⚡ Electricity ⚡

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Electricity

Electricity is charge in motion!

Formulas

$V=IR$

$I=V/R$

$R=V/I$

$I=Q/t$

$P=IV$

$P=I^2R$

$P=V^2/R$

P = Power (Watts)

V= Voltage (Volts)

I = Current (Amps)

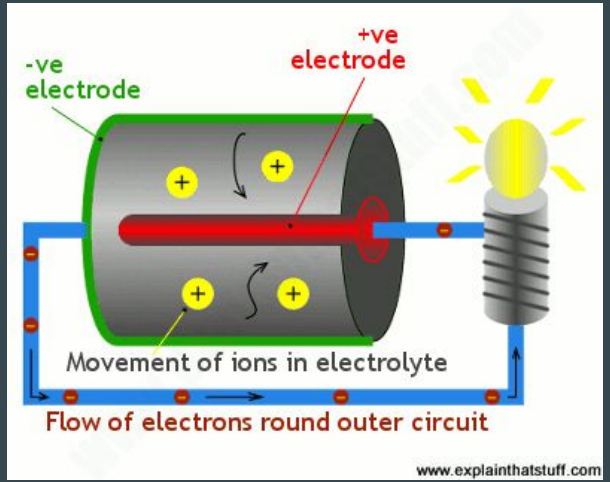
R = Resistance (ohms)

Q = Charge (Coulombs)

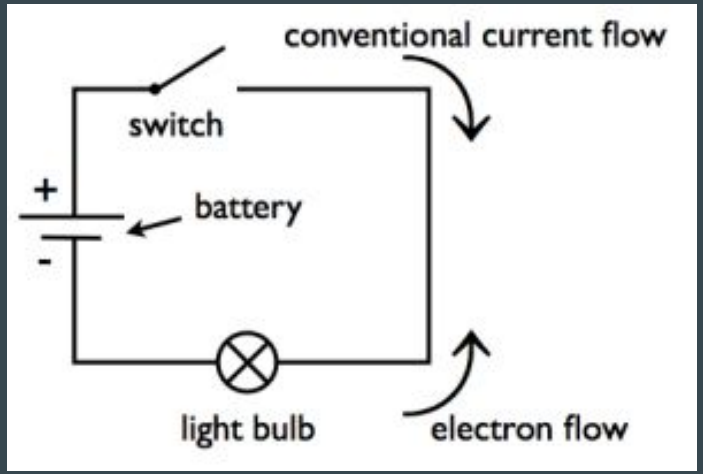
Energy = Work = Pt = (Joules)

Batteries

- Batteries supply electric energy to a system
- A common misconception is that batteries create electric charge
  - Batteries do NOT create or supply electric charge
  - Batteries only push charge



Electric Current



- Flow of electric charge
  - How much charge in a given amount of time
  - **$I=\Delta Q/\Delta t$**
  - Measured in amperes (A)
- A common misconception: Current is actually the electrons that flow from negative to positive
  - When it was invented it was thought that positive charge flowed into the wire
  - Therefore, current, also known as **conventional current**, is said to flow from positive to negative
- A misconception is the difference between AC and DC
  - DC (direct current) only flows in one direction
  - AC (alternating current) changes direction periodically

Ohm's Law

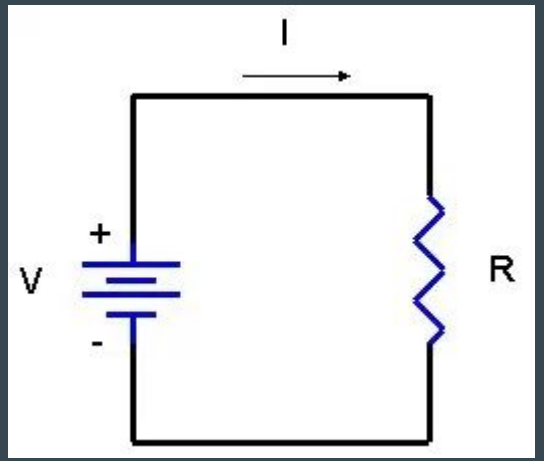
The current in a wire is proportional to the potential difference applied to its ends I:V

V/I= a constant which gives you a circuit's resistance (R) and thusly, V=I/R

Resistance- measured in ohms (Ω)

Common misconception: that conductors have zero resistivity

- All electric devices offer resistance to the flow of current

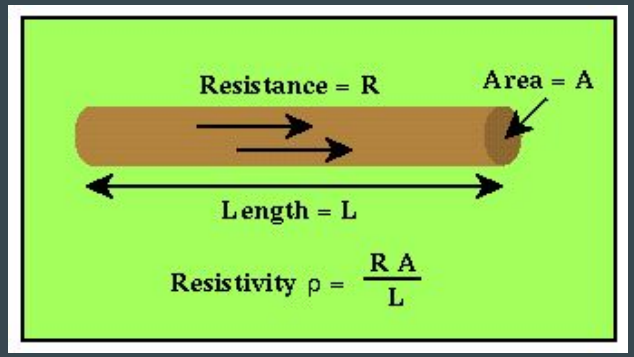


Resistivity

A property that tells how strongly a material will oppose the flow of an electric current

