Chapter 16 Electric Forces and Fields

2. How many electrons does it take to make one coulomb of negative charge?
A. $1.00 \times 10^9$
B. $6.25 \times 10^{18}$
C. $6.02 \times 10^{23}$
D. $1.66 \times 10^{18}$
E. $2.24 \times 10^4$

10. Two equal point charges are separated by a distance $d$. When the separation is reduced to $d/4$, what happens to the force between the charges?
A. It decreases by a factor of 4.
B. It increases by a factor of 4.
C. It increases by a factor of 8.
D. It increases by a factor of 16.
E. It increases by a factor of more than 16.

11. Two charges are separated by a distance $d$. If one the charges is doubled while the other is tripled, what happens to the force between the charges?
A. It increases by a factor of 5.
B. It increases by a factor of 6.
C. It increases by a factor of 12.
D. It increases by a factor of 18.
E. It increases by a factor of 36.

13. Two point charges are on the x-axis. One charge, $q_1 = 10.0 \text{ nC}$, is located at the origin, and the other charge, $q_2 = 18.0 \text{ nC}$, is located at $x = 9.00 \text{ m}$. What is the force on $q_2$?
A. $20.0 \text{ nN in the positive x-direction}$
B. $20.0 \text{ pN in the positive x-direction}$
C. $20.0 \text{ nN in the negative x-direction}$
D. $20.0 \text{ pN in the negative x-direction}$
E. $180 \text{ nN in the positive x-direction}$
14. Three point charges are located on the x-axis. The first charge, $q_1 = 10.0 \, \mu C$, is at $x = -1.00 \, m$; the second charge, $q_2 = 20.0 \, \mu C$, is at the origin; and the third charge, $q_3 = -30.0 \, \mu C$, is located at $x = 2.00 \, m$. What is the force on $q_2$?
A. 1.65 N in the negative x-direction
B. 3.15 N in the positive x-direction
C. 1.50 N in the negative x-direction
D. 4.80 N in the positive x-direction
E. 4.65 N in the negative x-direction

19. Three point charges are positioned as follows: $q_1$ is at $(0.00 \, m, 0.00 \, m)$, $q_2$ is at $(1.20 \, m, 0.00 \, m)$, and $q_3$ is at $(1.20 \, m, 1.60 \, m)$. If $q_1 = 1.00 \, \mu C$, $q_2 = 2.00 \, \mu C$, and $q_3 = 3.00 \, \mu C$, in what direction (ccw from the x axis) is the force on $q_2$?
A. 301°
B. 329°
C. 149°
D. 59.4°
E. 39.1°

20. Three point charges are positioned as follows: $q_1$ is at $(0.00 \, m, 0.00 \, m)$, $q_2$ is at $(1.20 \, m, 0.00 \, m)$, and $q_3$ is at $(1.20 \, m, 1.60 \, m)$. If $q_1 = 1.00 \, \mu C$, $q_2 = 2.00 \, \mu C$, and $q_3 = 3.00 \, \mu C$, what is the magnitude of the force on $q_2$?
A. $2.45 \times 10^{-2}$ N
B. $1.25 \times 10^{-2}$ N
C. $2.11 \times 10^{-2}$ N
D. $3.36 \times 10^{-2}$ N
E. $5.08 \times 10^{-2}$ N

21. Four point charges are located at the corners of a square, 1.00 m by 1.00 m. On each of two diagonally opposite corners are $1.00 \, \mu C$ charges. On each of the other two corners are $-1.00 \, \mu C$ charges. What is the direction of the force on each charge?
A. Positive charges away from the center of the square, negative inward toward center
B. Negative charges away from the center of the square, positive inward toward center
C. Positive and negative charges both toward the center of the square
D. Positive and negative charges both away from the center of the square
E. No direction (net force = 0)
22. Four point charges are located at the corners of a square, 1.00 m by 1.00 m. On each of two diagonally opposite corners are 1.00 μC charges. On each of the other two corners are -1.00 μC charges. What is the magnitude of the force on one of the positive charges?
A. $8.2 \times 10^{-3}$ N  
B. $1.3 \times 10^{-2}$ N  
C. $3.2 \times 10^{-3}$ N  
D. $1.9 \times 10^{-2}$ N  
E. 0.00

