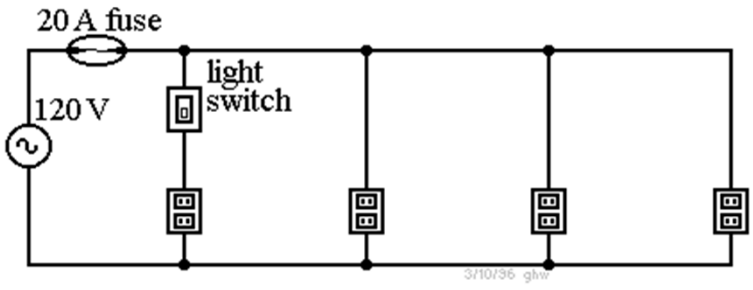
Household Circuits
and
Electrical Safety

Household Circuit

- A household circuit is a circuit with many resistances in parallel



- The source of electrical energy is the electricity supplied by the power company to the electrical panel in the house
- The resistances are the lights and the electrical appliances

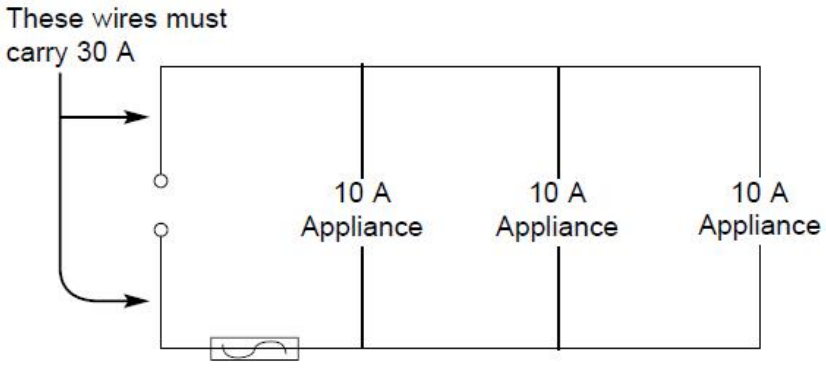
Why Parallel?

- If one device fails, the rest are not affected
- Voltage is the same for all devices

Safety

- Each time we add a resistance in parallel, the total resistance decreases and the total current increases
- Each device in the circuit only carries one part of the current, but there is a portion of the circuit that must carry ALL the current
- Since electrical energy is converted to heat in a circuit, the wires in a circuit heat up

- If too much resistance is added and the current exceeds the capacity of the wire, then the wire burns



Fuses & Circuit Breakers

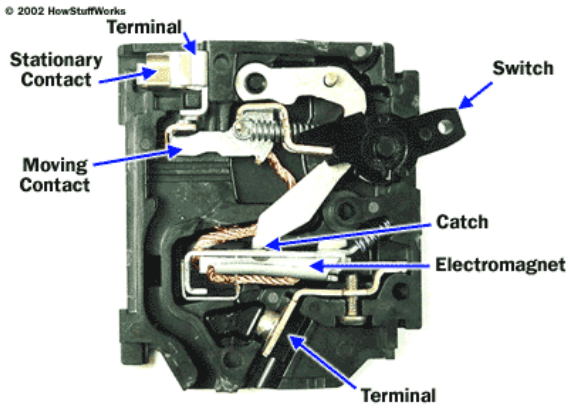
- A fuse or circuit breaker is added after the power source to protect the wires in a circuit from overheating

Fuse

- Small wire enclosed in a case
- The wire in the fuse is chosen so that it will burn at a set current
- If the current exceeds the fuse's rating, the fuse "blows" and the circuit ceases to work

Circuit Breaker

- Mechanical device that cuts off the power to an overloaded circuit



- When the current gets too high, the electromagnet attracts the moving contact flipping the switch and turning the circuit off

Electrical Power

- Power is defined as rate of energy delivered

$$P = \frac{E}{t}$$

- In an electrical circuit, power is related to both the current and the potential difference (voltage)

$$P = IV$$

Example

- An electric radiator uses a voltage of 240 V and draws a current of 2 A. Calculate the amount of power used.

$$P = IV$$

$$P = (2\ \text{A})(240\ \text{V})$$

$$P = 480\ \text{W}$$

Cost of Power

- Manitoba Hydro charges for the amount of energy used
- The amount of energy used is measured in kilowatt hours (kWh)

$$\boxed{Cost = P \times t \times (\text{unit charge})}$$

Example

- An electric radiator uses a voltage of 240 V and draws a current of 2 A. Calculate the cost of running the radiator for 3 hours. The cost of electrical power is 6.62¢/kWh.

$$P = IV$$

$$Cost = P \times t \times (\text{unit charge})$$

$$P = IV$$

$$P = (2\text{A})(240\text{V})$$

$$P = 480\text{W} = 0.480\text{kW}$$

$$Cost = P \times t \times (\text{unit charge})$$

$$Cost = (0.480\text{kW})(3\text{h})(\$0.0662/\text{kWh})$$

$$Cost = \$0.10$$