April 6: Electric Current

Objectives

- Relate current, potential and resistance using Ohm's Law.
- Determine the power in a current flow.

What's the point?

- How is energy transported and transformed in electrical components?

Electric current

The flow of electric charge is known as electric current. **Current** is defined as the amount of electric charge passing by a point in a specified time. The SI unit of current is the C/s, otherwise known as the **ampere** (A).

Electrical conductors

A **conductor** is a material in which some type of electrically charged particle travels freely; an **insulator** is a material in which electric charges can move only with great difficulty. All points within a good conductor have the same electric potential—or internal charges will quickly redistribute until they do.

Ohm's law

Most materials are not perfect conductors; charges lose kinetic energy traveling through them. An electric potential change (voltage) V is needed to drive a current through such a **resistor**. The current, voltage, and resistance are related by **Ohm's Law**:

$$I = V/R$$

where I is the current, V is the voltage across the resistor, and R is the resistance. The SI unit of **resistance** is the V/A, known as the **ohm** (Ω).

Electric power

Current flowing through a resistance consumes power at the rate of

$$P = VI$$

Since the unit of voltage V is J/C and the unit of current I is C/s, the power is in units of J/s = W, as it must be.

Combining this formula with Ohm's law gives equivalent expressions for power in terms of voltage or current and resistance: $P = V^2R = I^2/R$.