# Homework: Ch. 18

1. Can an object carry a charge of 2.0×10^{-19} C? Justify your answer.

2. Two positively charged particles are separated by a distance r. The force on particle 1 is F due to particle 2. The force on particle 2 is $2F$ due to particle 1. Is the previous sentence true or false? Explain why this is the case.

3. At a distance of one centimeter (1.0 cm) from an electron, the electric field strength has a value E. At what distance is the electric field strength equal to $E/2$? Justify your answer.

4. An electron enters a region of uniform electric field with an initial velocity of 40.0 km/s in the same direction as the electric field, which has a magnitude of 50.0 N/C. What is the speed of the electron 1.5 ns after entering this region?

5. What is the direction of the electrostatic force between these two particles? Draw the direction of the vectors on the figure for both charges.

$$q_1 = +3.2 \ \mu C \qquad q_2 = -1.6 \ \mu C$$
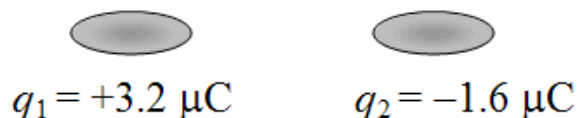
6. A charge of $q_1 = 6.00 \ \mu C$ is locate at (0.00 m, 12.0 m) and a charge $q_2 = 15.0 \ \mu C$ is placed at (8.00 m, 0.00 m). Assume that particle $q_3 = -5.00 \ \mu C$ is placed at the origin. What is the magnitude of the force on particle 3 due to particles 1 and 2?

7. Charge $q_1 = 2.0 \ \mu C$ is locate at the origin and a charge $q_2 = 10.0 \ \mu C$ is placed at (-3.0 m, 0.0 m). How far away from q_2 can a –4.0 μC charge be placed so that the force on it is zero?

8. An electron is accelerated eastward at 1.80×10^9 m/s^2 by an electric field. What is the magnitude and direction of this field?

9. An electron is released from rest in a uniform electric field of magnitude 2.0×10^{-6} N/C. Calculate the acceleration of the electron ($m_e = 9.11 \times 10^{-31}$ kg). (Ignore gravity.)

10. How far apart must be two protons be if the magnitude of the electrostatic force acting on either one due to the other is equal to the magnitude of the gravitational force on a proton at Earth's surface?

11. Assume you have three spherical conductors. Conductor A has a total charge of +4Q and B has a total charge of -6Q. The two spheres are fixed to the x-axis at a distance of d. The third sphere, C, has a total charge 0 and is free to be moved. You now perform two experiments:

   a. Touch sphere C to sphere A and then remove it. You then touch C to B. What is the charge on each sphere at the end of this part?
   b. Touch sphere C to sphere B and then remove it. You then touch C to A. What is the charge on each sphere at the end of this part?

12. (*This is a very hard problem. Try this one as a challenge!*) Four point charges are located at the corners of a square with each side of length $l = 5.0$ cm, as shown in the figure from the last problem. Charge $q_1 = q_2 = + 2.0$ μC and charge $q_3 = q_4 = + 1.0$ μC. Assume that a charge $q_5 = - 2.0$ μC is placed at point P.

   a. What is the force on charge 5 due to the other four charges?
   b. What is the electric field due to all the charges at point P?