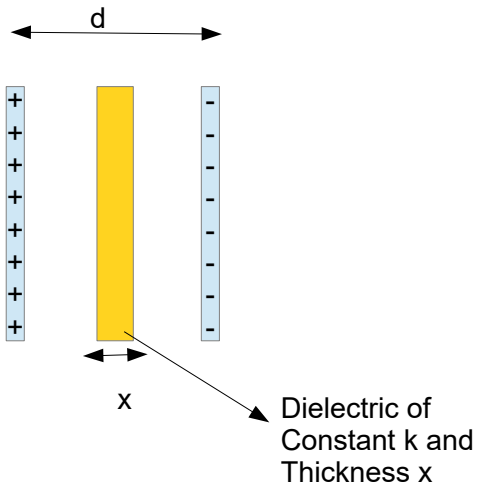
Physics 102 Electromagnetism tutorial 4 and 5
practice questions and problems

1. A parallel plate capacitor has area A and separation between the plates d. The plates are given a charhge $\pm Q$. The gap d is filled with a Dielectric slab of thickness x and dielectric constant k placed midway between the gap. What is the capacitance of this configuration? Explicitly show $\mathbf{D}, \mathbf{E}$, and potential V in this configuration.



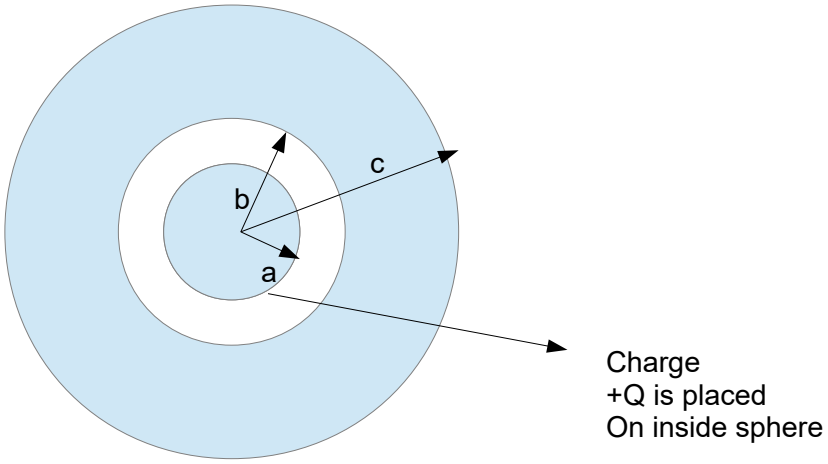
2. The dipole moment of water is $6.13 \times 10^{-29} C - cm$. Assume 1cc or 1gm of water is polarized fully with $\mathbf{P}$ pointing downward on the Z- axis. Find the electron charge density on the upper surface per cm^2 due to the polarization.

3. What is the electric field of a uniformly polarized sphere ?

4. Thomson's determination if e/m is an interesting experiment. A beam of electrons are accelerated by two electrodes to a potential difference eV and hits a screen that produces a spot. This beam with constant velocity v say in the x direction is subject to an electric field in the y direction via two parallel plates of length L. One can apply a $\vec{B}$ field in the Z direction confined to the region of parallel plates. For a given value of eV , electric field $\mathbf{E}$ find a alue of $\mathbf{B}$ so that the electrons are focussed back to the spot in absence of $\mathbf{E}$. From this condition can you get the value of e/m for an electron.

5. a) Find the field on the axis of a circular loop using Biot-Savart Law. (b)Find the field on the axis of a finite sized solenoid. Using the same result justify the solution obtained from Ampere's circuital law.

6. A spherical capacitor is made of an inner metal sphere of radius a. The outer shell has an inner radius b and outer radius c. A charge $+Q$ is given on the outer electrode. None of the electrodes are grounded. Find the capacitance in this configuration.



7. We modeled a plasma as a neutral medium. Charges excited in the plasma are modeled by a harmonic restoring force. A similar model for a metal takes a velocity dependent damping $\gamma\dot{x}$ and there is no harmonic restoring force. Find the condtion for constant velocity and arrive at a dispersion relation for the conductivity of the metal.

8. a) $\oint \mathbf{A}.\mathbf{dl} =?$ if $\mathbf{A}$ the source of a magnetic field.

9. Write down the electrostatic potential for a charged cylinder. By analogy write an expression for vector potential due to a current carrying cylinder.

10. Review the basic ideals and formulae in relativistic kinematics for the next problem set.