Chapter 25 - Electric Potential

1. The work done by the electric field is equal to the negative of the change in the electric potential energy:
$$W_{AB} = -(U_B - U_A).$$

2. The work done by an external force is equal to the sum of the change in the kinetic energy and the change in the potential energy.
$$W_{AB} = (K_B - K_A) + (U_B - U_A)$$
Usually the only force acting is the force due to the electric field. Then $W_{AB} = 0$ and we have conservation of energy:
$$\begin{aligned} 0 &= (K_B - K_A) + (U_B - U_A) \\ K_A + U_A &= K_B + U_B. \end{aligned}$$

3. Electric field lines point from high to low electric potential.

4. The electric potential is a scalar and can be positive, negative, or zero. (Compare to the electric field.)

5. A charge wants to travel from high to low potential energy.

6. A positive charge wants to travel from high to low potential.

7. A negative charge wants to travel from low to high potential.

8. Equipotential surfaces are perpendicular to electric field lines.

9. The electric potential can be calculated from the electric field or from superposition. The electric field can be calculated from the electric potential.

10. The electric potential energy of a system of charges is the total work needed to assemble the system charges from infinity.

11. The potential of an isolated conductor is constant and equal the potential at the surface of the conductor.

Chapter 26 - Capacitance

1. Capacitance is a geometrical factor and depends only of the shape and dimensions involved in the capacitor.

2. Capacitors in parallel have the same potential. The total charge for the system is the sum of the charges on the individual capacitors.

3. Capacitors in series have the same charge. The total potential for the system is the sum of the potentials for the individual capacitors.

4. The work done in charging the capacitor is stored in the electric field of the capacitor.

5. If a capacitor is charged by a battery and the capacitance is changed while the battery is still connected, the potential across the capacitor is unchanged. The charge, however, changes.

6. If a capacitor is charged by a battery and the capacitance is changed after the battery is disconnected, the charge on the capacitor is unchanged. The potential changes.

7. Inserting a dielectric (insulator) increases the capacitance of a capacitor.

Chapter 27 - Current and Resistance

1. The current is the rate of charge flow:
$$I = \frac{dQ}{dt}.$$

2. *Conventional* current flows is the direction that a positive charge would flow.

3. The current density (J) is defined as the the current per unit area:
$$J = \frac{I}{A}.$$

4. The current is proportional to the potential difference (Ohm's law):
$$V = IR.$$

5. The current flows from high to low potential.

6. Resistance is a property of an object. Resistivity is a property of a material.

7. The rate of energy transfer, or power, in an electrical device is the potential difference across the device times the current through the device:
$$P = IV.$$

Chapter 28 - Circuits

1. The emf device moves current from low to high potential.

2. The algebraic sum of the changes in potential encountered in a complete transversal of any loop of a circuit must be zero. (Kirchhoff's loop rule.)

3. The sum of the currents entering any junction must be equal to the sum of the currents leaving that junction. (Kirchhoff's junction rule.)

4. Resistors in series have the same current. The total potential across the system is equal to the sum of the potentials across each resistor.

5. Resistors in parallel have the same potential. The total current through the system is equal to the sum of the currents through each resistor.

6. There is a finite time needed to charge a capacitor. The time constant is the resistance times the capacitance.