The lower the resistivity, the easier the flow of the electric current

R=ρL/A



*ρ= resistivity

Common Misconception:

It is not a p, it is the greek letter rho

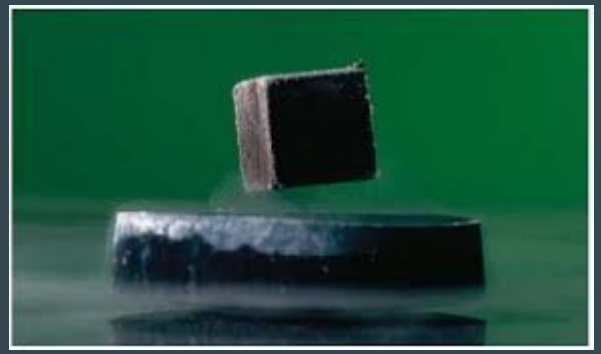
Measured in Ohm meters (Ωm)

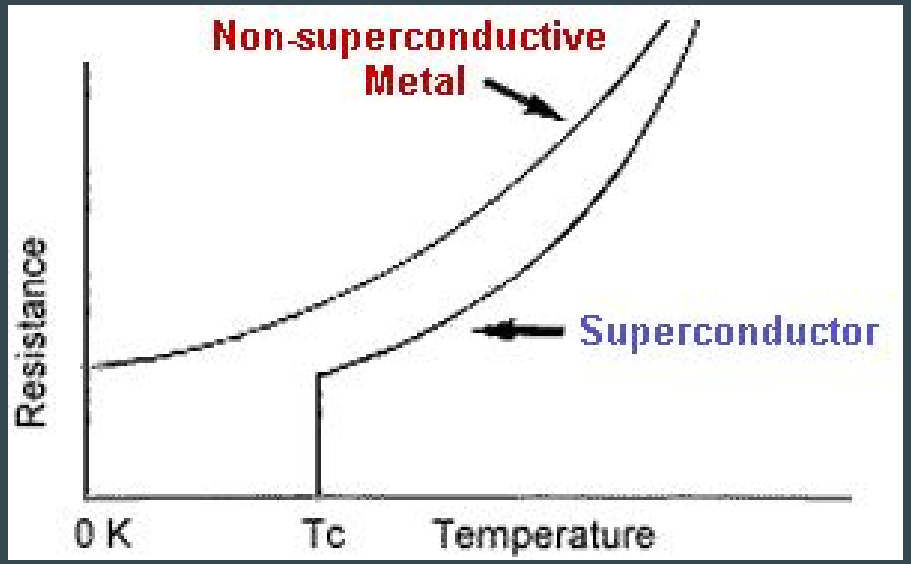
Superconductors

Even the best conductors put up some resistance to electric current.

Some materials, when cooled to a certain temperature or under, offer zero resistance.

This is called superconductivity!





Power

In kinematics, power is work/time. Energy can be thought of in a similar way. It can be easily transformed into other forms of energy.

Voltage is power per charge.