25. The electron orbiting the proton in the hydrogen atom is at a distance of $5.3 \times 10^{-9}$ m. What is the ratio of the electric force to the gravitation force between these particles (The mass of the proton is $1.67 \times 10^{-27}$ kg and the mass of the electron is $9.11 \times 10^{-31}$ kg.)?
A. $2.3 \times 10^{39}$  
B. $2.5 \times 10^{29}$  
C. $1.7 \times 10^{19}$  
D. $9.0 \times 10^{16}$  
E. $3.00 \times 10^{8}$

26. What is the magnitude of the electric field 30.0 cm from a point charge of 0.35 μC?
A. $1.2 \times 10^{-2}$ N/C  
B. $9.5 \times 10^{-4}$ N/C  
C. $9.5 \times 10^{4}$ N/C  
D. $3.5 \times 10^{4}$ N/C  
E. $1.1 \times 10^{4}$ N/C

27. Increasing the distance from a point charge by 34% changes the magnitude of the electric field by what amount?
A. It decreases by 16%.  
B. It decreases by 34%.  
C. It decreases by 44%.  
D. It decreases by 80%.  
E. It stays the same!
28. The electric field has a magnitude of 3.00 N/m at a distance of 60.0 cm from a point charge. What is the charge?
A. 1.40 nC  
B. 120 pC  
C. 36.0 mC  
D. 12.0 μC  
E. 3.00 nC

34. A 72 nC charge is located at x = 3.00 m on the x-axis and an 8.0 nC charge is located at x = 7.0 m. At what point on the x-axis is the electric field zero?
A. -9.0 m  
B. 4.0 m  
C. -5.0 m  
D. 6.0 m  
E. 6.3 m

36. In a diagram of electric field lines, what is represented by lines that are drawn closer together?
A. a more positive field  
B. a more negative field  
C. a stronger field  
D. a weaker field  
E. nothing (artistic license)

37. In a diagram of electric field lines, q₁ has 9 lines going into it and q₂ has 27 lines going out of it. If one of the charges is -40 mC, which of the following could be the other one?
A. -120 mC  
B. 18.0 mC  
C. -18.0 mC  
D. 120 mC  
E. none of these
43. A linear charge distribution has a charge per unit length of $2.3 \times 10^{-6}$ C/m. What is the magnitude of the electric field at a perpendicular distance of 0.50 m from the line charge?
A. 0.19 N/C  
B. 0.38 N/C  
C. $1.1 \times 10^2$ N/C  
D. $1.7 \times 10^4$ N/C  
E. $8.3 \times 10^4$ N/C

44. A conducting sphere of radius 10.0 cm holds a net charge of $4.4 \mu$C. What is the surface charge density?
A. 0.0  
B. $3.5 \times 10^{-5}$ C/m$^2$  
C. $1.1 \times 10^{-5}$ C/m$^2$  
D. $2.2 \times 10^{-4}$ C/m$^2$  
E. $5.6 \times 10^{-3}$ C/m$^2$

45. A thin spherical shell of radius 20.0 cm has $5.0 \mu$C of charge uniformly distributed over its surface. What is the electric field 10.0 cm from the center of the sphere?
A. $4.5 \times 10^6$ N/C inward  
B. $4.5 \times 10^6$ N/C outward  
C. $2.3 \times 10^6$ N/C inward  
D. $2.3 \times 10^6$ N/C outward  
E. 0

46. A thin spherical shell of radius 20.0 cm has $5.0 \mu$C of charge uniformly distributed over its surface. What is the magnitude of the electric field 2.00 m from the center of the sphere?
A. $2.3 \times 10^4$ N/C  
B. $1.1 \times 10^4$ N/C  
C. $1.4 \times 10^3$ N/C  
D. $2.3 \times 10^6$ N/C  
E. 0
48. A thin spherical shell of radius 20.0 cm has 5.0 $\mu$C of charge uniformly distributed over its surface. What is the electric flux through an area of 1.00 m$^2$ of a spherical surface concentric with the shell of charge but having a radius of 1.00 m?
A. $5.6 \times 10^5$ N·m$^2$/C
B. $4.5 \times 10^4$ N·m$^2$/C
C. $1.8 \times 10^4$ N·m$^2$/C
D. $2.3 \times 10^5$ N·m$^2$/C
E. 0

