Source: ⟦KBPhysicsMasterIndex⟧

1 | **Circuits**

First, 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

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 |===|||====

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

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

$\frac{1}{R_{eq}} = \frac{A_1 + A_2}{A_1 R_1}$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{A_2}{A_1 R_1}$

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

Resistance equation for series :pointup:

#disorganized

Calculate resistsance

Calculating Current in a Circut.

Traditional Kirkoff's Laws approach
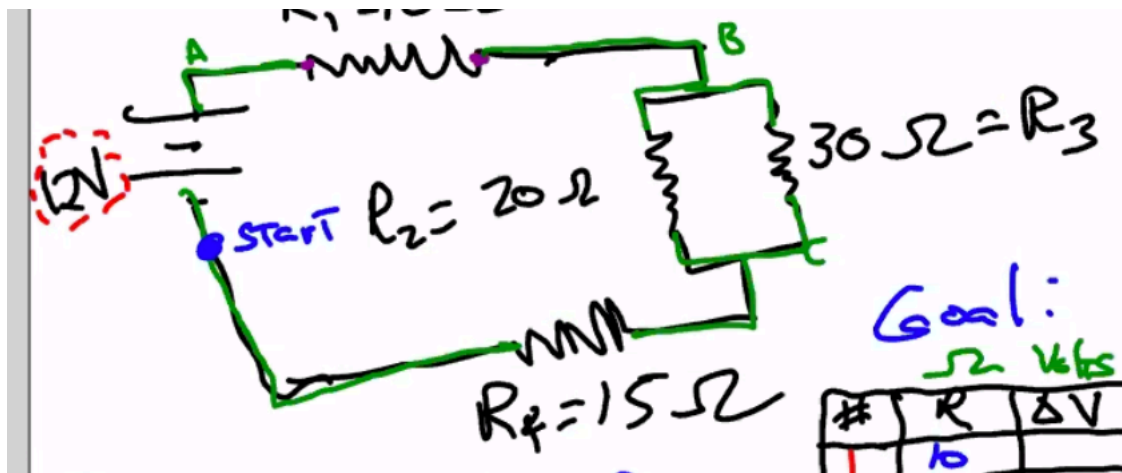
A circut!

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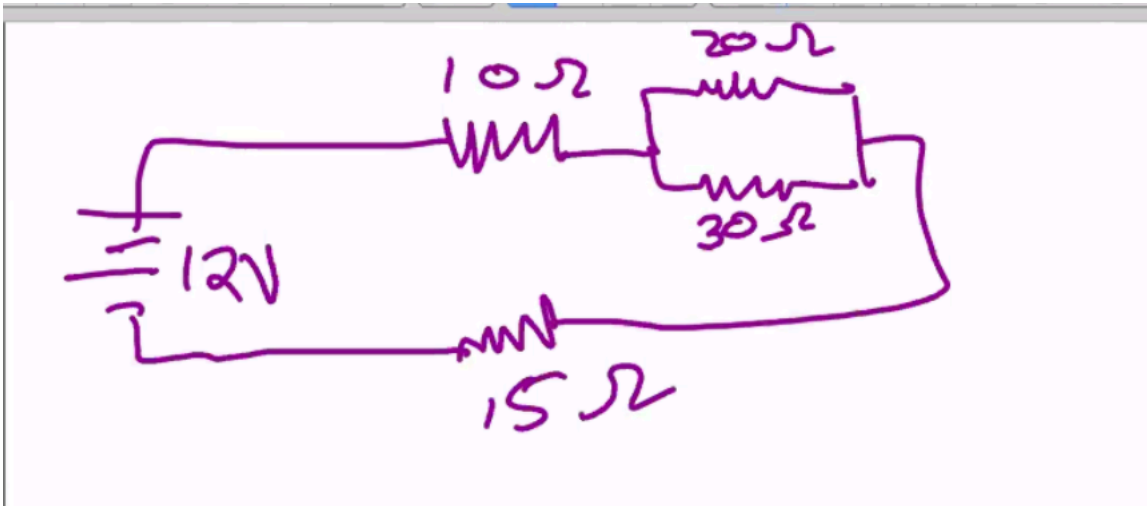**Through a resistor, the Current does NOT change, the Voltage drops.**

"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.

- 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