

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.

Either way, this is the are the rules that rules them all: **through a resistor, the Current does NOT change, the Voltage drops.**

### Kirkoff's Laws

These are the basic rules of circuit calculation: [KBhPHYS201KirkoffsLaws](#)

### Combining Resistors Method

#### 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

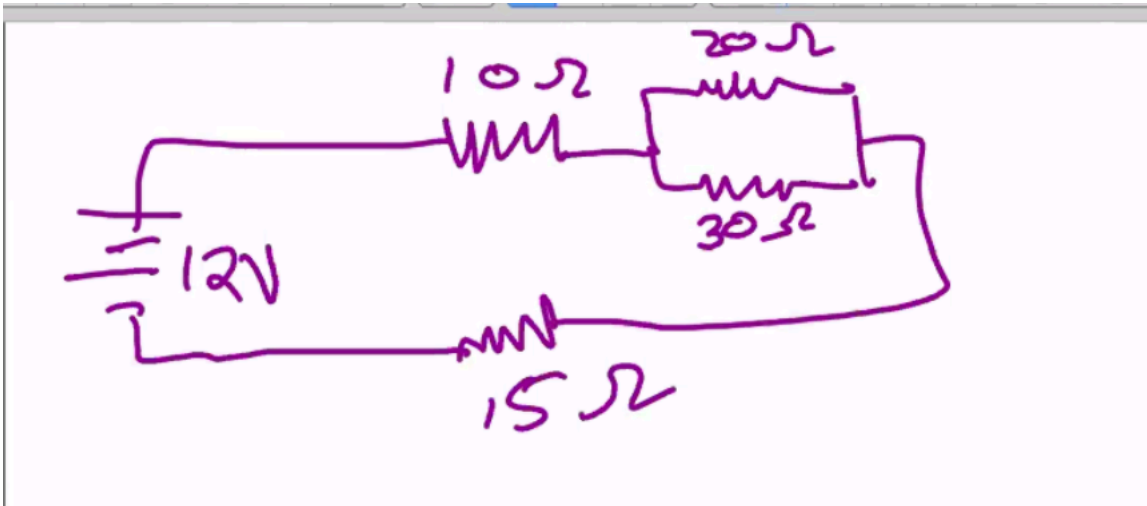
**“Combine Resistors” Method**

Figure 1: 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  $20\Omega$  and  $30\Omega$  in parallel as a single resistor of  $12\Omega$ .

Now the circuit becomes even simpler:



Figure 2: 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  $37\Omega$  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