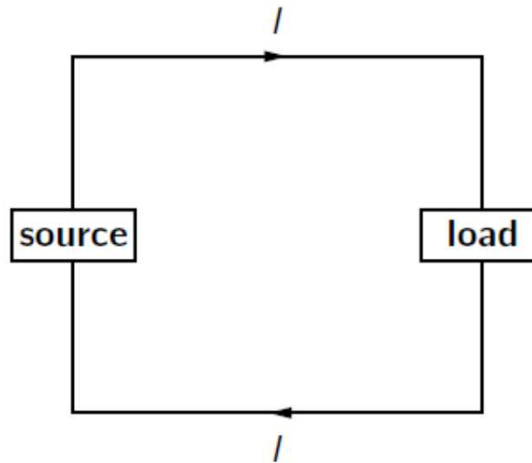


Electric power and energy

All the circuits can be considered to have a source and the load. The source is an electric component that provides a potential difference in the circuit, which may be a battery, power supply, the main outlet in a house. The load may be a resistor, light bulb, motor, heater or a combination of devices.



When a charge passes through a load, electrical energy gets 'lost' or in proper terms, is transferred. The electrical energy could be transferred to heat, mechanical or kinetic energy. The amount of energy that is transferred is given by $W = Vq$. The rate at which energy is transferred, i.e. **power** is given by

$$P = \frac{W}{t} = \frac{Vq}{t}$$

Using $I = \frac{q}{t}$

$$P = VI$$

The SI unit of power is the watt ($1 \text{ W} = 1 \text{ V A} = 1 \text{ J s}^{-1}$).

Different forms of energy and power

For a resistor carrying a steady current I , using the definition of resistance, power and energy can be expressed in different forms.

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

In a time t , the electrical energy converted into heat is given by

$$W = I^2 R t = \frac{V^2}{R} t$$

The kilowatt hour — a unit of energy

Most municipalities measure electrical energy in kilowatt hours (kWh). One kilowatt hour is defined as the electrical energy converted to other forms when a power of 1 kW is used for 1 hour. Thus

$$\begin{aligned}1 \text{ kWh} &= (1000 \text{ W}) \times (3600 \text{ s}) \\ &= 3.6 \times 10^6 \text{ Ws} \\ &= 3.6 \times 10^6 \text{ J}.\end{aligned}$$

Example 2.4: The cost of using electricity

A domestic electric heater is rated at 230 V; 9 A. If the consumer pays 30 c/kWh for electricity, what is the cost of running this appliance continuously for 11 hours?