1. (c).

2. (a).

3. (c).

9. $q = -ne = -(10^6)(1.6 \times 10^{-19}\text{ C}) = \boxed{-1.6 \times 10^{-13}\text{ C}}$.

10. $q = -ne$, ☞ $n = -\dfrac{q}{e} = -\dfrac{-50 \times 10^{-6}\text{ C}}{1.60 \times 10^{-19}\text{ C}} = \boxed{3.1 \times 10^{14}\text{ electrons}}$.

11. There are two protons in each α particle. So $q = +ne = (2)(2)(1.60 \times 10^{-19}\text{ C}) = \boxed{+6.40 \times 10^{-19}\text{ C}}$.

13. (a) The charge on the fur must be $\boxed{\text{(1) positive}}$ because of the conservation of charge. When one object becomes negatively charged, it gains electrons. These same electrons must be lost by another object, and therefore it is positively charged.

(b) $\boxed{+4.8 \times 10^{-9}\text{ C}}$ according to charge conservation. From $q = +ne$,

$n = \dfrac{q}{e} = \dfrac{4.8 \times 10^{-9}\text{ C}}{1.6 \times 10^{-19}\text{ C}} = 3.0 \times 10^{10}$ electrons. The mass is $(3.0 \times 10^{10})(9.11 \times 10^{-31}\text{ kg}) =$

$\boxed{2.7 \times 10^{-20}\text{ kg}}$.

(c) The electrons moved from fur to the rubber rod, so the mass is still $\boxed{2.7 \times 10^{-20}\text{ kg}}$.

14. (a). The fur is positively charged (see Exercise 15-13). When the positively charged fur is brought near an electroscope, the leaves are charged by polarization. So the charges on the leaves are positive.

15. (d). Water will be deflected towards the object regardless of being positively or negatively charged. The water is still neutral but polarized.

16. (d). The balloon clings to the wall regardless of being positively or negatively charged. The wall is still neutral but polarized.

21. (a).

22. (d).

23. Although the electric force is fundamentally much stronger than the gravitational force, both the Earth, our bodies, and other $\boxed{\text{objects are electrically neutral}}$, so there are no noticeable electric forces.

32. $F_e = \dfrac{kq_1q_2}{r^2} = \dfrac{(9.00 \times 10^9\text{ N·m}^2/\text{C}^2)(1.60 \times 10^{-19}\text{ C})^2}{(2.82 \times 10^{-10}\text{ m})^2} = \boxed{2.90 \times 10^{-9}\text{ N}}$.

$\boxed{33}$. (a) By symmetry, the electron has to be at the $\boxed{50\text{ cm}}$ mark, since both forces are repulsive and opposite.

(b) By symmetry, the proton has to be at the $\boxed{\text{50 cm}}$ mark, since both forces are attractive and opposite.

34. (a) $\boxed{\text{Nowhere}}$, since both forces are in the same direction.

37. (a) $F_e = \dfrac{kq_1q_2}{r^2} = \dfrac{(9.0 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(1.6 \times 10^{-19}\ \text{C})^2}{(5.3 \times 10^{-11}\ \text{m})^2} = \boxed{8.2 \times 10^{-8}\ \text{N}}$.

(b) The electric force provides the required centripetal force. $F_e = F_c = m\dfrac{v^2}{r}$,

so $v = \sqrt{\dfrac{F_c r}{m}} = \sqrt{\dfrac{(8.2 \times 10^{-8}\ \text{N})(5.3 \times 10^{-11}\ \text{m})}{9.11 \times 10^{-31}\ \text{kg}}} = \boxed{2.2 \times 10^6\ \text{m/s}}$.

(c) $a_c = \dfrac{v^2}{r} = \dfrac{F}{m} = \dfrac{8.2 \times 10^{-8}\ \text{N}}{9.11 \times 10^{-31}\ \text{kg}} = 9.0 \times 10^{22}\ \text{m/s}^2 = \boxed{9.2 \times 10^{21}\ g}$, where $g = 9.80\ \text{m/s}^2$.

41. (c).

42. (b).

43. (a), because the electron has a negative charge.

44. It is determined $\boxed{\text{from the relative lengths of the electric field vectors}}$ (the lengths of the arrows).

