PHYS 401 Homework #3 , Due on 10/8

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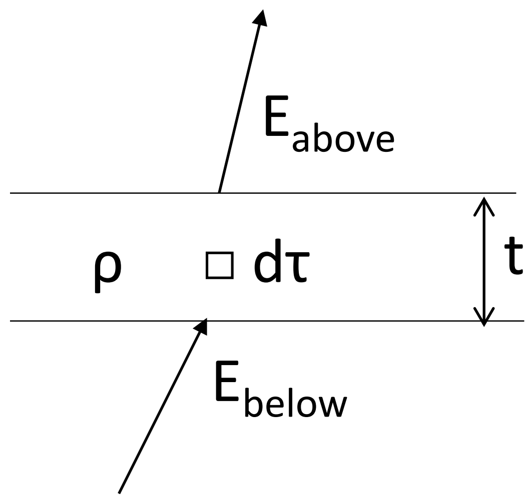

1) Consider a generic smooth membrane with thickness t which is electrically charged with a density ρ. The electric field just above the surface is E_a and the field just below the surface is E_b . Show that $\sigma = \epsilon_0(E_a - E_b)$. Where where σ is the total charge density per unit area on the surface.

   Now consider the force on an infinitesimal volume dτ. By integrating this from top to bottom of the membrane show that total force per unit area of the membrane is equal to $\frac{\sigma}{2}(E_a + E_b)$.

   (hint: use $\nabla \cdot E = {}^{\rho}/_{\epsilon_0}$ in the membrane)

2) A balloon is made of a conducting material. When it is electrically charged, it expands to the shape of a sphere of radius R. If the total charge is Q, what is the pressure on the balloon surface due to electrical repulsion. What is the force of repulsion between one half of the balloon (one hemisphere) on the other half.

3) Find the capacitance per unit length of two coaxial metal cylindrical tubes of radius a and b. If the potential difference between outer and inner cylinders is V, what is the stored electrical energy per unit length.

4) Griffith problem: 3.9 (page 129)

5) Griffith problem 3.11 (page 130)