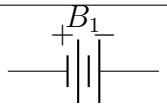
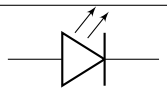
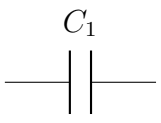
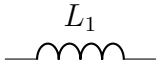
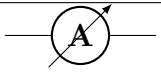
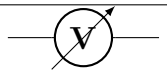
Things to Memorize: Circuits

Basics of Circuits

- For Electricity to flow, a circuit must make a complete path between the two sides of the source.
  - A Circuit that does not have a complete path is called an **Open Circuit**. No current flows in an open circuit.
  - A circuit that connects the two sides of the source without connecting any components in between is a **Short Circuit**. Large currents flow in short circuits, which often lead to fires and other bad things.
- **Voltage** is the energy per charge.
- **Current** is the amount of charge that passes a point in one second.
- **Resistance** is the hindrance to the flow of charge.

Circuit Components

Battery		*Source* - Stores energy for a circuit chemically.
Resistor		Dissipates electrical energy as heat; resists the flow of current.
Light Bulb		Similar to a resistor, but resistance changes with temperature.
Light Emitting Diode (LED)		Turns electrical enegy into light; only lets current flow one way. Must be used in series with a resistor or will be destroyed.
Capacitor		Stores energy in an electrical field.
Inductor		Stores energy in a magnetic field.
Ammeter		Measures Current
Voltmeter		Measures Voltage

Resistors

- Resistors are measured in Ohms (Ω).
- Resistors follow ohm's law.
- Resistors are usually made of carbon, silicon, or metal oxides.
- The resistance of a resistor can be calculated using its dimensions and the resistivity of the material it is made of.

Capacitors

- Capacitors are measured in Farads (F).
- Capacitors are really just two sheets of metal separated by a very small gap of air, vacuum, or some other nonconducting material.
- The capacitance of any capacitor can be calculated from its dimensions and the dielectric constant of any material between the two plates.

Inductors

- Inductors are measured in Henries (H).
- Inductors are really just a coil of wire.
- Calculating inductance is non-trivial. Most inductors are measured experimentally.

Types of Circuits

- **Series circuits** have only one path for current to flow.
  - Resistors in Series **add**.
  - Capacitors in Series **add as reciprocals**.
  - Current in series is **the same**.
  - Voltage in series **adds up** to the voltage of the source.
- **Parallel Circuits** have multiple paths for current to flow.
  - Resistors in Parallel **add as reciprocals**.
  - Capacitors in Parallel **add.**
  - Current in Parallel **adds up** to the current provided by the source.
  - Voltages in Parallel are **the same**.
- Some circuits have parts that are in series and other parts that are in parallel.

Meters and Measurements

- Ammeters should be connected in **Series**.
- Voltmeters should be connected in **Parallel**.

Kirchhoff's Laws

- **Kirchhoff's Current Law** states that the sum of the currents flowing into a junction must equal the sum of the currents flowing out of a junction.
  - Also known as Kirchhoff's First Law, Kirchhoff's Point rule, Kirchhoff's Junction Rule, and Kirchhoff's Nodal Rule.
- **Kirchhoff's Voltage Law** states that the sum of the voltage drops around any closed loop must equal zero.
  - This implies in a circuit with a single source, the total voltage of all sinks is equal to the voltage of the source.
  - Also known as Kirchhoff's Second Law, Kirchhoff's Loop Rule, Kirchhoff's Mesh Rule, and Kirchhoff's Second Rule.