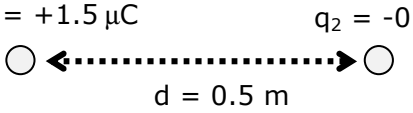
Coulomb's Law & Electric Fields:

1. Consider a fixed point charge of +1.5 μC (q_1). A 2nd charge of -0.5 μC (q_2) is placed at a distance of 0.5 m from q_1.



a. What is the magnitude and direction of the electric force exerted on q_2 due to q_1?

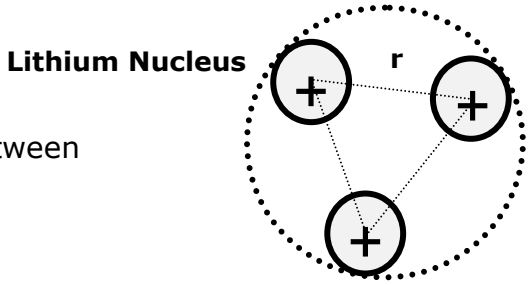
b. A 3rd charge of -1.0 μC (q_3) is placed 0.25 m directly to the right of q_2. What is the magnitude and direction of the electric force exerted on q_3?

c. If q_3 is exactly halfway between q_1 and q_2, what is the magnitude and direction of the electric force exerted on q_3?

d. If q_3 is moved 0.3 m downward but still equidistant to q_1 and q_2, what is the magnitude and direction of the electric force exerted on q_3?

e. Where would q_3 need to be placed such that there is no electrical force acting on the charge?

2. Consider a simple model of an atomic nucleus. In this case, three protons are present in the nucleus of a lithium atom, forming an equilateral triangle. The distance, r, between each pair of protons is 1.5 x 10^{-15} m.



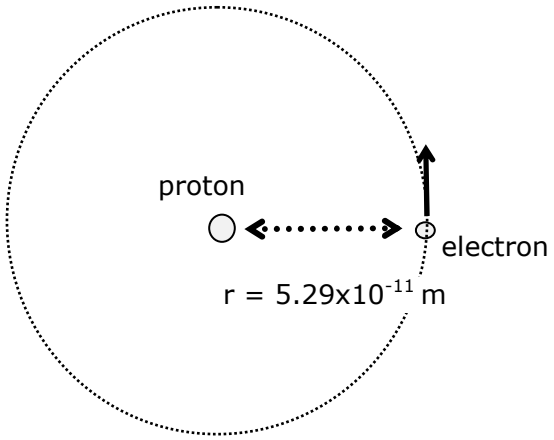
a. What is the magnitude of the electric force exerted between any two of the protons?

b. What is the magnitude and direction of the total electric force exerted on a proton (due to its neighboring protons). You will need to assign an appropriate coordinate system.

c. Express the total electric force vector, in component form.

d. What is the net force acting on the subject proton in (b) & (c)? Explain.

3. Consider the "Bohr Model" of the atom, where an electron moves around a proton in a circular orbit. Assume the proton and electron are separated by a distance, r, of 5.29×10^{-11} m.



a. What is the magnitude and direction of the electric force exerted on electron?

b. The electron is in uniform circular motion at a radius of r. What is the centripetal force exerted on the electron such that it maintains this orbit?

c. What is the speed of the electron?

d. What is the kinetic and potential energy, respectively, for the electron in J and eV?

e. What is the total energy of the electron in J and eV?

f. Calculate the orbital radius for an electron with a total energy (K+ U) of -3.40 eV.

4. What is the total electric charge of 1.0 moles of electrons?

5. How many electrons are present in -1.5 μC?