PLTW Engineering

10-12/Advanced Parallel Circuit Calculations

April 22, 2020

10-12/DE

Lesson: **4/22/2020**

Objective/Learning Target: Students will be able to calculate unknown resistance, current, or voltage values in a PARALLEL circuit with 3 or more components.

Review

In the previous lesson, we learned how to use Ohm's law to calculate unknown values in a very basic circuit.

However circuits have evolved over time and have become increasingly complex.

The following slides will show you how to calculate unknown resistance, current, or voltage values in a circuit with 3 or more components.

Ohm's Law Review

Ohms law review

$$V = I \times R$$

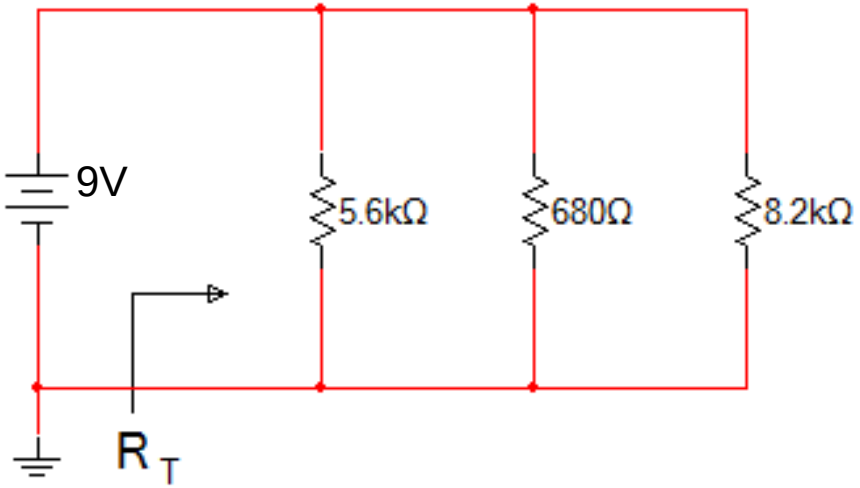
$$I = V / R$$

$$R = V / I$$

Ohm's Law Total Resistance in Parallel

In the circuit shown to the right, we see there are 3 resistors in PARALLEL. In a parallel circuit, the reciprocal of the reciprocals of the resistor values are added together to determine the total resistance.

$$R_T = \frac{1}{\frac{1}{5.6k\Omega} + \frac{1}{680\Omega} + \frac{1}{8.2k\Omega}}$$



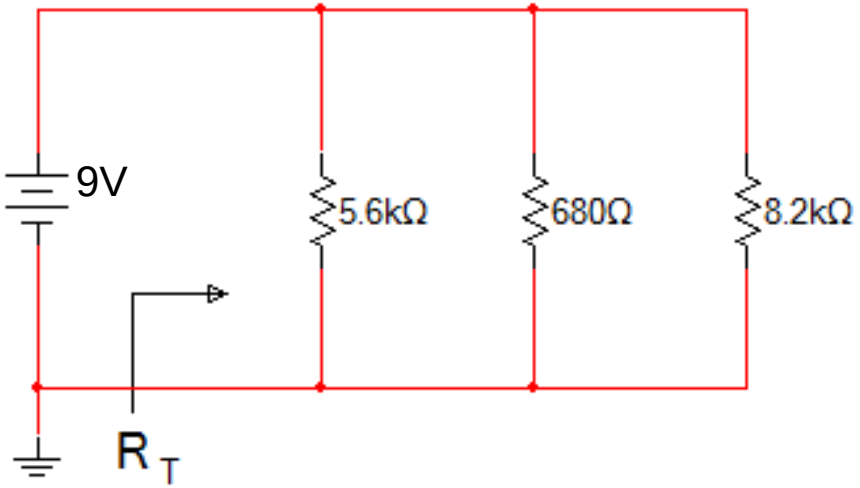
Ohm's Law Total Resistance in Parallel

$$R_T = \frac{1}{\frac{1}{5.6k\Omega} + \frac{1}{680\Omega} + \frac{1}{8.2k\Omega}}$$

$$R_T = \frac{1}{.17857\Omega + .00147\Omega + .12195k\Omega}$$

$$R_T = \frac{1}{.3019912195}$$

$$R_T = 3.311\ k\Omega$$



Ohm's Law Total Current

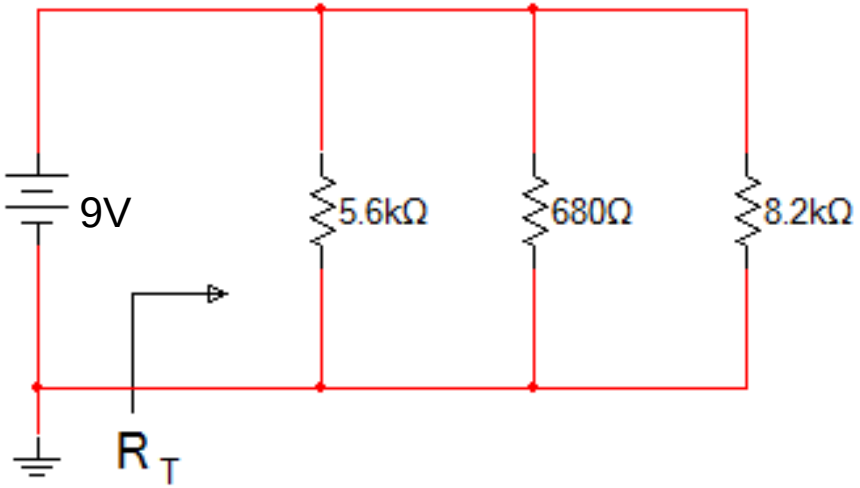
With the total resistance calculated, we can now use Ohm's law to find the remaining unknown values.

