Source: [[KBhPHYS201IntroToElectrostaticsLN]]

1 | Resistance and Current

Resistance roughly measures how much pressure against current — electron flow there is in a conductor.

Current

Use the variable I, a unit $\frac{C}{s}$, $Amps$, to measure current. This also equals $\frac{\Delta V}{Resistance}$. Big resistance, little current. Current is measured in a unit $\frac{C}{s}$, which intuitively makes sense — Current/second is kind of like metres^3/second — it measures, roughly, the "amount of flow"/second.

Definition 1 · **Current** I A value measured in unit $\frac{C}{s}$, a.k.a. $Amps$ that measures electron flow

Resistance

So, let's figure out resistance.

We know that… $V = \frac{J}{C}$, per [[KBhPHYS201Voltage]], and we also know that resistance would equal a unit $\frac{Vs}{c}$ given that $I = \frac{C}{s} = \frac{\Delta V}{Resistance}$. Plugging in the definition of voltage, we get that resistance is measured in $\frac{Js}{C^2}$. We call this unit Ohms, or Ω.

Definition 2 · **Resistance** Ω A value measured in $\frac{Js}{C^2}$ that measures the resistance to current

Calculating resistance

- So, let's think. With a wire of length L and with a wire of area A, if we increase L, the resistance in the wire would increase; if we increase area A, the resistance in the the wire would decrease.
- $Resistance = \frac{L}{A} * ResistivityOfMaterial$ with units $\frac{m}{m^2}(\Omega \times m)$.

and, indeed, resistivity of materials are measured in $\Omega \times m$, which also makes sense intuitively.

Resistors in Different configurations

Series

If you have two resisters…

−−|||−−|||−−

With the first having a resistance of $A\Omega$ and the second $B\Omega$.

The total resistance would simply be $(A + B)\Omega$.

- Same as equivalent of "electricity!" go through the first then the second

#disorganized

Parallel

Smaller area |−−|||−− | Bigger area |===|||====

$R_2 = R_1 \times \frac{A_1}{A_2}$

$R_{eq} = R_1 \times \frac{A_1}{A_1+A_2}$

$\frac{1}{R_{eq}} = \frac{A_1+A_2}{A_1R_1}$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{A_2}{A_1R_1}$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R2}$

Resistance equation for series :pointup:

#disorganized

Calculate resistsance

Calculating Current in a Circut.

Traditional Kirkoff's Laws approach

A circut!

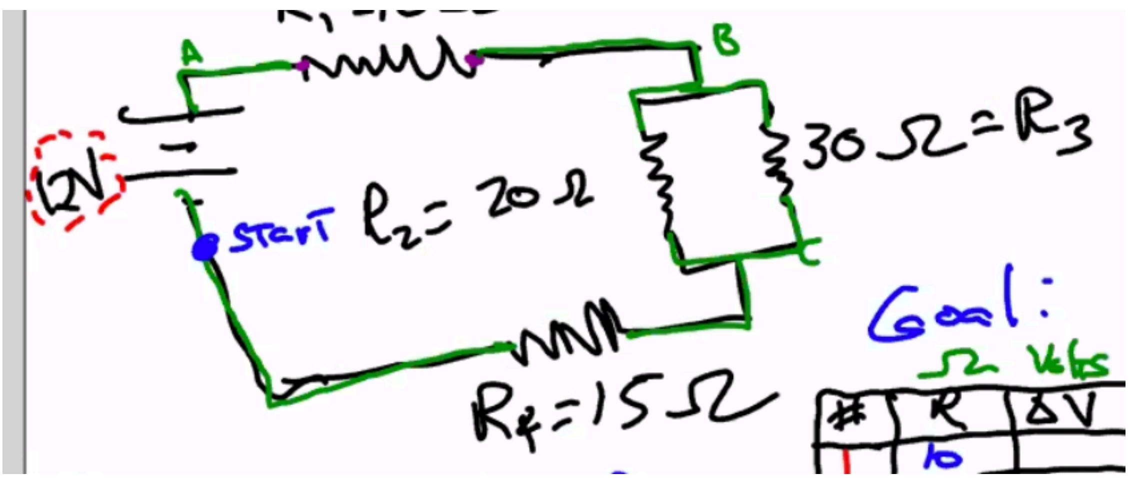

Figure 1: Screen Shot 2020-09-14 at 10.38.44 AM.png

Kirkoff's First Law **Sum of voltage in any closed loop should add up to 0**
As in, the sum of all voltage changes from Start => Start will add up to 0.

