CHAPTER 16: Electric Charge and Electric Field

Problems

16–5 and 16–6 Coulomb's Law

$[1\,\text{mC} = 10^{-3}\,C, 1\,\mu\text{C} = 10^{-6}\,\text{C}, 1\,\text{nC} = 10^{-9}\,\text{C}.]$

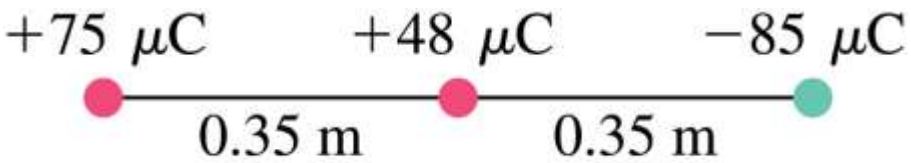
4. (I) What is the repulsive electrical force between two protons $5.0\times10^{-15}\,\text{m}$ apart from each other in an atomic nucleus?

7. (II) Two charged spheres are 8.45 cm apart. They are moved, and the force on each of them is found to have been tripled. How far apart are they now?

8. (II) A person scuffing her feet on a wool rug on a dry day accumulates a net charge of $-42\,\mu\text{C}$. How many excess electrons does she get, and by how much does her mass increase?

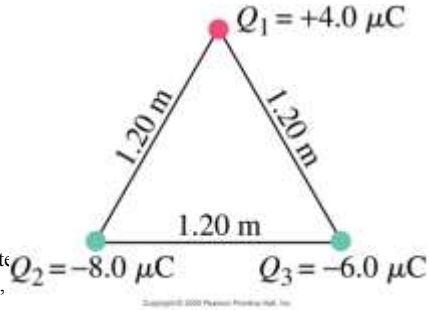
10. (II) Compare the electric force holding the electron in orbit ($r = 0.53\times10^{-10}\,\text{m}$) around the proton nucleus of the hydrogen atom, with the gravitational force between the same electron and proton. What is the ratio of these two forces?

12. (II) Particles of charge $+75, +48,$ and $-85\,\mu\text{C}$ are placed in a line (Fig. 16–49). The center one is 0.35 m from each of the others. Calculate the net force on each charge due to the other two.



14. (II) A charge of 6.00 mC is placed at each corner of a square 0.100 m on a side. Determine the magnitude and direction of the force on each charge.

17. (II) Three charged particles are placed at the corners of an equilateral triangle of side 1.20 m (Fig. 16–53). The charges are $+4.0\,\mu\text{C}, -8.0\,\mu\text{C},$ and $-6.0\,\mu\text{C}$. Calculate the magnitude and direction of the net force on each due to the other two.



19. (III) Two charges, $-Q_0$ and $-3Q_0$, are a distance l apart. These two charges are free to move but do not because there is a third charge nearby. What must be the charge and placement of the third charge for the first two to be in equilibrium?

16–7 and 16–8 Electric Field, Field Lines

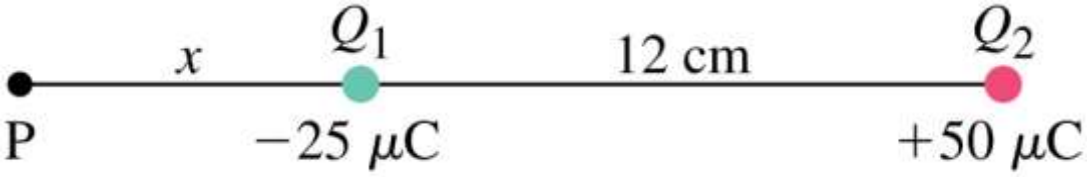
23. (I) What are the magnitude and direction of the electric force on an electron in a uniform electric field of strength $2360\ \text{N/C}$ that points due east?

24. (I) A proton is released in a uniform electric field, and it experiences an electric force of $3.75\times10^{-14}\ \text{N}$ toward the south. What are the magnitude and direction of the electric field?

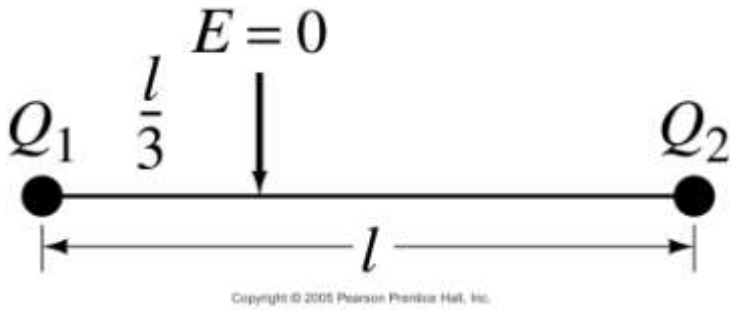
27. (II) What is the magnitude of the acceleration experienced by an electron in an electric field of $750\ \text{N/C}$? How does the direction of the acceleration depend on the direction of the field at that point?

33. (II) Calculate the electric field at the center of a square 52.5 cm on a side if one corner is occupied by a $+45.0\ \mu\text{C}$ charge and the other three are occupied by $-27.0\ \mu\text{C}$ charges.

36. (II) Two point charges, $Q_1 \equiv 25\ \mu\text{C}$ and $Q_2 = +50\ \mu\text{C}$, are separated by a distance of 12 cm. The electric field at the point P (see Fig. 16–55) is zero. How far from Q_1 is P?



39. (II) You are given two unknown point charges, Q_1 and Q_2. At a point on the line joining them, one-third of the way from Q_1 to Q_2, the electric field is zero (Fig. 16–58). What is the ratio Q_1/Q_2?



40. (III) Determine the direction and magnitude of the electric field at the point P shown in Fig. 16–59. The two charges are separated by a distance of $2a$. Point P is on the perpendicular bisector of the line joining the charges, a distance x from the midpoint between them. Express your answers in terms of Q, x, a, and k.