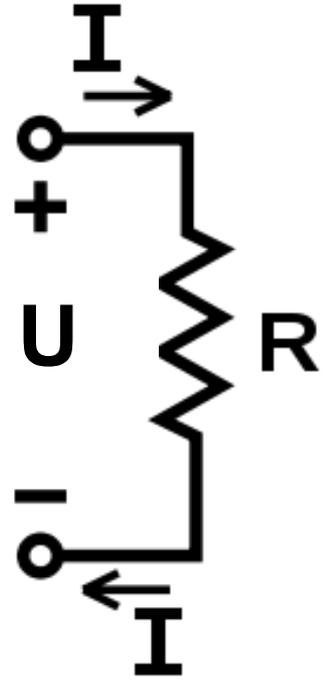# Ohm's Law

$$V = I \cdot R$$

- **V** is **Voltage**, the **Potential Difference** between two ends of a wire (or resistor, light bulb etc). Measured in **Volts [V]**

- **I** is **Electric Current,** the total charge flowing through the wire in 1 sec. Measured in **Amperes [A]** (Coulomb per second) **: 1A=1C/s**

- **R** is **Resistance** of the wire. Measured in **Ohms [Ω].** 1Ω=1V/A
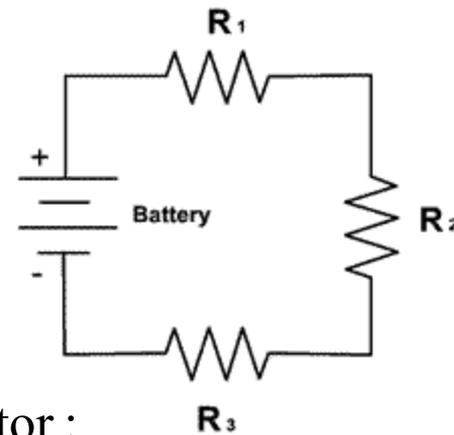
Serial connection:

Current the same. Voltage adds up.

$$I_{total} = I_1 = I_2 = I_3$$

$$U_{total} = U_1 + U_2 + U_3$$

the circuit can be replaced with an single resistor :
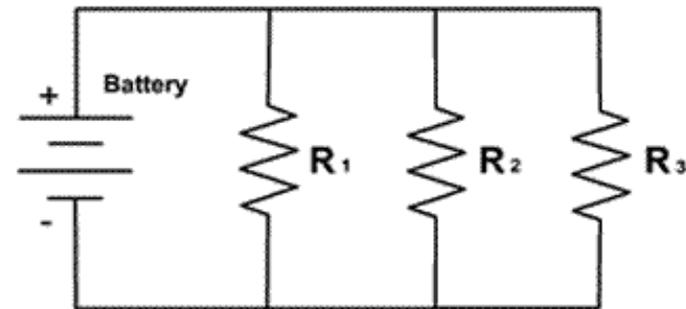
$$R = \frac{U_{total}}{I_{total}} = R_1 + R_2 + R_3$$

Parallel connection:

Voltage the same. Current adds up.

$$U_{total} = U_1 = U_2 = U_3$$

$$I_{total} = I_1 + I_2 + I_3$$

$$\frac{1}{R} = \frac{I_{total}}{U_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

POWER

$$Power = \frac{Work}{time}, \qquad P = \frac{\Delta W}{\Delta t}$$

- **W** may be mechanical work, or work done by a battery driving an electric current.

- In this definition, **Work** can also be replaced with **Heat**. That will be thermal power rather than mechanical or electric one.

- Units of power are Watts [W]: 1W=1J/s (Joule per second)

POWER IN ELECTRIC CIRCUIT

$$Power = Current \times Voltage, \qquad P = I \cdot V$$

Homework

Problem 1. Derive expression for Power **P** consumed by a resistor or a light bulb with resistance **R**, for two cases : (a) you know the current **I** flowing through it, (b) you know the voltage **V** applied to it.

Problem 2.
A light bulb has power P= 100 W when plugged into 110 Volt outlet. Find the total power of three such light bulbs, when they are plugged into the same outlet
a) in parallel,
b)   in series.

Problem 3
An electric motor is used to lift a load of mass **m=50 kg** to height **h=10m** , over time **t=10s**
Find the power of the motor and current that runs through it, if the voltage on the motor is **V=110V**.