5 Electric Potential, Electric Potential Energy

5.1 Book Notes

- The potential-energy difference $U_a - U_b$ equals the work that is done by the electric force when the particle moves from a to b. When U_a is greater than U_b, the field does positive work on the particle as it "falls" from a point of higher potential energy (a) to a point of lower potential energy (b).
- The potential-energy difference $U_a - U_b$ is then defined as the work that must be done by an external force to move the particle slowly from b to a against the electric force.
- **Potential** is potential energy per unit charge.
- SI unit of potential is called one volt ($1\mathbf{V}$).
- The potential difference between two points is often called **voltage**.
- V_{ab}, the potential of a with respect to b, equals the work that must be done to move a UNIT charge slowly from b to a against the electric force.
- The electric potential at a certain point is the potential energy that would be associated with a unit charge placed at that point. That's why potential is measured in joules per coulomb, or volts. Keep in mind, too, that there doesn't have to be a charge at a given point for a potential V to exist at that point. (In the same way, an electric field can exist at a given point even if there's no charge there to respond to it.)
- Moving with the direction of $\tilde{\mathbf{E}}$ means moving in the direction of *decreasing* V, and moving against the direction of $\tilde{\mathbf{E}}$ means moving in the direction of *increasing* V.

5.2 Lecture Notes

- $\Delta U = -[W_{\text{conservative}}]_{i \to f}$
  - Always ask yourself which work you are calculating.
- Don't fall into the trap of making r_{12} a square.
- Potential energies are defined relative to some configuration of objects that you are free to choose.
  - For example, it often makes sense to define the gravitational potential energy of a ball to be zero when it is resting on the surface of the earth, but you don't have to make that choice.

- Our equation for the electric potential energy of two charged particles uses the convention that the potential energy is zero when the particles are infinitely far apart.
- Protons fall down, electrons fall up.
- An electron volt (eV) is the energy acquired by a particle of charge e when it moves through a potential difference of 1 volt.