**ChEn 513**

**Homework #3**

**Problem #1**

Do problem #5 from Section 5.5.1.

Note: The purpose of this problem is to think about the concept of phase space and how we usually “project” complex motion (phase space) onto two dimensions to “visualize” them. For example, in this problem, many things are changing all the time: the x position, the y position, the x velocity, the y velocity, the x acceleration, the y acceleration, etc. We can’t graph 6 dimensions, so we “project” this complex motion by only looking at two things at a time.

*Hints:*

- To graph these, make y a function of x by getting rid of the t.

- Let =1 and mass=1 for graphing purposes.

- Your equations for y and py should have - in them. Values of this difference are given in the problem statement.

**Problem #2**

Do problem #13 from Section 5.5.1.

*Hint:* You need to use *undetermined multipliers* to solve this problem by hand. Don’t just use a solver/optimizer.

**Problem #3**

Do problem #3 from Section 5.5.1.

*Hints:*

* The “E” in the equations given in the problem is not energy but electric field.
* The following relationships need to be used.

and

**Problem #4**

Do problem #8 from Section 5.5.1.

*Hints:*

* You are going to have to perform an integral over momentum and position space. Because the molecule is fixed, this means that you have to integrate over .
* The following identity may be of use: .

**Problem #5**

Do problem #9 from Section 5.5.1.

**Problem #6**

Do problem #10 from Section 5.5.1.

*Hints:*

* Table 5.3 should help get you started.
* means the Helmholtz’s energy of the real gas minus that of the ideal gas.
* The ideal gas partition function is .