50. A thin metallic spherical shell of radius 50 cm has a total charge of 4.0 $\mu$C placed on it. At the center of the shell is placed a point charge of 2.00 $\mu$C. What is the electric field at a distance of 90 cm from the center of the spherical shell?
A. $4.4 \times 10^4$ N/C outward
B. $2.7 \times 10^3$ N/C inward
C. $6.7 \times 10^4$ N/C outward
D. $8.8 \times 10^4$ N/C outward
E. $6.7 \times 10^4$ N/C inward

51. A thin metallic shell of radius 40 cm has a charge of -25 nC on it. At the center of the sphere is a point charge of 35 nC. What is the electric field 15 cm from the center of the shell?
A. $2.4 \times 10^4$ N/C inward
B. $1.4 \times 10^4$ N/C inward
C. $2.4 \times 10^4$ N/C outward
D. $1.4 \times 10^4$ N/C outward
E. $4.0 \times 10^4$ N/C outward

53. An electron gun sends electrons through a region with an electric field of $1.5 \times 10^4$ N/C for a distance of 2.5 cm. What is the acceleration of the electrons while in this electric field?
A. $1.4 \times 10^8$ m/s$^2$
B. $2.6 \times 10^{11}$ m/s$^2$
C. $1.4 \times 10^{12}$ m/s$^2$
D. $2.6 \times 10^{15}$ m/s$^2$
E. $3.0 \times 10^8$ m/s$^2$
54. An electron gun sends electrons through a region with an electric field of $1.5 \times 10^4$ N/C for a distance of 2.5 cm. If the electrons start from rest, how fast are they moving after traversing the gun?
A. $1.1 \times 10^4$ m/s  
B. $1.1 \times 10^7$ m/s  
C. $2.3 \times 10^4$ m/s  
D. $2.3 \times 10^7$ m/s  
E. $2.6 \times 10^{15}$ m/s

55. An electron gun sends electrons through a region with an electric field of $1.5 \times 10^4$ N/C for a distance of 2.5 cm. If the electrons start from rest, how long does it take for the electrons to traverse the gun?
A. 1.1 ns  
B. 1.1 μs  
C. 2.2 ns  
D. 2.2 μs  
E. 4.4 ns

59. For a conductor in electrostatic equilibrium, which of the following statements is not true?
A. The electric field inside the conductor is zero.  
B. The charge distributes itself uniformly throughout the conductor.  
C. The electric field at the surface of the conductor is perpendicular to the surface of the conductor.  
D. The greatest concentrations of charge on the surface are in the regions of highest curvature.  
E. None of the statements about a conductor in electrostatic equilibrium above is false.

60. If more field lines leave a closed surface than enter that surface, then:
A. a net positive charge is contained inside the surface.  
B. a net negative charge is contained inside the surface.  
C. an error has been made since the number of field lines entering a surface must equal those leaving the surface.  
D. an operating electron gun is inside the surface.  
E. there must be a charge on the surface.

61. A cylinder contains a charge Q. The flux through the curved side of the container is $3\pi kQ$. What is the flux through the ends of the cylinder?
A. $3\pi kQ$  
B. $5\pi kQ$  
C. $9\pi kQ$  
D. $\pi kQ$  
E. 0.0
62. We find from Gauss's law that the flux through a closed surface:
A. is proportional to the net charge enclosed.
B. is inversely proportional to the net charge enclosed.
C. is proportional to the square root of the charge enclosed.
D. is zero.
E. is less the larger the closed surface.

63. An electric dipole is surrounded by a closed surface with the surface nearer to the negative end of the dipole than the positive end. The flux through the surface is:
A. positive.
B. negative.
C. proportional to the negative charge.
D. inversely proportional to the positive charge.
E. zero.

67. A long linear charge distribution of charge density 1.35 nC/m is surrounded by a concentric cylindrical surface of length 1.60 m and radius 23.6 cm. What is the magnitude of the electric field at the curved surface of the cylinder?
A. 436 N/C
B. 103 N/C
C. 51.5 N/C
D. 135 N/C
E. 0.0