Grade 9 Science

Electricity

Class 12

Power

- Rate at which electrical energy is produce or consumed in a given time
- Units = Watt (W) or Joule/second (J/s)
- Ex: a 60W incandescent lightbulb uses more energy than a 15W compact fluorescent bulb even though both produce the same amount of light

Comparing Energy Efficiency

- Kilowatt•hour is used to measure energy usage
- Efficiency – the measure of how much useful energy an electrical device produces compared with the amount of energy supplied to the device
  - Old Dryer = 800 kW•h; New Dryer = 300 kW•h

Calculating Efficiency

$$\text{percent efficiency} = \frac{\text{energy out}}{\text{energy in}} \times 100\ \%$$

$$\%\ \text{efficiency} = \frac{E_{out}}{E_{in}} \times 100\ \%$$

- Energy out – measure of how much useful energy the device puts out to do its task
- Energy in – measure of how much energy the device requires

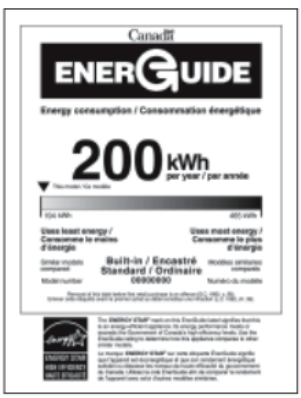
Checkpoint

a) A light bulb uses 100J of electrical energy and produces 35 J of light energy. Calculate the percent efficiency of the light bulb.

b) A toaster oven uses 1200J of energy to produce 850J of thermal energy. Calculate the percent efficiency of the toaster oven.

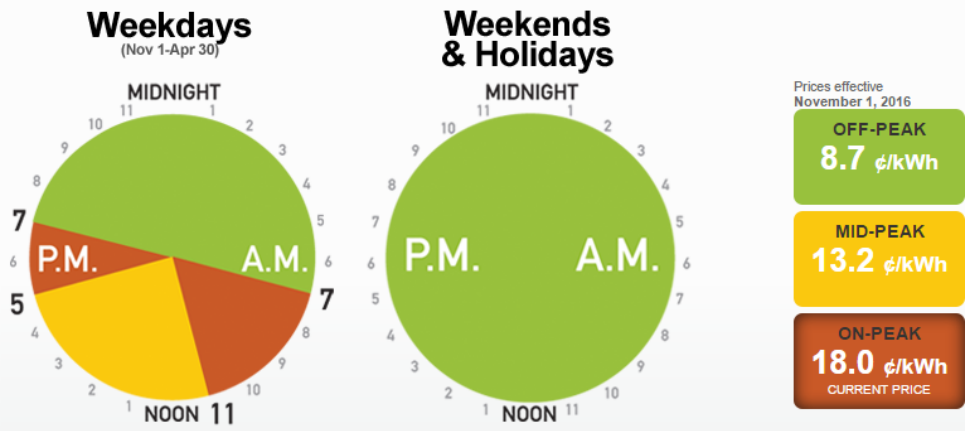
Cost of Electricity

- Price of electricity changes throughout the day
  - Highest during the weekdays from 9am-5pm



- In Ontario, it costs:
  - $0.087/kW•h for off-peak hours
  - $0.132/kW•h for mid-peak hours
  - $0.180/kW•h for on-peak hours

cost to operate = power used × time × cost of electricity

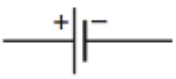


Checkpoint

a) A laptop uses 75W when it is plugged in. Electricity costs $0.087/kW•h. Calculate how much it would cost to operate the laptop for 1 year for 24 hours a day.

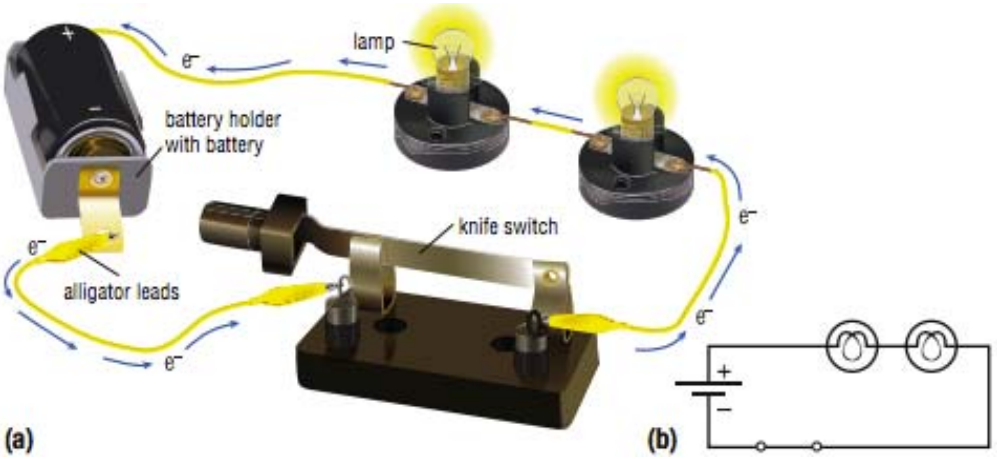
b) Calculate the cost of operating a 1500W hair dryer to dry your hair for 6 minutes per day for 3 days. The cost of electricity is $0.087/kW•h.