45. It is determined $\boxed{\text{by the relative density or spacing of the field lines}}$. The closer the lines, the greater the magnitude.

$\boxed{52}$. $E = \dfrac{kq}{r^2} = \dfrac{(9.0 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(2.0 \times 10^{-12}\ \text{C})}{(0.75 \times 10^{-2}\ \text{m})^2} = \boxed{3.2 \times 10^2\ \text{N/C away from the charge}}$

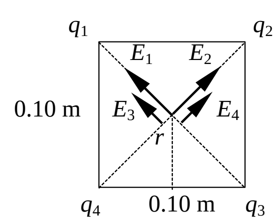
58. The point has to be between the two charges. Assume it is d from the +4.0 μC charge.

For the electric field to be zero, $\dfrac{kq_1}{r_1^2} = \dfrac{kq_2}{r_2^2}$, ☞ $\dfrac{4.0\ \mu\text{C}}{d^2} = \dfrac{9.0\ \mu\text{C}}{(0.30\ \text{m} - d)^2}$.

Taking the square root on both sides gives $\dfrac{2}{d} = \dfrac{3}{0.30 - d}$. Therefore $3d = 2(0.30 - d)$.

Solving, $d = 0.12\ \text{m} = \boxed{\text{12 cm from the charge of 4.0 }\mu\text{C (between the charges)}}$.

61. $E_1 = E_2 = \dfrac{kq}{r^2} = \dfrac{(9.0 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(10 \times 10^{-6}\ \text{C})}{(0.05\ \text{m})^2 + (0.05\ \text{m})^2} = 1.8 \times 10^7\ \text{N/C}$.



$E_3 = E_4 = \dfrac{(9.0 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(5.0 \times 10^{-6}\ \text{C})}{(0.05\ \text{m})^2 + (0.05\ \text{m})^2} = 9.0 \times 10^6\ \text{N/C}$.

Due to symmetry, the net electric field will be upward. It is equal to

$E = (E_1 + E_3)\cos 45° + (E_2 + E_3)\cos 45°$

$= 2(1.8 \times 10^7\ \text{N/C} + 9.0 \times 10^6\ \text{N/C})\cos 45° = \boxed{3.8 \times 10^7\ \text{N/C in the } +y \text{ direction}}$.

67. (b) since there is no electric field inside a conductor in electrostatic equilibrium.

68. (a) since there is no electric field inside a conductor in electrostatic equilibrium.

69. (b).

72. This is because [charges accumulate at sharp points, and lightening hits the tall rods first].

[73]. (a) The inner surface of the shell will have [(1) negative] charge due to induction.

(b) [Zero] since all excess charge resides on the surface of the conductor in electrostatic equilibrium.

(c) [$+Q$] since all excess charge resides on the surface of the conductor in electrostatic equilibrium.

(d) [$-Q$] by induction and the conservation of charge.

(e) [$+Q$] by induction and the conservation of charge.

74. (a) There is [none], since the electric field is zero in the interior of the solid sphere.

(b) [Outward] from the center of the sphere, since the charge on the surface of the sphere is positive.

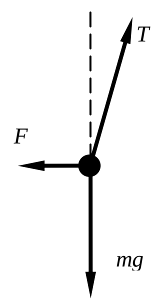
(c) There is [none], since the electric field is zero. The field by the sphere cancels out the field by the inner surface of the shell.

(d) [Outward] from the center of the sphere. The net excess charge is positive on the outer surface of the shell.

78. (b), since field lines point away toward negative charge.

79. (c).

80. (c).



86. (a) Since the charge is negative, and the electric force has to be to the left to keep the ball balanced, the direction of the electric field is to the [right].

(b) In the vertical direction: $T\cos\theta = mg$, ☞ $T = \dfrac{mg}{\cos\theta}$.

In the horizontal direction: $F = qE = T\sin\theta$.

So $E = \dfrac{T\sin\theta}{q} = \dfrac{mg\sin\theta}{q\cos\theta} = \dfrac{mg\tan\theta}{q} = \dfrac{(6.00\times10^{-6}\text{ kg})(9.80\text{ m/s}^2)\tan 12.3°}{1.50\times10^{-9}\text{ C}} = \boxed{8.55\times10^{3}\text{ N/C}}$.