Source: [[KBhPHYS201CircuitsIndex]]

1 | Calculations Surrounding a Circuit

There are two ways to calculate the resistance within a circuit. In reality, they are all based on the same set of rules — but one way applies them directly and the other uses a higher-level abstraction that is often easier.

Kirkoff's Laws

These are the basic rules of circut calculation: [[KBhPHYS201KirkoffsLaws]]

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 Kickoff's's Laws approach

A circut!

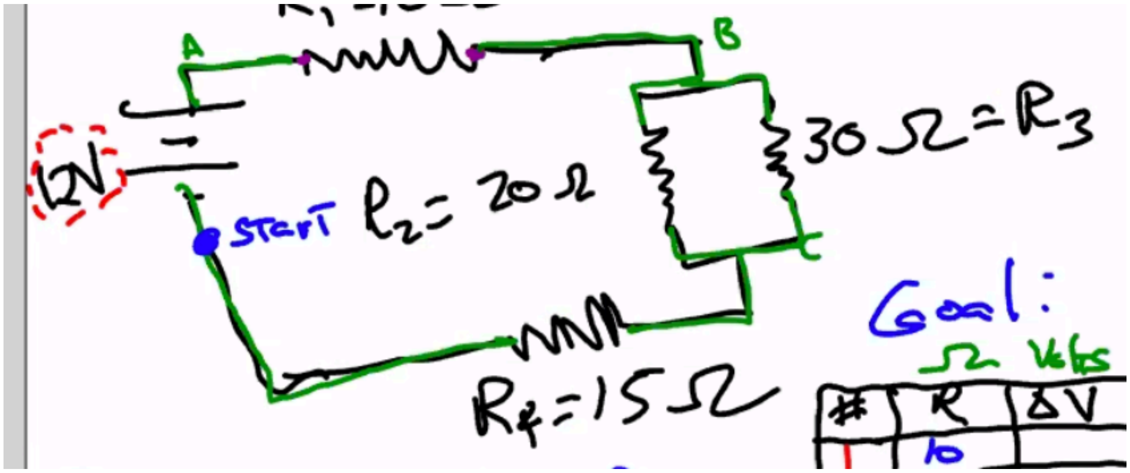

Figure 1: Screen Shot 2020-09-14 at 10.38.44 AM.png

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

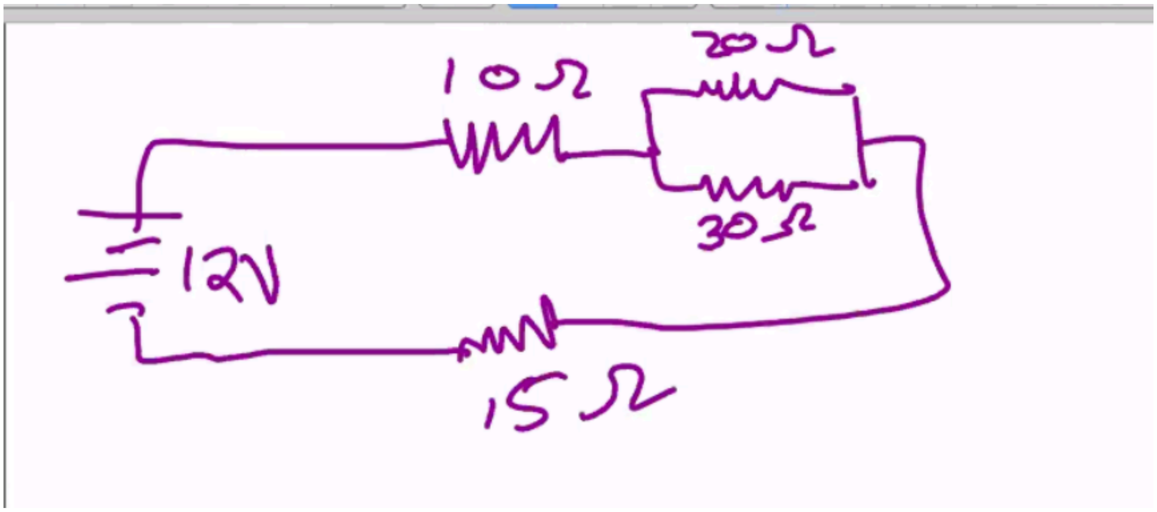

Figure 2: Screen Shot 2020-09-14 at 11.02.45 AM.png

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:

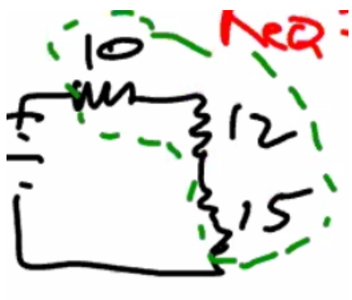

Figure 3: Screen Shot 2020-09-14 at 11.05.49 AM.png

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.

- Multiples battries can't be solved with the combined resistor method
- So, first guess the current flow
    - Each batteries' current will flow back to itself
    - When currents meet, they will combine

- Use currents identified before + Kirkoff's second law
- Use Kirkoff's first law to find loops (and hence equations) that, together, **covers all components**
- If resulting currents is negative, that means that you drew the current in the wrong direction, or you are charging a battery
  - Either way, if the signs are preserved to solve the rest of the equation, you should be fine numerically
  - Just update your graph to reflect the actual currents' directions

LED longer leg is positive