# Static Charge, Electric Fields, and Electric Potential
## Worksheet 1: Coulomb's Law

1. Given the mathematical representation of Coulomb's Law, $F = k\frac{q_1 q_2}{r^2}$, where $k = 9.0 \times 10^9 \, Nm^2/C^2$, describe in words the relationship among electric force, charge, and distance.

2. By how much does the electric force between a pair of charged bodies diminish when their separation is doubled? tripled?

3. The most common isotope of hydrogen contains a proton and an electron separated by about $5.0 \times 10^{-11}$ m. The mass of a proton is approximately $1.7 \times 10^{-27}$ kg. The mass of the electron is approximately $9.0 \times 10^{-31}$ kg.

   a) Use Newton's law of universal gravitation to calculate the gravitational force between the electron and proton in the hydrogen atom.

   b) Use $1.6 \times 10^{-19}$ C as the elementary unit of charge to determine the force of attraction between the two particles.

   c) How many orders of magnitude greater is the electric force between the two particles than the gravitational force between the two particles? How important are gravitational force effects in this case?

4. Two charged spheres are on a friction-less horizontal surface. One has a charge of $+3.0 \times 10^{-6}$ C, the other a $+6.0 \times 10^{-6}$ C charge. Sketch the two spheres, showing all forces on them. Make the length of your force arrows proportional to the strength of the forces.

5. Two positive charges of $6.0 \times 10^{-6}$ C are separated by 0.50 m. Draw a force diagram for each of the charges, considering only electrostatic forces. What is the magnitude of the force between the charges? Is this force repulsive or attractive?

6. A negative charge of $2.0 \times 10^{-4}$ C and a positive charge of $8.0 \times 10^{-4}$ C are separated by 0.30 m. What is the magnitude of the force between the charges? Is this force repulsive or attractive?

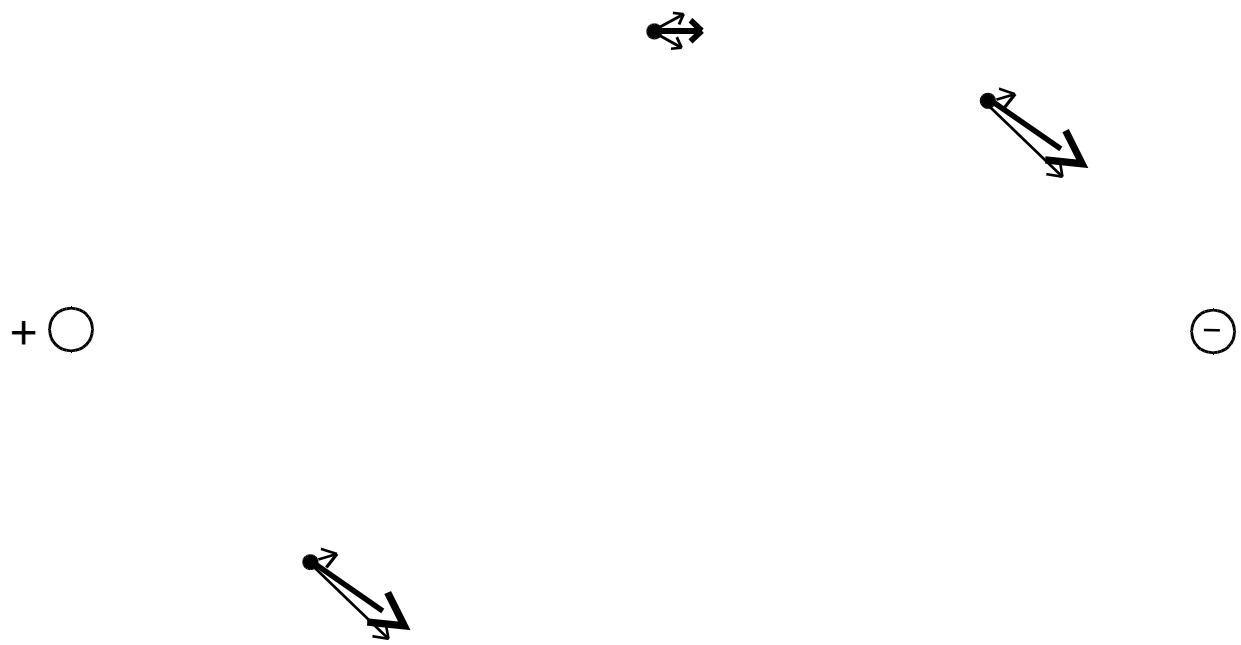
7. A young man accumulates a charge $q_1$ of $+2.0 \times 10^{-5}$ C while sliding out of the front seat of a car. His girlfriend, who had been waiting in the wind, has picked up some extra electrons and now has a charge $q_2$ of $-8.0 \times 10^{-5}$ C.

   Draw a sketch of the situation. Estimate the magnitude of the electrical force that each person exerts on the other when separated by a distance of 6.0 m. Is the force attractive or repulsive?

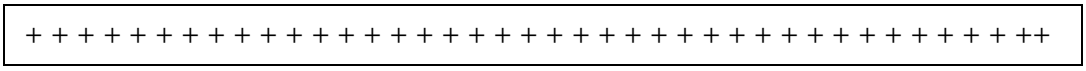
8. Suppose the two people in the previous problem move toward each other. Calculate the magnitude of the electrical force of one on the other when their separation is reduced by a factor of 10.

# E-Fields Worksheet 2

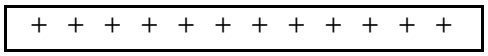
1. In the diagram below, the electric field vector has been determined at three locations. Using symmetry considerations, sketch the net electric field vector at the rest of the locations.

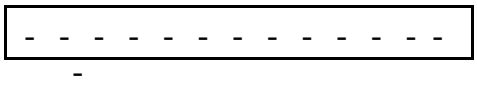



2. Draw the electric field lines around a **positively** charged plate as shown.

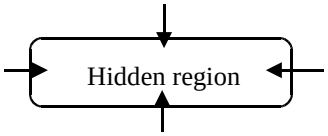


3. Two large charged plates are shown below. Imagine that you could place a small positive test charge at various locations on the lower surface of the positively charged plate. If this test charge is released, what will happen to it? Where will it end up?
   Trace the path that you think it will follow from different release locations. Draw at least six such paths.




4. Suppose you are given an electric field, but the charges that produce the field are hidden. If a positive test charge brought into the region shows that all the field lines point *into* the hidden region, what can you say about the sign of the charge in that region? How do you know?




5. Suppose you are asked to detect the presence of and measure the strength of an electrical field in space.
   a) What do you need to do to detect the presence of an electric field at a location in space?

   b) What do you need to measure to determine the magnitude (strength) of the field?

   c) How should the size of the test charge compare to the amount of charge that produces the field?

Name _____ Date _____ Pd _____

# E-Fields Worksheet 3

1. Use Coulomb's Law and the definition of Electric Field to derive an equation for the electric field around a point charge.

2. What is the relationship between the electric field strength and the distance from the point source? If you move three times farther away, what will happen to the field strength?

3. What is the relationship between the electric field strength and the charge of the point source? If the charge of the point source is increased by a factor of three, what happens to the electric field strength?

4. What is the magnitude and direction of the electric field 0.25 meters away from a point charge with -5.0 μC. Draw a diagram. Use proportional reasoning to find the field strength at positions 0.125 meters away and 0.75 meters away.