Circuit Diagrams

	Part of circuit and symbol		
sources of electrical energy	electric cell 	three-cell battery 	variable DC power supply 
electrical conductor	connecting wire		
control device	open switch 	closed switch 	
loads	lamp 	electric motor 	

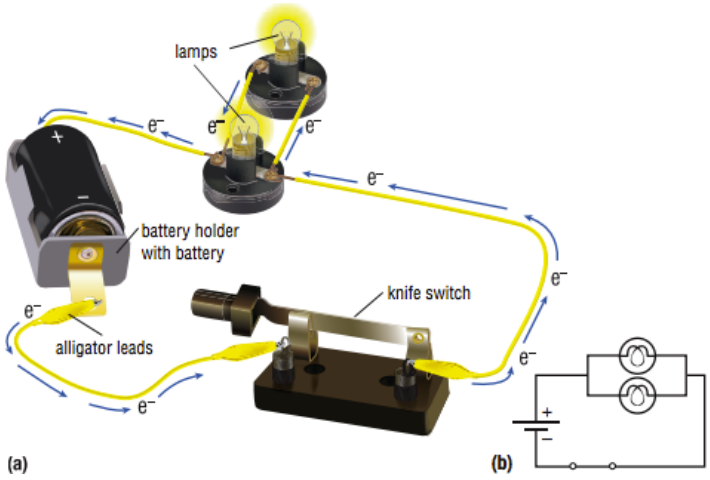
Series Circuit

- A circuit that contains only one path for electrons to flow



Parallel Circuits

- A circuit in which the loads are connected by branches so that there are two or more paths for electrons to flow



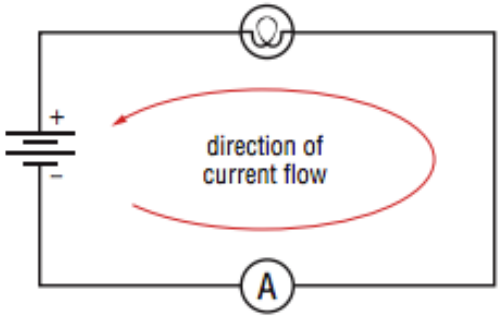
Checkpoint

a) Draw a circuit diagram showing an electric cell, a switch, and three lamps connected in series.

b) Draw a circuit diagram showing a two-cell battery with three lamps connected in parallel. Include a switch for controlling each lamp.

Electric Current, I

- The measure of the rate of electron flow past a given point in a circuit; measured in Amperes (A)
  - Measured by an ammeter that must be connected in series

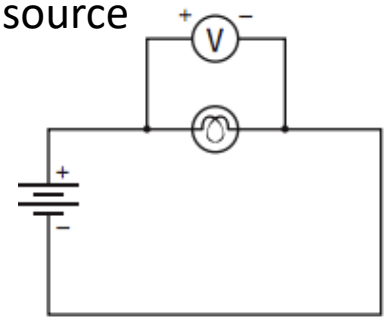


Safety with Electric Currents

- Every home has circuit breakers or fuses for appliances or wall outlets
  - When there is too much current, the fuse blows so that no current flows through protecting appliances
- Human Body
  - 0.001A – slight tingling
  - 0.050-0.150A – cause muscles to convulse
  - 1.0-4.3A – stop your heart
  - *Wall outlet delivers 15A!

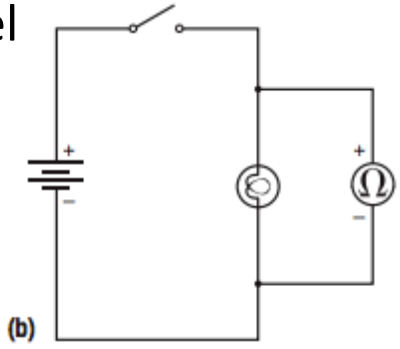
Potential Difference, V

- Potential Difference or Voltage is the difference in electric potential energy per unit charge measured at two difference points; units = Volts (V)
  - Measured by a voltmeter that must be connected in parallel to the load or energy source



Resistance, R

- Electrical Resistance is the ability of a material to oppose the flow of electric current, measured in Ohms (Ω)
- Measured by an ohmmeter
- Must be connected in parallel



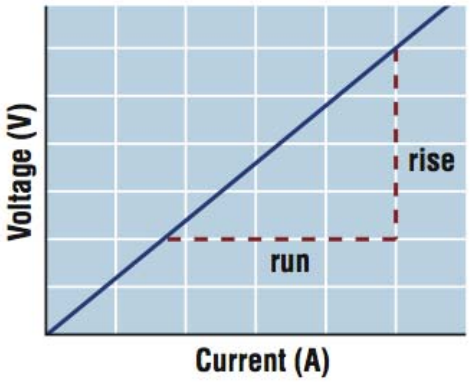
- Factors that Affect Resistance
  - Type of Material
    - Insulators have high resistance
    - Conductors have low resistance
  - Cross-Sectional Area
    - Thicker wires have less resistance
    - Thinner wires have more resistance
  - Length
    - Longer the wire, resistance increases
    - Shorter the wire, resistance decreases
  - Temperature
    - Resistance increases with temperature

Resistors

- A device that reduces the current in a circuit
  - Used to adjust brightness in lights, volume controls

Ohm's Law

$$R = \frac{V}{I}$$



- R = Resistance
- V = Voltage or Potential Difference
- I = Current

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$\text{slope} = \frac{\text{voltage } (V)}{\text{current } (I)}$$

$$\text{slope} = \text{resistance } (R)$$

Checkpoint

a) A load has a 1.2A of current flowing through it. The voltage across the load is 6.0V. Calculate the resistance of the load.

b) A 110Ω resistor is connected to a power supply set at 12V. Calculate the current going through the resistor.