Coulomb's Law Key

Questions to Consider

1. How does the potential energy change if we increase the distance *d* between two charges?

   The energy must decrease because there is an inverse relationship between energy, V, and distance, d.

2. What is the potential energy if the charges are infinitely far apart?

   If the distance, d, is infinitely large, then the denominator is infinitely large and the energy approaches zero. The energy of a "free" electron, therefore, is zero. This is an important point to remember.

3. Assuming that *d* has a finite value and that the potential energy is negative; what must be true of q_1 and q_2?

   The charges q_1 and q_2 must have different signs since the distance cannot be negative. This is the only way to make the potential energy negative.

4. If *q* for an electron is –1, what are the values of *q* for a proton and for a neutron? What is *q* for the nucleus of an atom of nitrogen?

   A proton's charge is +1. A neutron has no charge, so its value for q is 0. The nucleus of an atom of nitrogen has seven neutrons so it has a charge of +7.

5. An atom of ^{1}H has a single proton and a single electron separated by a distance *d*. Is the electron's potential energy positive or negative? If the electron moves further from the nucleus, what happens to its potential energy? Can you extend this conclusion to other atoms?

   The electron's potential energy is negative because q_1 is –1 and q_2 is +1. Increasing the distance between the electron and proton makes the potential energy less negative, approaching a limit of zero when the electron and neutron are sufficiently far apart. We can extend this generalization to any atom.