Kirkoff's Second law **Net current flowing into a node is 0**
With a current i_0, when it flows into a junction like B, the current i_0 splits into i_2 and i_3

So, to calculate the resistance and current at every point o

START at start

- $+12$

- $-I_1 * 10$ (per $I = \frac{\Delta V}{resistance}$)
- $-I_2 * 20$
- $-I_1 * 15$
- $= 0$

$I_1 - I_2 - I_3 = 0$, per Kirerbab's Second Law.

Through a resistor, the Current does NOT change, the Voltage drops.

"Combine Resistors" Method

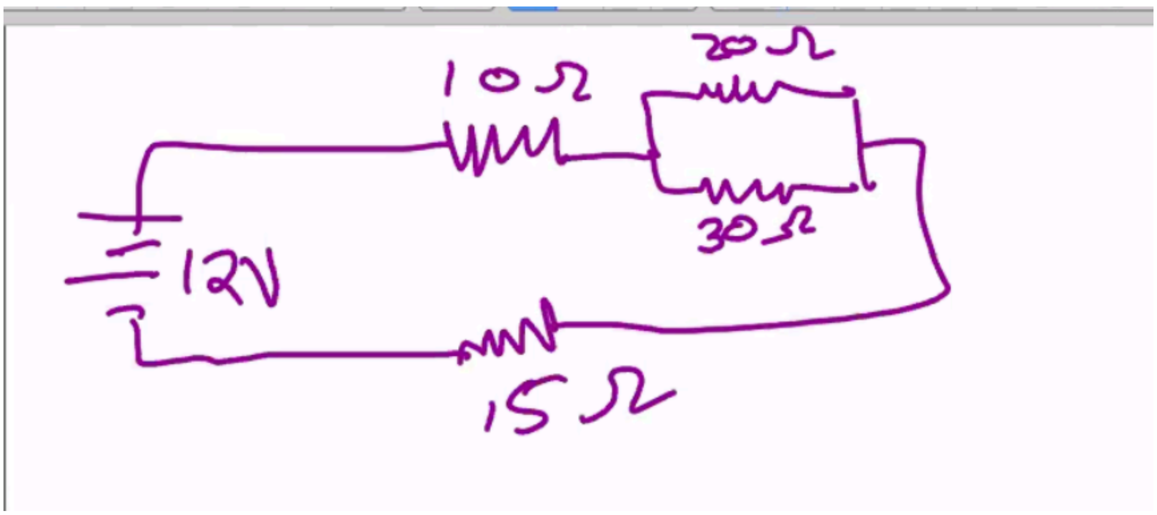

Figure 2: Screen Shot 2020-09-14 at 11.02.45 AM.png

Parallel Resistors as Single Resistors Per the previous resisters rules, that $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R2}$, we could treat the 20Ω and 30Ω in parallel as a single resistor of 12Ω.

Now the circut becomes even simpler:

Figure 3: Screen Shot 2020-09-14 at 11.05.49 AM.png

Sequence Resistors as Single Resistors Per the sequence resisters rules, that total resistance is $(A + B)\Omega$, we could combine these three resistors as a 37Ω resistor.

Combined Current We know that $12V/37\Omega = 0.324Amps$ is the current that returns to the battery and what the battery starts with, for if we treat the circuit as a single resistor, the 12 volts would only be working against.

From there, once we have a current for beginning and end, we could work our way up backwards by calculating the final voltage.