Physics 3201
Problem Set 4, modified on Sept. 24 to postpone Problem 6

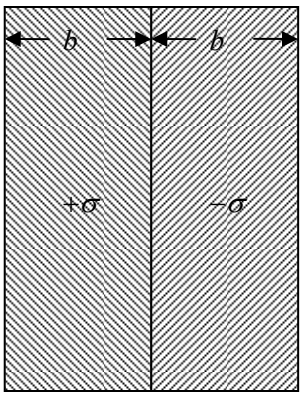
Due: Thursday, September 26. Solutions will be posted on September 27.

Notes: This problem set covers Sections 1.1–1.4 and 2.1–2.4 of Griffiths, as well as the start of Section 1.5. You should be reading them, along with Sections 2.5 and 3.1.

1. Griffiths, Problem 1.40 (problem 1.38 in 3rd Ed.)

2. (Based on Purcell problem 1.66)
   (a) Two infinitely long nonconducting strips of width b are placed side-by-side as shown. They have negligible thickness, and they have uniform area charge densities $\pm\sigma$. Find the electric field due to the left-hand strip at a distance x away from it, in the plane of the page. (*Hint*: divide up the strip into thin charged wires.)

   (b) Show that the force per unit length on the right-hand strip is $\sigma^2 b(\ln 2)/\pi\varepsilon_0$, directed to the left. Note that this result is finite, even though you will find that the electric field diverges as you get close to the left-hand strip.



3. Griffiths problem 2.36 (problem 2.34 in 3rd Ed.).

4. In a simple model, a unit cell of the NaCl salt crystal is a cube with four Na^+ ions and four Cl^- ions located at alternating corners of a cube. Find the total electrostatic energy of this unit cell if the length of each side is a. (This should *not* be particularly time consuming if done in the optimal way.)

5. First do parts (a) and (b) of Griffiths problem 2.34 (problem 2.32 in 3rd Ed.). Now use the result to find the *classical electron radius*, by assuming that the electron is a sphere of uniform charge, and that its entire rest energy $U = m_e c^2$ is electrostatic in origin. Evaluate this radius numerically by inserting the charge and mass of the electron.

6. ***Deferred until Problem Set 5***: Griffiths, problem 1.44 (problem 1.43 in 3rd Ed.).

Honors: Add problem 2.54 (2.49 in the 3rd Ed.), except that you can omit parts (e) and (f) unless you are feeling exceptionally capable and clever this week. However, you will probably want to use the result of part (e), which is given in the problem statement, to complete part (g). We will meet next on Friday, September 27.