38. (II) Use Coulomb's law to determine the magnitude and direction of the electric field at points A and B in Fig. 16–57 due to the two positive charges ($Q = 7.0\,\mu C$) shown. Are your results consistent with Fig. 16–31b?

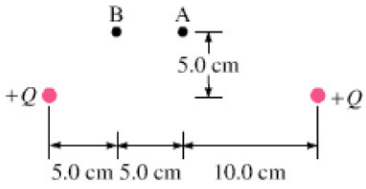

FIGURE 16–57 Problem 38.

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?

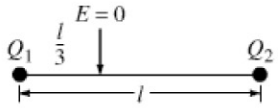

FIGURE 16–58 Problem 39.

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.

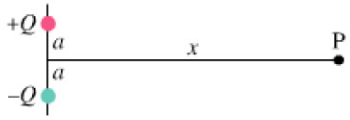

FIGURE 16–59 Problem 40.

41. (III) An electron (mass $m = 9.11 \times 10^{-31}$ kg) is accelerated in the uniform field $\vec{\mathbf{E}}$ ($E = 1.45 \times 10^4$ N/C) between two parallel charged plates. The separation of the plates is 1.10 cm. The electron is accelerated from rest near the negative plate and passes through a tiny hole in the positive plate, Fig. 16–60. (*a*) With what speed does it leave the hole? (*b*) Show that the gravitational force can be ignored.

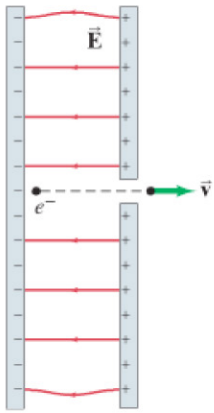

FIGURE 16–60 Problem 41.

42. (III) An electron moving to the right at 1.0% the speed of light enters a uniform electric field parallel to its direction of motion. If the electron is to be brought to rest in the space of 4.0 cm, (*a*) what direction is required for the electric field, and (*b*) what is the strength of the field?

* 16–10 Gauss's Law

*** 43.** (I) The total electric flux from a cubical box 28.0 cm on a side is $1.45 \times 10^3\ N \cdot m^2/C$. What charge is enclosed by the box?

*** 44.** (II) A flat circle of radius 18 cm is placed in a uniform electric field of magnitude 5.8×10^2 N/C. What is the electric flux through the circle when its face is (*a*) perpendicular to the field lines, (*b*) at 45° to the field lines, and (*c*) parallel to the field lines?

*** 45.** (II) In Fig. 16–61, two objects, O_1 and O_2, have charges $+1.0\,\mu C$ and $-2.0\,\mu C$, respectively, and a third object, O_3, is electrically neutral. (*a*) What is the electric flux through the surface A_1 that encloses all three objects? (*b*) What is the electric flux through the surface A_2 that encloses the third object only?

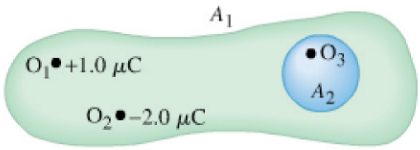

FIGURE 16–61 Problem 45.

*** 46.** (II) A cube of side l is placed in a uniform field $E = 6.50 \times 10^3$ N/C with edges parallel to the field lines. (*a*) What is the net flux through the cube? (*b*) What is the flux through each of its six faces?

*** 47.** (II) The electric field between two square metal plates is 130 N/C. The plates are 1.0 m on a side and are separated by 3.0 cm. What is the charge on each plate (assume equal and opposite)? Neglect edge effects.

*** 48.** (II) The field just outside a 3.50-cm-radius metal ball is 2.75×10^2 N/C and points toward the ball. What charge resides on the ball?

*** 49.** (II) A solid metal sphere of radius 3.00 m carries a total charge of $-3.50\,\mu C$. What is the magnitude of the electric field at a distance from the sphere's center of (*a*) 0.15 m, (*b*) 2.90 m, (*c*) 3.10 m, and (*d*) 6.00 m? (*e*) How would the answers differ if the sphere were a thin shell?

*** 50.** (III) A point charge Q rests at the center of an uncharged thin spherical conducting shell. (See Fig. 16–33.) What is the electric field E as a function of r (*a*) for r less than the inner radius of the shell, (*b*) inside the shell, and (*c*) beyond the shell? (*d*) Does the shell affect the field due to Q alone? Does the charge Q affect the shell?

* 16–11 DNA

*** 51.** (III) The two strands of the helix-shaped DNA molecule are held together by electrostatic forces as shown in Fig. 16–44. Assume that the net average charge (due to electron sharing) indicated on H and N atoms is $0.2e$ and on the indicated C and O atoms is $0.4e$. Assume also that atoms on each molecule are separated by 1.0×10^{-10} m. Estimate the net force between (*a*) a thymine and an adenine; and (*b*) a cytosine and a guanine. For each bond (red dots) consider only the three atoms in a line (two atoms on one molecule, one atom on the other). (*c*) Estimate the total force for a DNA molecule containing 10^5 pairs of such molecules.