Electricity

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$$Q = It, \text{ so current = rate of flow of charge}$$

$$W = QV, \text{ so potential difference is the energy per unit charge}$$

$$V = IR, \text{ for an Ohmic conductor } I \propto V$$

A shallower gradient on I-V graph = increased resistance

- An Ohmic conductor as a straight line I-V graph
- A silicon diode conducts no current until V ≈ 0.7 V, after which current flows with very little resistance
- A filament bulb gives an S-curve: greater resistance at higher voltages as the filament heats up due to increased current flow.
- The unknown-resistor circuit consists of a variable resistor in series with the unknown resistance, an ammeter and a voltmeter in parallel with the unknown resistance. It can be used to determine the resistance of the unknown resistor.

Resistivity

$$\text{resistivity, } \rho = \frac{RA}{l} \quad \text{unit: } \Omega\ m$$

Superconductors have a resistivity of 0 Ω m. These are certain materials, which must be cooled below a "transition temperature".

Uses include power transmission lines, strong electromagnets, and very high speed electronic systems.

Power

$$P = \frac{E}{t} = IV = \frac{V^2}{R} = I^2R$$

$$E = VIt$$

EMF and internal resistance

The internal resistance of a cell can be imagined much like a resistor in series with the cell.

$$\text{Electromotive force, } \varepsilon = \frac{\text{energy, } E}{Q} = I(R + r) = \text{terminal pd + lost volts}$$

It is helpful to have awareness of potential dividers and resistive input transducers in this section.