Current Electricity

- Cells consist of different types of metals in an acidic or basic bath that provide a potential difference called an electromotive force (EMF)
(Voltage / Potential difference)

EMF ∴ cell provides a potential that causes charges to flow around a circuit.

- In a conductor, the # of number of charges passing a given point, in a unit of time is called current

$$I = Q/\Delta t$$

Unit of current : Coulombs / Second = Amps.

ex. 1 trillion electrons flow past a point in 0.50 s, what is current?

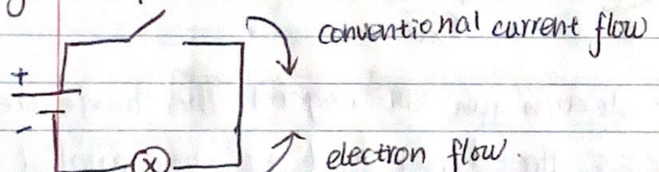
$I = Q/\Delta t$

$I = 1\times10^{12} \times 1.6\times10^{-19} \div 0.50 =$

- Conventional current : flows in the direction positive charges would move, even though electrons are moving the opposite.

- In old convention, we still use current flow from positive terminal to negative terminal. [but reality is the opposite]

Diagram Representation :



- Voltage is the reason that electrons to move.

Problems : #7, 25, 60.

- Electrical Power :

$$\text{Power} = \frac{E}{t} = \frac{Q \cdot V}{t} = IV \quad \therefore \boxed{P = IV} \qquad \boxed{P = \frac{E}{t}}$$ (units : Watts, J/s)

Electrical energy is in kW·h (kilowatt hour)

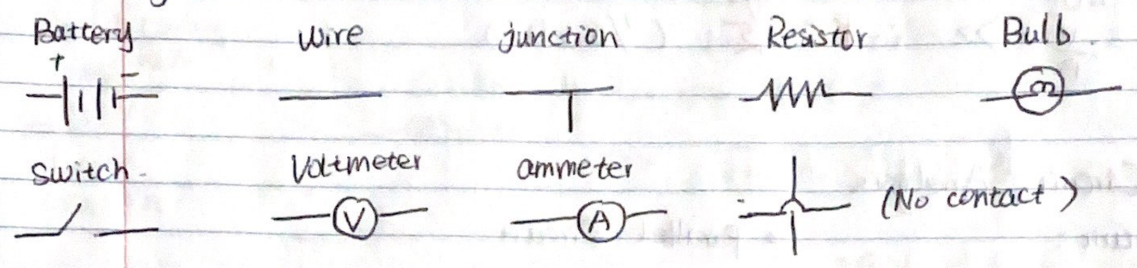
Kilo Watt · hour = 1000J/s × 3600 = 3.6×10^{6} J [it costs 14 cents in 2018]

Example: How much does it cost to run a 1000 Watt hairdryer for 10.0 minutes.

Solution: $1000 \text{ Watts} \times \frac{1\,kW}{1000\,W} \times 10 \text{ minutes} \times \frac{1}{60 \text{ minutes}} \times 0.14 c/kW\cdot h = \$0.024$.

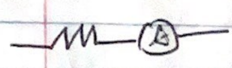
- Schematic Diagrams

Circuit Symbol:



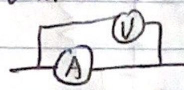
(No contact)

- meter placement:



Ammeters in series.

Voltmeter



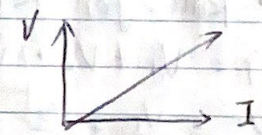
~~Vol~~ be in parallel, across the device.

- An ideal magical ammeter would have 0 resistance.
- An ideal magical voltmeter would have infinite resistance (no current flow through)

Ohm's Law >>

Resistance in a circuit is like friction on a moving object, it impedes the flow of charge.

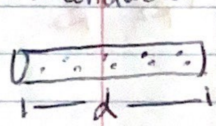
$V = IR$ (Resistance: Ω Ohms)



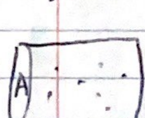
Ohmic Resistor

Resistor symbol

A ~~d~~ conductor:



$R \propto \frac{\lambda}{A}$ (length) (area)



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

[row]

(ρ : resistivity $\Omega \cdot m$)

{ λ : length (m)

A : area m^2 }

20.4.

Read 20.2 and 20.3, problems. #12, 29

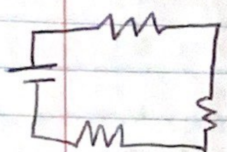
Power Dissipated by a Resistor

$$V = I \cdot R, \quad P = IV \quad \gg \quad \therefore P = I^2 R \quad (J/s)(W)$$

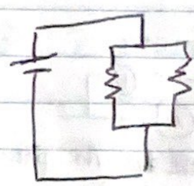
$$P = IV, \quad I = \frac{V}{R} \quad \gg \quad \therefore P = \frac{V^2}{R} \quad (J/s)(W)$$

→ Circuit Analysis

- Series Circuit:



- Parallel Circuit



- In Parallel Circuits:

$$V_T = V_1 = V_2$$

$$I_T = I_1 + \cdots I_2$$

- In a Series circuit.

$$V_T = V_1 + \cdots V_2$$

$$I_T = I_1 = I_2$$

→ Rules for R_T

- Series: $V_T = V_1 + V_2 + V_3$

$$\therefore \frac{V_T}{I_T} = \frac{V_1}{I_1} + \frac{V_2}{I_2} + \frac{V_3}{I_3}$$

(note $I_T = I_1 = I_2 = I_3$)

$$\therefore R_T = R_1 + R_2 + R_3$$

(sum of Resistance)

- Parrallel: $I_T = I_1 + I_2 + I_3$

$$\frac{I_T}{V_T} = \frac{I_1}{V_1} + \frac{I_2}{V_2} + \frac{I_3}{V_3}$$

(note: $V_T = V_1 = V_2 = V_3$)

$$\therefore \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

VIR chart

V		I		R	
V_T	9.0	I_T	0.05	R_T	180Ω
V_1	4.0	I_1	0.05	R_1	80Ω
V_2	5.0	I_2	0.05	R_2	100Ω