

Source: [KBPhysicsMasterIndex](#)

1 | 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

Resistors in Different configurations

Series

If you have two resistors...

--|||--|||--

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 |===|||===

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

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

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

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

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Resistance equation for series :pointup:

#disorganized

Calculate resistance

Calculating Current in a Circuit.

Traditional Kirkoff's Laws approach

A circuit!

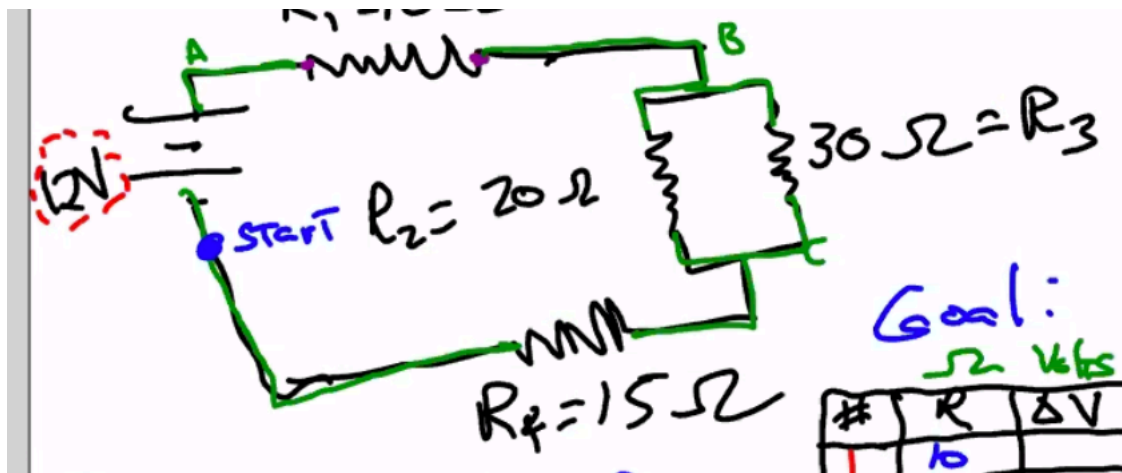


Figure 1: Screen Shot 2020-09-14 at 10.38.44 AM.png

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

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

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

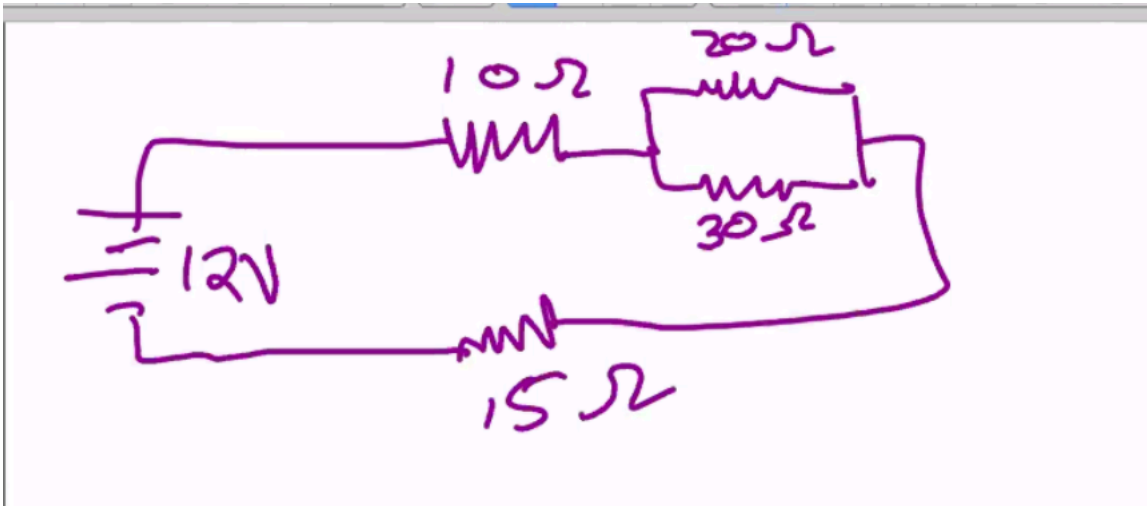
“Combine Resistors” Method

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

Parallel Resistors as Single Resistors Per the previous resistors rules, that $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$, we could treat the 20Ω and 30Ω in parallel as a single resistor of 12Ω.

Now the circuit becomes even simpler:



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

Sequence Resistors as Single Resistors Per the sequence resistors 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 batteries 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