Electric Circuits

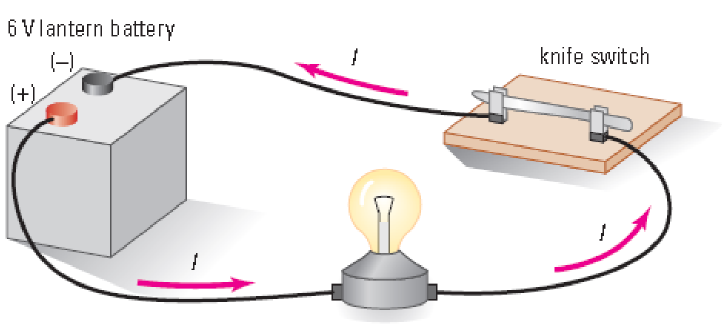


Figure 15.10 A realistic sketch of even a simple circuit is cumbersome.

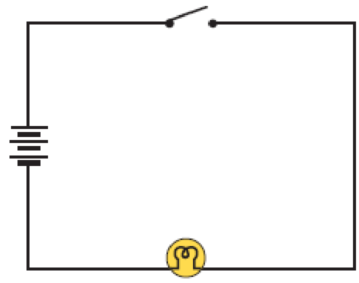
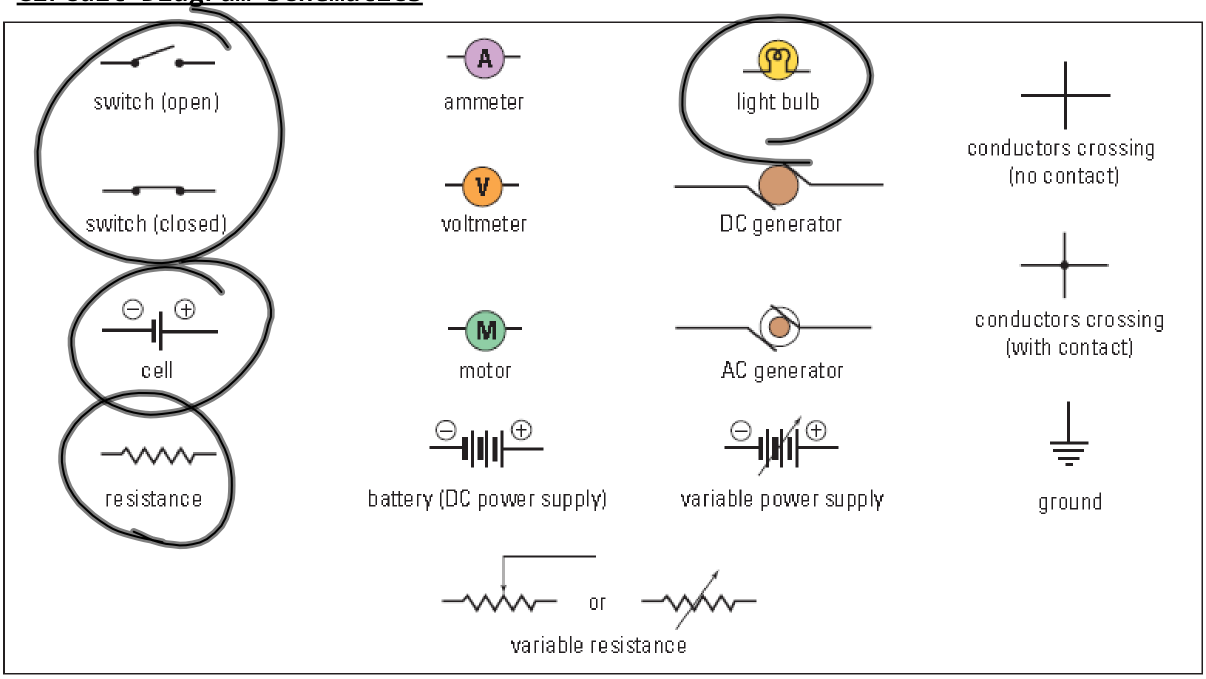
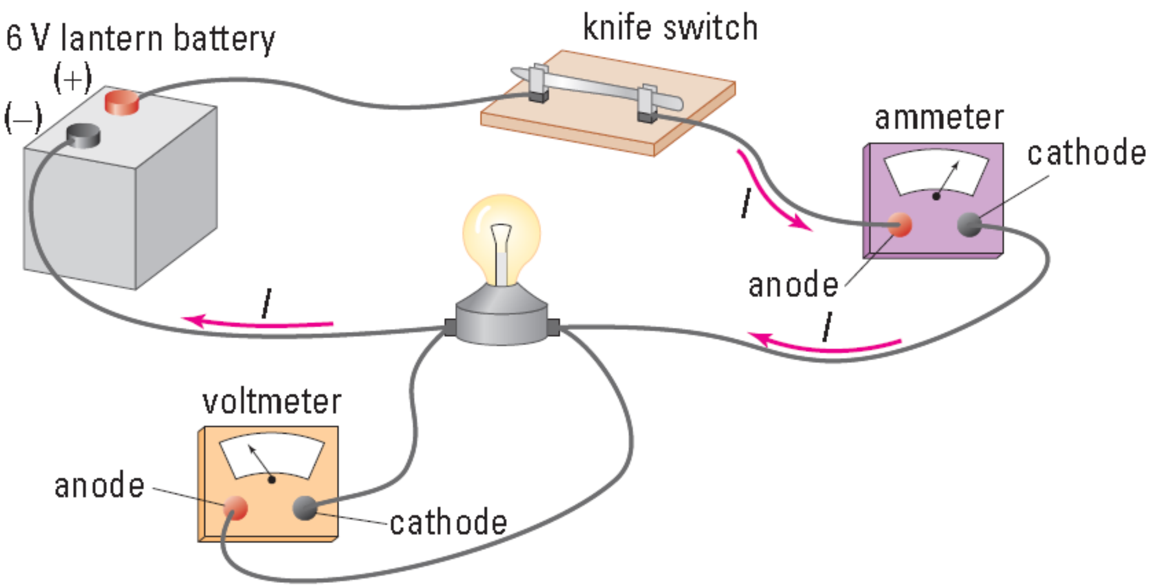