$P=IV$ $P=I^2R$ $P=V^2/R$

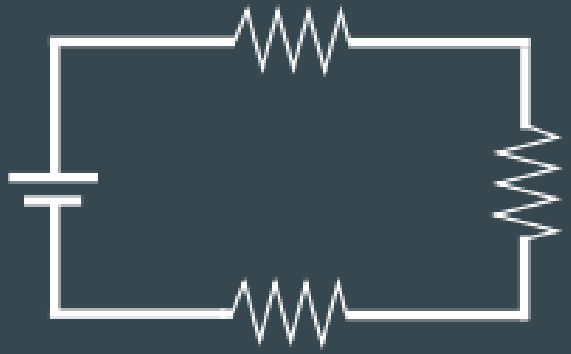
Series

Voltage: $V = V_1 + V_2 + V_3 + \ldots$

Current: I = constant

Resistance: $R_{eq} = R_1 + R_2 + R_3 + \ldots$

Capacitors: $1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3 + \ldots$



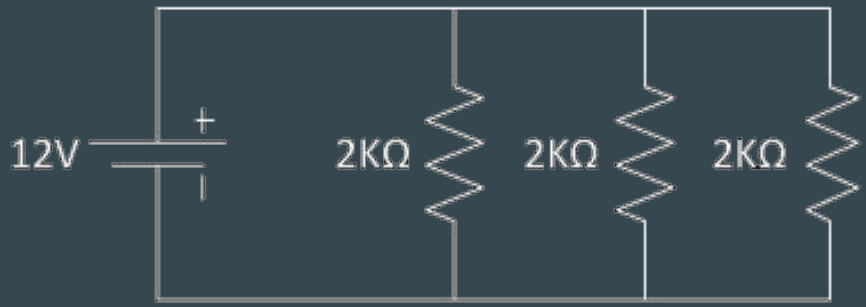
Parallel

Voltage: V = constant

Current: $I = I_1 + I_2 + I_3 + \ldots$

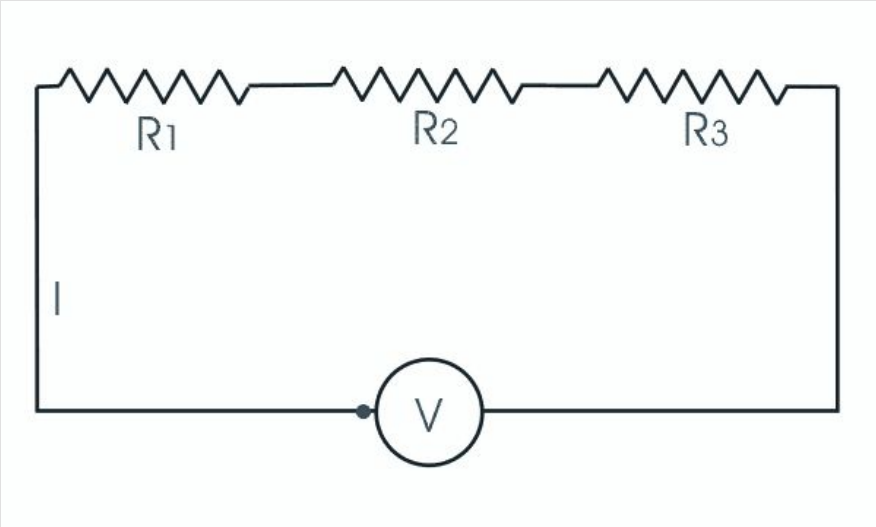
Resistance: $1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3 + \ldots$

Capacitors: $C_{eq} = C_1 + C_2 + C_3 + \ldots$

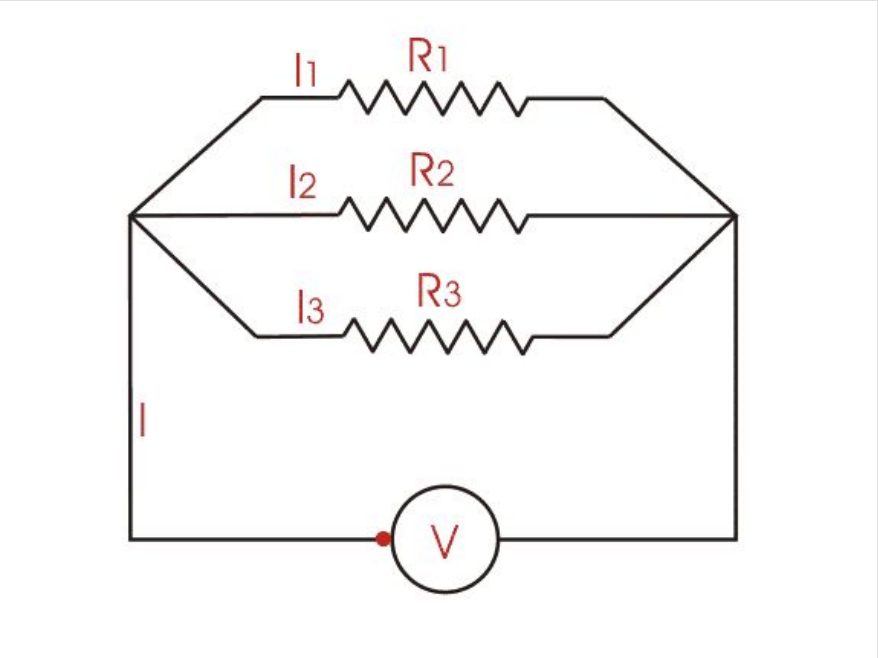


A common misconception is the difference between series and parallel!

Series

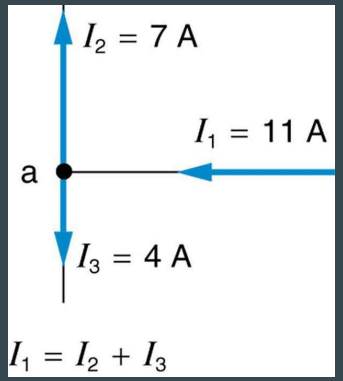


Parallel

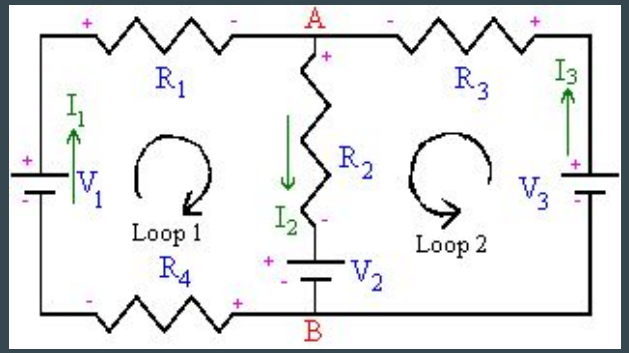


Kirchhoff's Rules

1. **Junction Rule**- At any junction, the sum of the currents in equals the sum of the currents out
   a. Conservation of charge



2. **Loop Rule**- The sum of the changes in potential around any closed path of a circuit must be zero
   a. Conservation of energy



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