

Physics 380-001

Homework #3:

Practice Problems:

We have listed problems from the textbook that involve related skills and concepts; answers to these problems may be found in the back of the text. You should use these extra problems for practice and review, but they do *not* need to be turned in. Selected Practice Problems from Griffiths: 2.23, 2.24, 2.25, 2.27, 2.31, 2.32, 2.35, 2.38, 2.55.

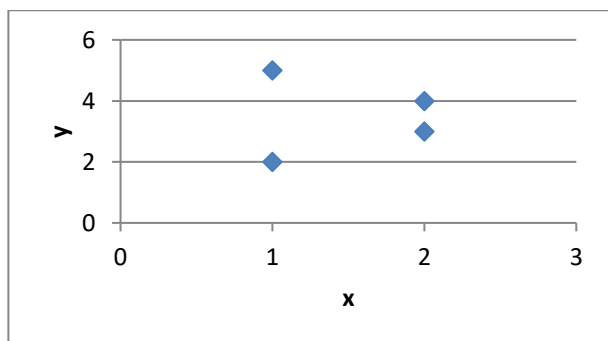
1. Spherical fun (6 pts): Do problem 2.21 in textbook

2. Not my kind of ice cream cone (6 pts): Do problem 2.26 in textbook

3. Many, Many Electrons (4 pts): Your experiment has detected 3708 electrons at various positions in a box. Please go to Moodle and download the X, Y, and Z positions of each electron contained in a file titled: "2013 - Phys380 - HW2 – RandomCharges.csv". (Don't get carried away with units too much, I'd like to know what the relative potential is at various points.) Feel free to use any tool that you would like.

- What is the potential at (0,0,0)?
- What is the potential at (1,0,0)?

4. Doing some work (4 pts): Use the following charge distribution for the problem 4:



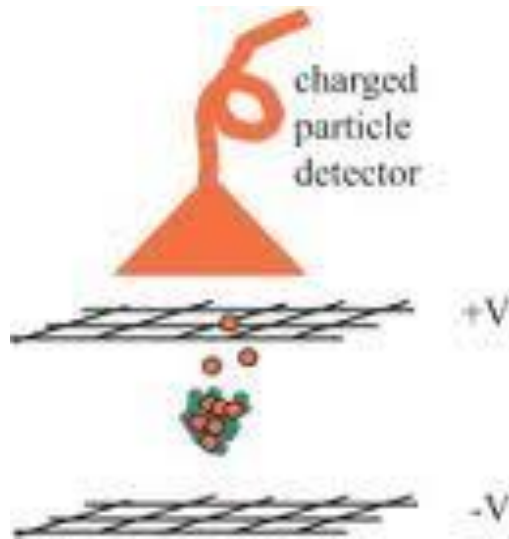
- How much work is required to bring in one additional charge at (1,1)?
- How much work is required to assemble the whole thing?

5. More spherical fun (6 pts): Do problem 2.34 in textbook

6. More spherical fun (6 pts): Do problem 2.39 in textbook

7. Gravitational fun (6 pts): Do problem 2.56 in textbook

8. Ultracold Plasmas (6 pts):



Ultracold plasmas and ultracold Rydberg atoms are exciting research tools. In particular, one of the exciting avenues for quantum computation comes from using the extremely long range interaction of these atoms to create a logic gate. (Read one of the early articles on the subject in Science Magazine (Vol. 287 no. 5452 pp. 463-465)).

Detection of the Rydberg atoms is usually done with a microchannel plate – ion detector. Atoms start at rest, literally near $T=0\text{K}$. In order to detect the atoms, researchers suddenly apply a large electric field between two plates (There are holes in the plates so the ions can get through, but for this problem it is safe to assume they are smooth and infinite.) The atoms are in the center of field plates placed 10 cm away. The microchannel plate is placed 10 cm away from the last grid. $V = 1500$ Volts.

- Discuss the electric field in the different regions.
- How long will it take for an electron to reach the detector?
- How long will it take an Rb^+ ion to reach the detector?