Figure 15.12 This diagram of the same circuit is easier to draw and to analyze.

Circuit Diagram Schematics



Connecting Ammeters and Voltmeters



15.3 Resistance to Flow of Charge

Factors Affecting Current Flow

Imagine water in a garden hose

- longer the hose, the greater the drag of the water on the side of the hose
- larger the hose, (diameter) the lower the drag, ie a greater portion of the water can flow unrestricted through the hose

- Current resistance in conductors is similar
  - resistance (R) is directly proportional to length (L)
  - resistance (R) is inversely proportional to Cross sectional Area (A)

$$R \propto L \qquad R \propto \frac{1}{A}$$

therefore,

$$R \propto \frac{L}{A} \quad \text{or} \quad R = \rho \frac{L}{A}$$

RESISTANCE OF A CONDUCTOR

The resistance of a conductor is the product of the resistivity and the length divided by the cross-sectional area.

$$R = \rho\frac{L}{A}$$

Quantity	**Symbol**	**SI unit**
resistance	R	Ω (ohm)
resistivity	ρ	Ω · m (ohm metres)
length of conductor	L	m (metres)
cross-sectional area	A	m^2 (square metres)

Unit Analysis

$$(\text{ohm metres})\frac{\text{metres}}{\text{square metres}} = \Omega \cdot \cancel{m}\frac{\cancel{m}}{\cancel{m^2}} = \Omega$$

Table 15.1 Resistivity of Some Conductor Materials

Material	*Resistivity, ρ (Ω · m)
silver	1.6×10^{-8}
copper	1.7×10^{-8}
aluminum	2.7×10^{-8}
tungsten	5.6×10^{-8}
Nichrome™	100×10^{-8}
carbon	3500×10^{-8}
germanium	0.46
glass	10^{10} to 10^{14}

*Values given for a temperature of 20°C

Using Resistivity

Calculate the resistance of a 15 m length of copper wire, at 20°C, that has a diameter of 0.050 cm.

$$R = \frac{\rho L}{A} \qquad R = \frac{(1.7\times10^{-8})(15)}{1.96\times10^{-7}}$$

$d = .05\,cm$ $\qquad R = 1.3\,\Omega$

$r = 0.025\,cm$

$r = 0.00025\,m$

$A = \pi(0.00025)^2$

$A = 1.96\times10^{-7}$