoms acting as slits.

(c) The prism has a index of refraction n that depends on the wavelength λ, with n increasing as λ increases.

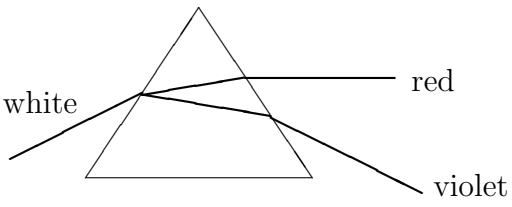
(d) The prism has a index of refraction n that depends on the wavelength λ, with n decreasing as λ increases.

Explain how each of the following is relevant to your decision:

- Atoms in a crystal such as the prism are separated by distances around 1 nm.

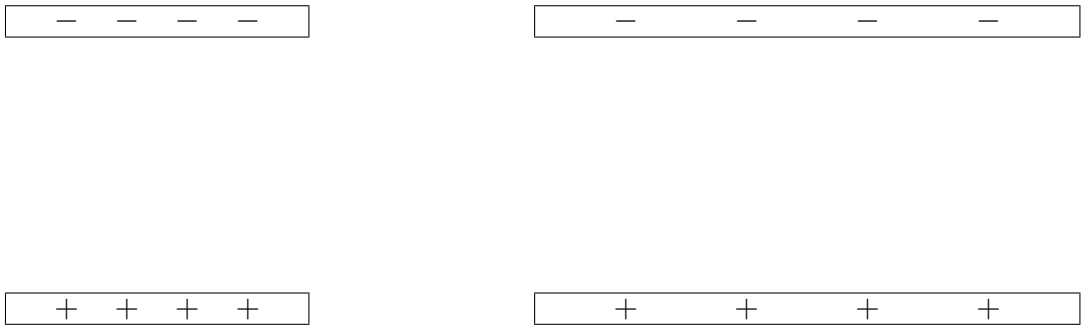
- No white light gets through; only the rainbow pattern is seen.

- Red light appears at the top, violet at the bottom:



2. (30 points) Use the rules concerning equipotential lines and electric field lines to figure out what happens when you double the plate area of a parallel plate capacitor. You have a capacitor with plate area A and plate separation d with charges $\pm Q$ on its plates, with a voltage difference of 4.0 V between the plates. You also have a capacitor that is identical in every respect, except that the same charge is distributed throughout double the area, $2A$. What will the voltage reading on the second capacitor be? Draw electric field lines and equipotential lines at 1 V intervals, and explain your reasoning.

Remember that the the magnitude of the uniform electric field produced by an infinite plane of charge is proportional to the charge density (charge per unit area).



3. (40 points)

(a) You have a parallel plate capacitor. The left plate is set at a potential of 5 V, the right at 0 V. Draw in equipotential lines in between at 1, 2, 3, and 4 V, and the electric field lines. Finally, find an expression for the *total electrical force* by which the plates are attracted toward one another, in terms of the constant ϵ_0, the charge Q on each plate, the plate area A, and the plate separation d.

(b) You now have a cylindrical capacitor: two concentric metal rings with equal and opposite charges. Draw a qualitative map of the equipotential lines and electric field lines for this case. Also include the voltage and electric fields inside the inner ring. What is the total electrical force acting on each ring?