CHAPTER 16

1. The number of electrons is
   $N = Q/e = (-30.0 \times 10^{-6}\text{ C})/(-1.60 \times 10^{-19}\text{ C/electrons}) =$ $\boxed{1.88 \times 10^{14}\text{ electrons.}}$

2. The magnitude of the Coulomb force is
   $F = kQ_1Q_2/r^2.$
   If we divide the expressions for the two forces, we have
   $F_2/F_1 = (r_1/r_2)^2;$
   $F_2/(4.2 \times 10^{-2}\text{ N}) = (8)^2$, which gives $F_2 =$ $\boxed{2.7\text{ N.}}$

3. The magnitude of the Coulomb force is
   $F = kQ_1Q_2/r^2.$
   If we divide the expressions for the two forces, we have
   $F_2/F_1 = (r_1/r_2)^2;$
   $3 = [(20.0\text{ cm})/r_2]^2$, which gives $r_2 =$ $\boxed{11.5\text{ cm.}}$

4. The magnitude of the Coulomb force is
   $F = kQ_1Q_2/r^2.$
   If we divide the expressions for the two forces, we have
   $F_2/F_1 = (r_1/r_2)^2;$
   $F_2/(0.0200\text{ N}) = (150\text{ cm}/30.0\text{ cm})^2$, which gives $F_2 =$ $\boxed{0.500\text{ N.}}$

5. The magnitude of the Coulomb force is
   $F = kQ_1Q_2/r^2$
   $= (9.0 \times 10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(26)(1.60 \times 10^{-19}\text{ C})(1.60 \times 10^{-19}\text{ C})/(1.5 \times 10^{-12}\text{ m})^2 =$ $\boxed{2.7 \times 10^{-3}\text{ N.}}$

6. The magnitude of the Coulomb force is
   $F = kQ_1Q_2/r^2$
   $= (9.0 \times 10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(1.60 \times 10^{-19}\text{ C})(1.60 \times 10^{-19}\text{ C})/(5.0 \times 10^{-15}\text{ m})^2 =$ $\boxed{9.2\text{ N.}}$

7. The magnitude of the Coulomb force is
   $F = kQ_1Q_2/r^2$
   $= (9.0 \times 10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(15 \times 10^{-6}\text{ C})(3.00 \times 10^{-3}\text{ C})/(0.40\text{ m})^2 =$ $\boxed{2.5 \times 10^3\text{ N.}}$

8. The number of excess electrons is
   $N = Q/e = (-60 \times 10^{-6}\text{ C})/(-1.60 \times 10^{-19}\text{ C/electrons}) =$ $\boxed{3.8 \times 10^{14}\text{ electrons.}}$
   The mass increase is
   $\Delta m = Nm_e = (3.8 \times 10^{14}\text{ electrons})(9.11 \times 10^{-31}\text{ kg/electron}) =$ $\boxed{3.4 \times 10^{-16}\text{ kg.}}$

9. Because the charge on the Earth can be considered to be at the center, we can use the expression for the force between two point charges. For the Coulomb force to be equal to the weight, we have
   $kQ^2/R^2 = mg;$
   $(9.0 \times 10^9\text{ N}\cdot\text{m}^2/\text{C}^2)Q^2/(6.38 \times 10^6\text{ m})^2 = (1050\text{ kg})(9.80\text{ m/s}^2)$, which gives $Q =$ $\boxed{6.8 \times 10^3\text{ C.}}$