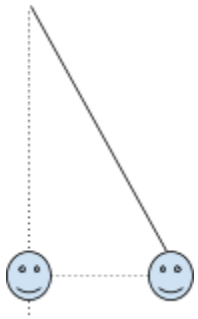
Charge!

1. Particles A and B are separated by 5.0 cm. A has a net charge of +2.0 μC while B has a net charge of –3.0 μC.
    a. Calculate the magnitude of the interaction force on each of the particles.
    b. Describe each force as attractive or repulsive. Explain your reasoning.

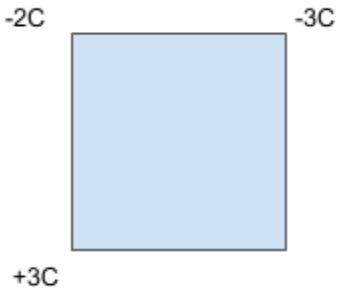
2. An alpha particle (charge = +2*e*) is sent at high speed toward a gold nucleus (charge = +79*e*). Calculate the electric force acting on the alpha particle when the alpha particle is $2.0X10^{-14}$ m from the gold nucleus.

3. In a hydrogen atom, the electron and the proton are separated by an average of $5.3X10^{-11}$ m.
    a. Calculate the electrostatic force between them.
    b. Calculate the **gravitational force** between the electron and the proton.
    c. Determine the ratio of the electrostatic force to the gravitational force.

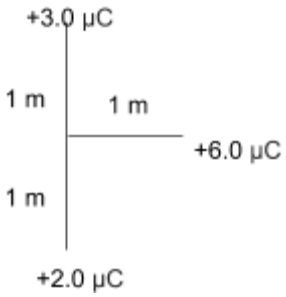
4. A 2.5 gram ping pong ball is hanging from a 20 cm string and charged to 5.0 μC. When an second charged ball is placed directly below the support point of the string as shown, the string makes a 15 degree angle to the vertical.
    a. Calculate the vertical component of the force of the string on the hanging ball.
    b. Calculate the horizontal component of the force of the string on the hanging ball.
    c. What is the charge on the second ball?



5. Three charges are placed on the corners of a square with side lengths 2.0 cm as shown. Determine the net force on the –2C particle.



6. Three positive point charges of 3.0 μC, 6.0 μC, and 2.0μC are arranged in a triangular pattern as shown on the right. Find the magnitude and direction of the electric force acting on the 6.0 μC charge.



7. Explain why two field lines from the same field can't cross one another.

8. Draw the field lines and equipotential surfaces for a point charge -q.

9. Draw some representative electric field lines for two charges of +q and -3q separated by a small distance.

10. Find the electric field at a point midway between two charges of $+30.0X10^{-9}$ C and $+60.0X10^{-9}$ C separated by a distance of 30.0 cm.

11. Two point charges lie in a straight line. A charge $q_1 = -9.0$ μC and a charge $q_2 = -8.0$ μC are placed 10 m apart. Determine the point along this straight line where the electric field zero.

12. Two point charges $q_1 = +e$ and $q_2 = +e$ are placed $1.0X10^{-10}$ m apart.
    a. Describe the potential at the point midway between the charges.
    b. How would this change if $q_1 = +2e$ and $q_2 = +2e$?
    c. How would this change if $q_1 = +e$ and $q_2 = -e$?
    d. How would this change if $q_1 = +2e$ and $q_2 = -2e$?

13. In the Bohr model of the hydrogen atom, electrons can exist only in circular orbits of certain radii about a proton.
    a. Will a larger orbit have higher, lower, or equal electric potential than a smaller orbit? Why?
    b. What is the potential difference between two orbits of radii .21 nm and .48 nm?

14. Two -1.4 μC charges are placed 8.0 mm apart.
    a. How much work is required to completely separate the charges?
    b. If these two charges were released from their original separation, how much kinetic energy would the two charges have when they are very distant from one another?

15. During a thunderstorm, the electric potential difference between a cloud and the ground is $V_{cloud} - V_{ground} = 1.3X10^{8}$ V, with the cloud being at the higher potential. What is the change in an electron's potential energy when the electron moves from the ground to the cloud.

16. An electron is released from rest at the negative plate of a parallel plate capacitor and accelerates to the positive plate. The plates are separated by a distance of 1.2 cm, and the electric field within the capacitor is $2.1X10^{6}$ V/m.
    a. What is the electron's potential energy difference between the initial and final positions of the electron?
    b. What is the electron's final velocity?