[[KBhPHYS201CircuitsIndex]] # Circuits ## Some key vocab… ### Current Current is a measure for the flow of electrons. Think about it as "how much water goes through this arbitrary box on this river per second".

See [[KBhPHYS201Current]]

Resistance

Resistance is a measure of the restriction of electron flow (and hence decrease of voltage — the pressure of electrons), for instance, a lovely resistor.

[[KBhPHYS201Resistance]] Resistance

Rule of thumb:

- *current does change when resistors are parallel, current does not change when resistors are in sequence.*
- *voltage splits in half when encountering a parallel circuit, current splits, but not in half, based on the capacitance on each of the parallel circuits.*

Circuit Calculations

Learning all this map and vocab is not really helpful in itself. However, it becomes super helpful when it could help you figure out mathematically different expected values in a circuit!

See [[KBhPHYS201CircuitCalculations]]

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 Kickoff's's Laws approach

A circut!

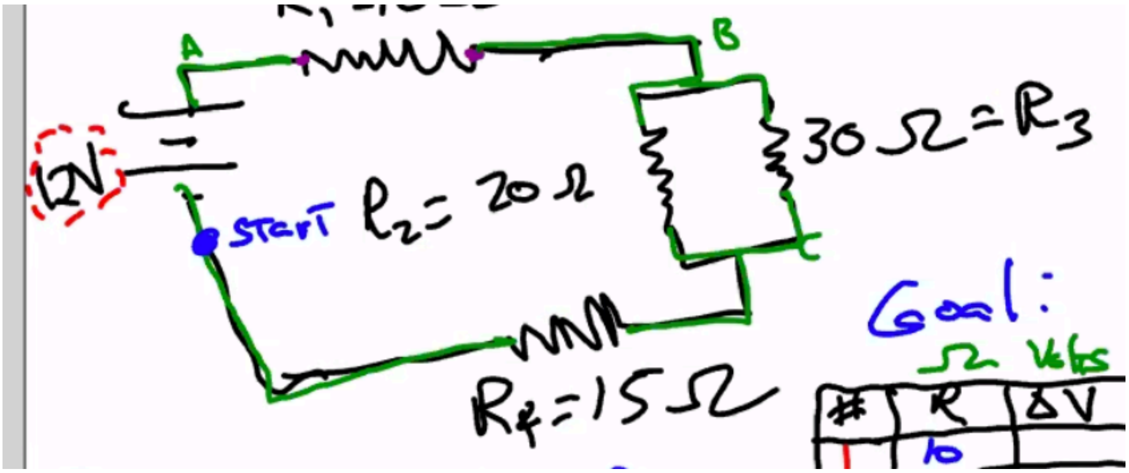

Figure 1: Screen Shot 2020-09-14 at 10.38.44 AM.png

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

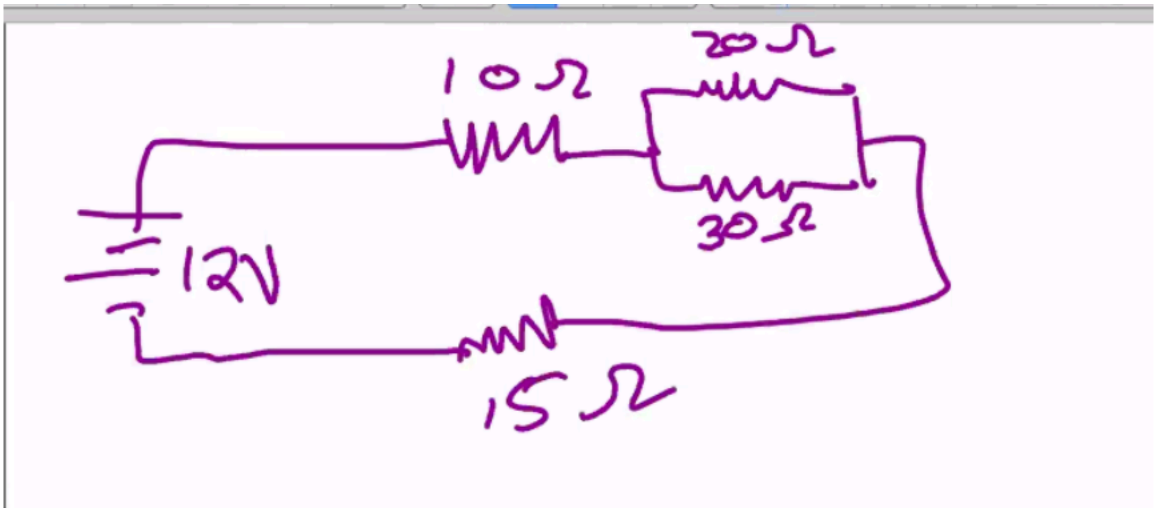

Figure 2: Screen Shot 2020-09-14 at 11.02.45 AM.png

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