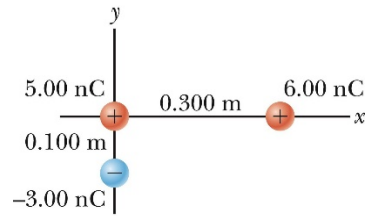
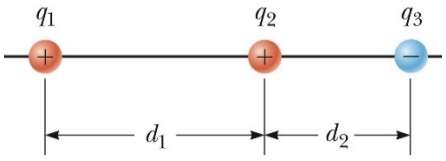
University Physics II

Homework Set 1

1. How many electrons are required to generate at total charge of – 1.00 C?
2. You have a pure ring (24-karat) gold ring of mass 10.8 *g*. Gold has an atomic mass of 197 *g*/*mol* and an atomic number of 79.
   a. How many total protons are in the ring?
   b. What is their total positive charge?
3. Find the magnitude of the electric force between a Na^+ (*sodium*) ion and a Cl^- (*chlorine*) ion separated by 0.50 *nm*. Would the answer change if the sodium ion were replaced by Li^+ (*Lithium*) and the chlorine ion by Br^- (*Bromine*)? Explain.
4. ***Neurons*** are components of the nervous system of the body that transmit signals as electric impulses travel along their length. These impulses propagate when charge suddenly rushed into and then out of a part of the neuron called an ***axon***. Measurements have shown that, during the inflow part of this cycle, approximately 5.6×10^{11} Na+ ions per meter, each with a charge of $+e$, enter the axon. How many coulombs of charge enter a 1.5 *cm* long axon during this process?
5. A 7.50 nC point charge is located 1.80 *m* from a 4.20 nC point charge.
   a. Find the magnitude of the electric force that one particle exerts on the other.
   b. Is the force attractive or repulsive?
6. Three point charges are arranged as shown in the figure at right. Find:
   a. The magnitude of the electric force on the particle at the origin.
   b. The direction of the electric force on the particle at the origin

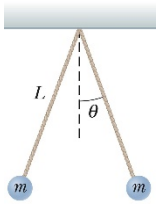


7. Three point charges lie along a straight line as shown in the figure at right, where $q_1 = 6.00\ \mu C$, $q_2 = 1.50\ \mu C$, and $q_3 = -2.00\ \mu C$. The separation distances are $d_1 = 3.00$ *cm* and $d_2 = 2.00$ *cm*. Calculate the magnitude and direction of the net electric force on



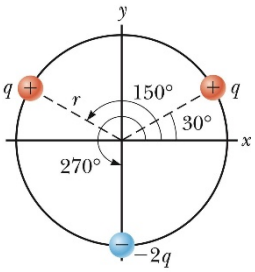
   a. q_1
   b. q_2
   c. q_3
8. Suppose you had two small boxes, each containing 1.0 *g* of protons. One box is placed on the surface of moon by an astronaut, the other is left on the earth. The boxes are somehow connected by very light (and very long!) string. What would the tension in the string connecting the boxes be? Take the distance between the boxes to be 3.763×10^8 *m*.
9. A small object of mass 3.80 *g* and charge -18.0 μC is suspended motionless above the ground when in the presence of a uniform electric field perpendicular to the ground. What are the magnitude and direction of the electric field?

10. Two small metallic spheres, each of mass $m = 0.200\ g$, are suspended as a pendulum by light strings of length L as shown in the figure at right. The spheres are given the same electric charge of 7.2 nC, and they come to equilibrium when each string is at an angle of $\theta = 5.00^{o}$ with the vertical. How long are the strings?

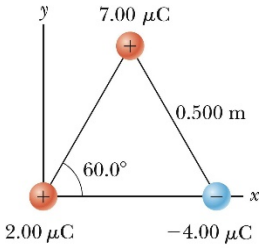


11. **Three point charges lie along a circle of radius r at angles 30°, 150°, and 270° as shown in the figure at right. Find a symbolic expression for the resultant electric field at the center of the circle.

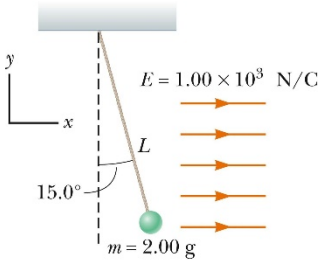
    Hint: *Use symmetry to your advantage*



12. Three charged particles are at the corners of an equilateral triangle as shown in the figure at right.
    a. Calculate the net electric force on the 7.00 μC charge.
    b. Calculate the net electric field at the 7.00 μC charge location.



13. A small, 2.00 *g* plastic ball is suspended by a 20.0 *cm* long string in a uniform electric field as shown in the figure at right. If the ball is in equilibrium when the string makes a 15.0° angle with the vertical, what is the net charge on the ball?



14. Two initially uncharged identical metal spheres, 1 and 2, are connected by an insulating (unstretched) spring of length $L_o = 1.00\ m$ and spring constant $k = 25.0\ N/m$. A charge of $+q$ is placed on sphere 1 and a charge of $-q$ on sphere 2. Afterward, spring contracts to a length of $L = 0.635\ m$. Determine the magnitude of the charge q.

15. A small sphere of charge $q_1 = 0.800\ \mu$C hangs from the end of an insulating spring as shown in the figure at right. When another small sphere of charge $q_2 = -0.600\ \mu$C is held beneath the first sphere, the spring stretches by $d = 3.50\ cm$ from its original length and reaches a new equilibrium position with a separation distances between the charges of $r = 5.00\ cm$. What is the value of the spring constant, k?