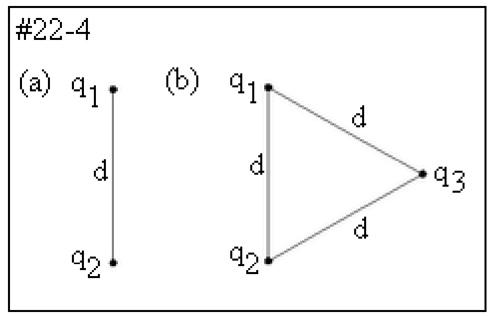
Phsx 2220 — Homework #1

22-1. What would be the electrostatic force between two 1.00 C charges separated by a distance of (a) 1.00 m and (b) 1.00 km if such a configuration could be set up?

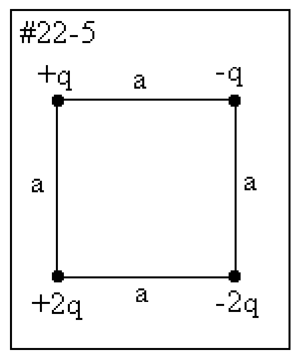
22-2. What must be the distance between point charge q_1 = 26.0 μC and point charge q_2 = -47.0 μC for the electrostatic force between them to have a magnitude of 5.70 N?

22-3. Two equally charged particles, held 3.2 x 10^{-3} m apart, are released from rest. The initial acceleration of the first particle is observed to be 7.0 m/s^2 and that of the second to be 9.0 m/s^2. If the mass of the first particle is 6.3 x 10^{-7} kg, what are (a) the mass of the second particle and (b) the magnitude of the charge of each particle?

22-4. The figure at right shows two charges, q_1 and q_2, held a fixed distance d apart. (a) What is the magnitude of the electrostatic force that acts on q_1? Assume that q_1 = q_2 = 20.0 μC and d = 1.5 m. (b) A third charge q_3 = 20.0 μC is brought in and places as shown at right. What now is the magnitude of the electrostatic force on q_1?



22-5. In the figure at right, what are the horizontal and vertical components of the resultant electrostatic force on the charge in the lower left corner of the square if q = 1.0 x 10^{-7} C and a = 5.0 cm?

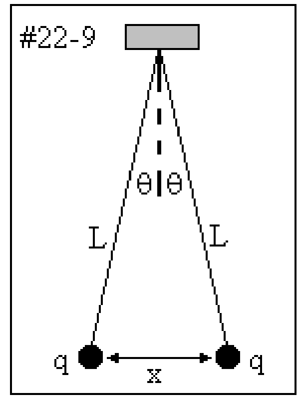


22-6. Two small, positively charged spheres have a combined charge of 5.0 x 10^{-5} C. If each sphere is repelled from the other by an electrostatic force of 1.0 N when the spheres are 2.0 m apart, what is the charge on each sphere?

22-7. Two fixed particles, of charges q_1 = +1.0 μC and q_2 = -3.0 μC are 10 cm apart. How far from each should a third charge be located so that no net electrostatic force acts on it?

22-8. (a) What equal positive charges would have to be placed on Earth and on the Moon to neutralize their gravitational attraction? Do you need to know the lunar distance to solve this problem? Why or why not? (b) How many thousand kilograms of hydrogen would be needed to provide the positive charge calculated in (a)?

22-9. In the figure at right, two tiny conducting balls of identical mass m and identical charge q hang from nonconducting threads of length L. Assume that θ is so small that tan θ can be replaced by its approximate equal, sin θ. (a) Show that, for equilibrium,



$$x = \left(\frac{q^2 L}{2\pi\varepsilon_0 mg}\right)^{1/3}$$

where x is the separation between the balls. (b) If L = 120 cm, m = 10 g, and x = 5.0 cm, what is q?

22-10. What is the magnitude of the electrostatic force between a singly charged sodium ion (Na^+, of charge +e) and an adjacent singly charged chlorine ion (Cl^-, of charge -e) in a salt crystal if their separation is 2.82×10^{-10} m?

22-11. Two tiny, spherical water drops, with identical charges of -1.00×10^{-16} C, have a center-to-center separation of 1.00 cm. (a) What is the magnitude of the electrostatic force acting between them? (b) How many excess electrons are on each drop, giving it its charge imbalance?

22-12. In the basic CsCl (cesium chloride) crystal structure, Cs^+ ions form the corners of a cube and a Cl^- ion is at the cube's center (see figure at right). The edge length of the cube is 0.40 nm. The Cs^+ ions are each deficient by one electron (and thus each has a charge of +e), and the Cl^- ion has one excess electron (and thus has a charge of -e). (a) What is the magnitude of the net electrostatic force exerted on the Cl^- ion by the eight Cs^+ ions at the corners of the cube? (b) If one of the Cs^+ ions is missing, the crystal is said to have a *defect*; what is the magnitude of the net electrostatic force exerted on the Cl^- ion by the seven remaining Cs^+ ions?