16. (II) At each corner of a square of side l there are point charges of magnitude Q, $2Q$, $3Q$, and $4Q$ (Fig. 16–52). Determine the force on (*a*) the charge $2Q$, and (*b*) the charge $3Q$, due to the other three charges.

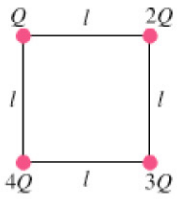

FIGURE 16–52 Problem 16.

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 $+4.0\,\mu C$, $-8.0\,\mu C$, and $-6.0\,\mu C$. Calculate the magnitude and direction of the net force on each due to the other two.

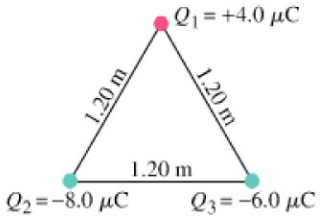

FIGURE 16–53 Problem 17.

18. (III) Two point charges have a total charge of $560\,\mu C$. When placed 1.10 m apart, the force each exerts on the other is 22.8 N and is repulsive. What is the charge on each?

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?

20. (III) A $+4.75\,\mu C$ and a $-3.55\,\mu C$ charge are placed 18.5 cm apart. Where can a third charge be placed so that it experiences no net force?

21. (III) Two small nonconducting spheres have a total charge of $90.0\,\mu C$. (*a*) When placed 1.06 m apart, the force each exerts on the other is 12.0 N and is repulsive. What is the charge on each? (*b*) What if the force were attractive?

22. (III) A charge Q is transferred from an initially uncharged plastic ball to an identical ball 12 cm away. The force of attraction is then 17 mN. How many electrons were transferred from one ball to the other?

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 N/C that points due east?

24. (I) A proton is released in a uniform electric field, and it experiences an electric force of 3.75×10^{-14} N toward the south. What are the magnitude and direction of the electric field?

25. (I) A downward force of 8.4 N is exerted on a $-8.8\,\mu C$ charge. What are the magnitude and direction of the electric field at this point?

26. (I) What are the magnitude and direction of the electric field 20.0 cm directly above an isolated 33.0×10^{-6} C charge?

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

28. (II) What are the magnitude and direction of the electric field at a point midway between a $-8.0\,\mu C$ and a $+7.0\,\mu C$ charge 8.0 cm apart? Assume no other charges are nearby.

29. (II) Draw, approximately, the electric field lines about two point charges, $+Q$ and $-3Q$, which are a distance l apart.

30. (II) What is the electric field strength at a point in space where a proton $(m = 1.67 \times 10^{-27}\,\text{kg})$ experiences an acceleration of 1 million "g's"?

31. (II) An electron is released from rest in a uniform electric field and accelerates to the north at a rate of $115\,\text{m/s}^2$. What are the magnitude and direction of the electric field?

32. (II) The electric field midway between two equal but opposite point charges is 745 N/C, and the distance between the charges is 16.0 cm. What is the magnitude of the charge on each?

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 $+45.0\,\mu C$ charge and the other three are occupied by $-27.0\,\mu C$ charges.

34. (II) Calculate the electric field at one corner of a square 1.00 m on a side if the other three corners are occupied by 2.25×10^{-6} C charges.

35. (II) Determine the direction and magnitude of the electric field at the point P in Fig. 16–54. The charges are separated by a distance $2a$, and point P is a distance x from the midpoint between the two charges. Express your answer in terms of Q, x, a, and k.

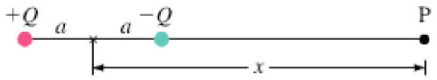

FIGURE 16–54 Problem 35.

36. (II) Two point charges, $Q_1 = -25\,\mu C$ and $Q_2 = +50\,\mu C$, 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?

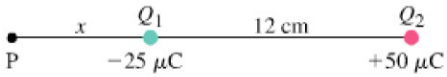

FIGURE 16–55 Problem 36.

37. (II) (*a*) Determine the electric field $\vec{\mathbf{E}}$ at the origin 0 in Fig. 16–56 due to the two charges at A and B. (*b*) Repeat, but let the charge at B be reversed in sign.

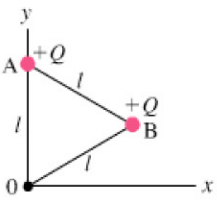

FIGURE 16–56 Problem 37.