**8.02 - FRIDAY COMPUTATIONAL THINKING - Week 1**

**HANDOUT (no coding required):**

**Physics Learning objectives**

* Reinforce your understanding of the vectors involved in the calculation of the electric field produced by a point charge
* Reinforce your understanding of superposition
* Provide you with a visualization tool that you will be able to use as you work on new problems

(e.g. , you can make your analytical prediction, and then verify it numerically)

**CS Learning objectives**

* Review lists
* Review functions (why they are used, syntax)
* Review basic use of NumPy arrays
* Start developing an understanding of the role computation can play in solving problems.

**Syntax and Jupyter warmup (optional):**

<https://mybinder.org/v2/gh/ESG-802/spring21/HEAD?filepath=%2F0-%20Python%20warmup.ipynb>

**In class group problem solving:**

<https://mybinder.org/v2/gh/ESG-802/spring21/HEAD?filepath=%2F1-%20Electric%20Field%20Visualization.ipynb>

**INSTRUCTORS NOTES:**

This is the location or the original files: <https://mybinder.org/v2/gh/ESG-802/spring21/HEAD>

If you make changes the students will not see them unless you commit them in Github

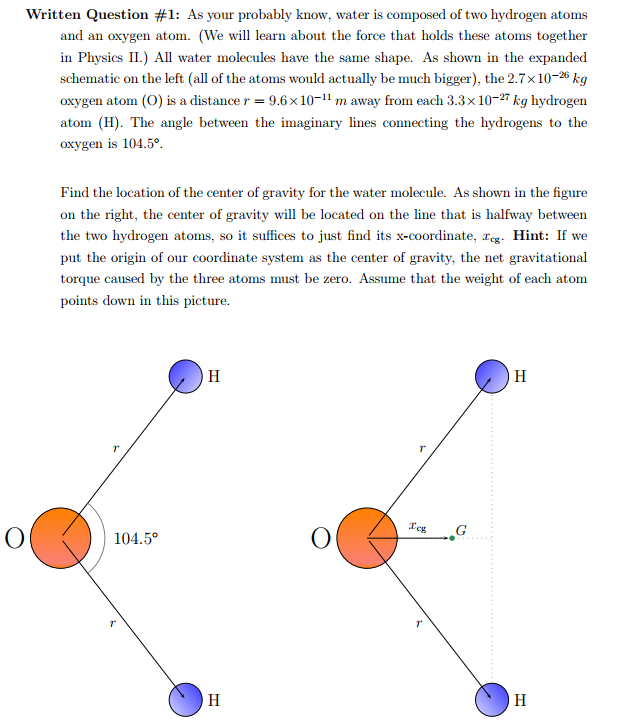
<https://github.com/ESG-802/spring21>

The solutions are in a private repository.

**POSSIBLE EXTENSIONS**

1. Model water and other polar molecules. Estimate the dipole moments or the effective charges. **no coding required**

**Problem: water molecule**



Water is a polar molecule. The H atoms are partially positively charged, and the O atom is partially negatively charged such that the whole molecule is neutral. Suppose the length of each O-H bond is , the partial positive charge on a H atom is and that the O atom is at the origin.

1. Calculate the electric dipole moment vector of the water molecule.
2. Calculate the E field produced by the water molecule at a general point on the positive x-axis such that
3. Solve for the point(s) where E=0 along the positive x-axis.
4. Use the E-field visualization code to model the water molecule in the picture above given (normalized to 1 for simulation purposes) and Visualize the field at two points on the x axis and on two separate graphs. Does the visualization match your result from part c?

e) If the magnitude of the total dipole moment vector of the water molecule is given to be C.m, find the absolute value of the effective partial charge in Coulombs.

1. Model the force and torque on a uniform dipole

<https://www.compadre.org/PICUP/exercises/exercise.cfm?A=torqueondipole>

**Additional CS learning objectives that can be addressed with extension 2, with coding:**

* Solve an initial value problem
* Describe convergence