

Electrostatics Problem Set

1. Describe what happened in the two demonstrations (balloon-hair and tape-tape). Discuss how the objects were given a charge, what type of force existed between the two objects, and how the charges effected the force.
2. You are given an apple and an orange. The apple has a net charge of $+3 \times 10^{-17} \text{ C}$. The orange has a net charge of $-3 \times 10^{-17} \text{ C}$. With only this information, can you determine which one has more total electrons? Explain.
3. An electron has a mass of $9.11 \times 10^{-31} \text{ kg}$. What is the charge of 1.00 grams of pure electrons?
4. The nucleus of a helium atom contains two protons, two neutrons, and no electrons. Neutrons have no net charge. What is the charge of the nucleus?
5. Two scientists are locked in a bitter dispute about the charge on a particularly famous particle of dust. Maria claims it has a charge of $2.40 \times 10^{-19} \text{ C}$. Richard disagrees; he thinks its charge is $3.20 \times 10^{-19} \text{ C}$. Which scientist should you believe? Explain
6. A positively charged eraser is placed near the "0 cm" end of a 10 cm metal ruler. As a result of the induced charge effect, which end of the ruler becomes positively charged: the "0 cm" end, or the "10 cm" end?
7. In an experiment, a particle called a pion (π) is observed to decay into two other particles, a muon and a neutrino. The muon then decays into an electron and two more neutrinos. Neutrinos are electrically neutral. (a) What is the charge of a muon? (b) Pions come in three types: π^+ has a charge of $+1.60 \times 10^{-19}$, π^- has a charge of -1.60×10^{-19} , and π^0 is electrically neutral. What kind of pion could decay as described in this experiment?
8. Three indistinguishable balloons are given charges of $-1.1 \mu\text{C}$, $-2.5 \mu\text{C}$, and $+2.0 \mu\text{C}$ respectively. You are given two of them at random, and you observe that they repel each other. Find the total charge of the balloons you have been handed.
9. Two grapes are given equal charges and held apart at a distance of 1.3 m. They experience a repulsive force of 2.2 N. Find the magnitude of the charge on each grape.
10. Two steel juggling balls each carry a charge of $2.75 \mu\text{C}$. There is a repulsive force between them of 1.45 N. What is the distance between the centers of the two balls?