 Phys 1402 2017-09-19 Lec 5

Electrostatic Force $F_E = q_0 E$

Electric Field $E = \frac{kQ}{r^2}$

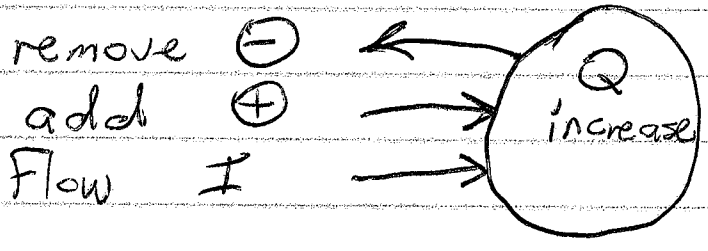
In circuits, V means ΔV

DC Electricity

Current is rate of flow of charge.

$$I = \frac{\Delta Q}{\Delta t}$$

If we had a metal ball, how could we make it <u>more positive</u>?



Current Flowing in is a synonym for:

- ⊕ Charges flowing in.
- ⊖ Charges flowing out.

In wires, only ⊖ move.

Our DC Electricity always flows in circuits.

Resistors allow current to flow, with effort.

$$\text{Effort} = \text{Result} * \text{Difficulty}$$

$$V = I\ R$$

$$\text{Voltage} = (\text{Current})(\text{Resistance})$$

Electricity Carries Energy

$$\text{Power} = \frac{\text{Energy}}{\Delta t} = \left(\frac{\text{Energy}}{\text{Charge}}\right)\left(\frac{\text{Charge}}{\text{Time}}\right)$$

$$\text{Power} = P = V\ I$$

Ex: Flashlight w/ 3.0 v Battery
Current is 0.2 A.

Resistance is $R = \frac{V}{I} = \frac{3.0\,v}{0.2\,A} = 15\,\Omega$

Power is $P = VI = (3.0\,v)(0.2\,A) = 0.6\,W$

Power (P) is measured in watts (W).

(3)

Cost of Energy $0.12/kWh

$$\text{Power} = \frac{\text{Energy}}{\Delta t} \Rightarrow \text{Energy} = P\Delta t$$

In S.I. Units: $1\ J = (1\ W)(1\ s)$

On elec bill: $1\ kWh = (1000\ W)(3600\ s)$

$= 3.6\ MJ$

Ex: Cost to leave a light on:

$P = 9\ W$ (Reading Lamp)

$\Delta t = 1\ month$

$= 30\ days\left(\frac{24\ h}{day}\right) = 720\ hours$

$\text{Energy} = (9\ W)(720\ h) = 6480\ Wh$

$= 6.48\ kWh$

$\text{Net Cost} = \text{Amount} \cdot \text{Rate}$

$= (6.48\ kWh)(\$0.12/kWh)$

$= \$0.78$

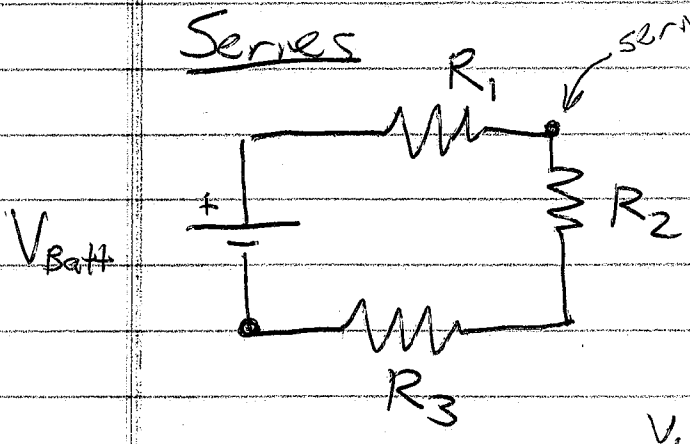
Circuits consist of sources and loads.

Sources: Wall outlet, Battery, Power Supply, Generator

Loads: Resistor, Light Bulb, Heater, Motor, Battery being charged.

Hooking up multiple Loads.

Series



Current same everywhere.

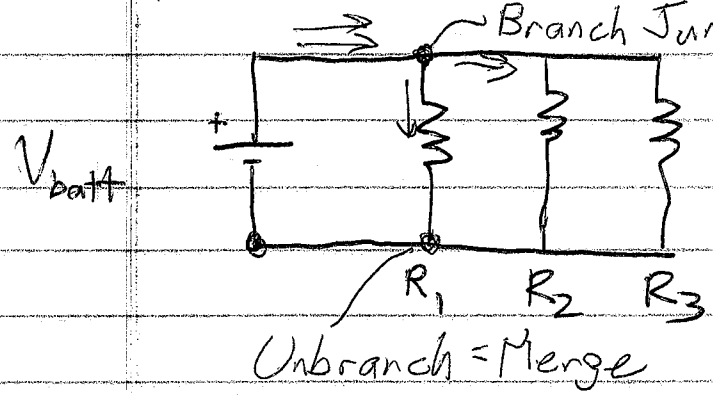
$I = I_1 = I_2 = I_3 = \dots$

Voltage adds.

$V_{Tot} = V_1 + V_2 + V_3 + \dots$

V_{batt}

Parallel - Branches give charges a choice.



Voltage is the same

$V = V_1 = V_2 = V_3 = \dots$

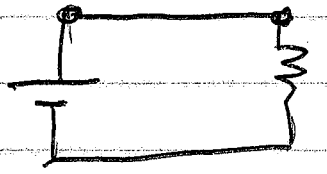
Current adds

$I_{tot} = I_1 + I_2 + \dots$

(5)

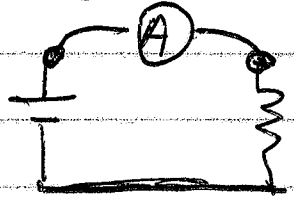
Measuring Current

Circuit

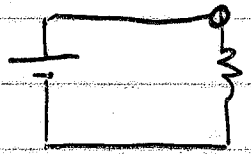


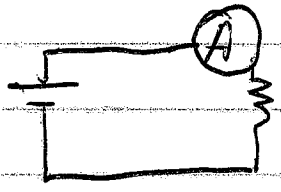
Replace 1 wire

With Ammeter

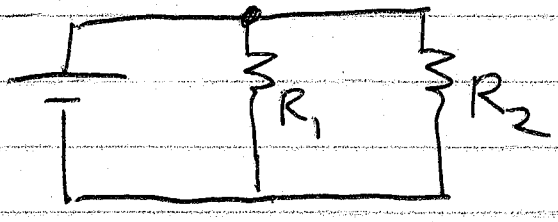


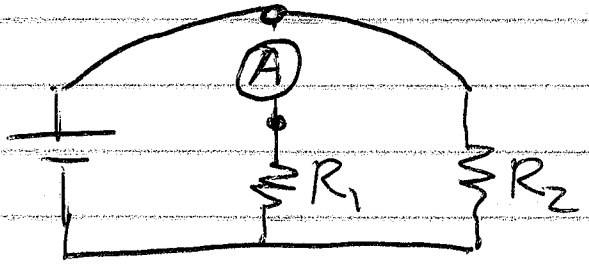
Break ⓐ Connection





Either way, —(A)— in series with —/\/\/\—





Measuring I_1

Measuring I_2