$R_T = 3.311k\Omega$

$I_T = V / R$

$I_T = 9v / 2{,}170\Omega$

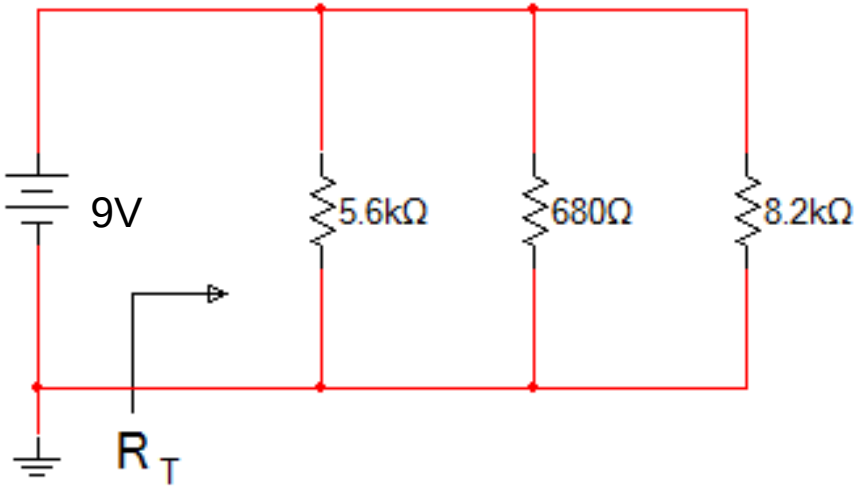
$I_T = 2.72$ mA



Ohm's Law Advanced

With the total resistance and current calculated, we can calculate the current drops at each resistor. This is important when designing a circuit because it can help determine if a larger power source is needed.

$R_T = 3.311k\Omega$
$I_T = 2.72\ mA$



Ohm's Law Current Drops

$I = V / R_1$

$I = 9v / 5.6k\Omega$

$I_{R1} = 1.6\ k\Omega$

$I = V / R_2$

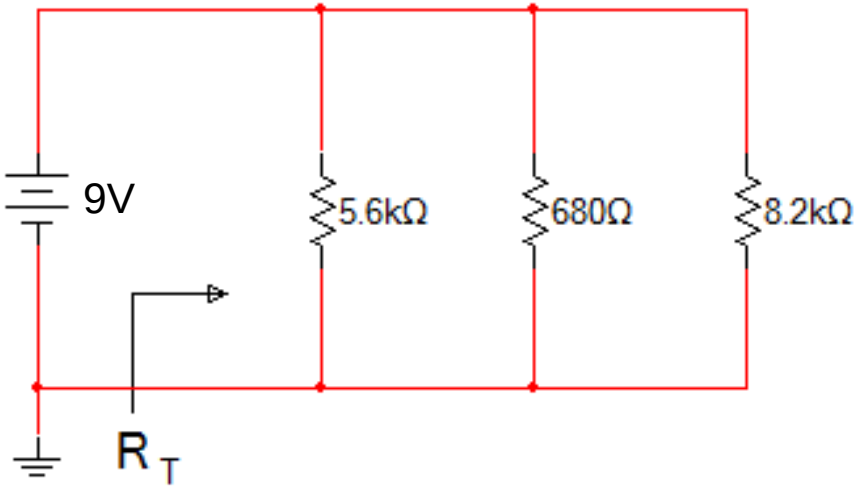
$I = 9\ v / 680\Omega$

$I_{R2} = 0.013$

$I = V / R_3$

$I = 9\ V / 8.2k\Omega$

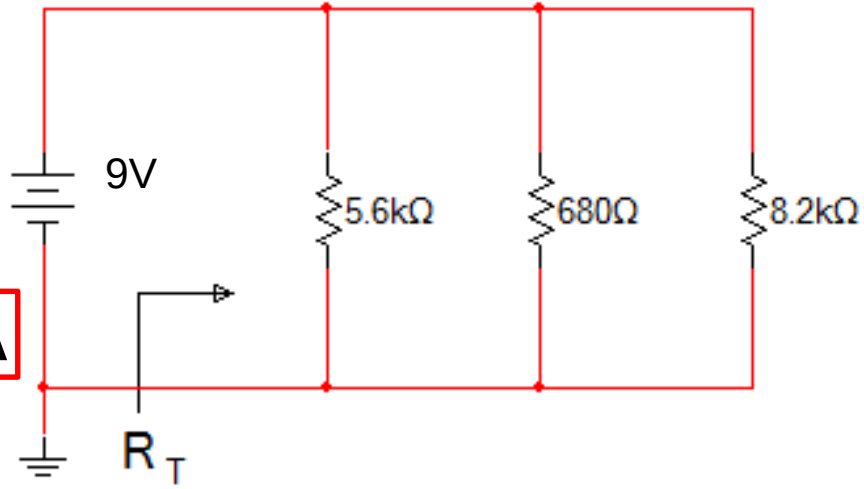
$I_{R3} = 1.09$



Kirkchoff's Current Law

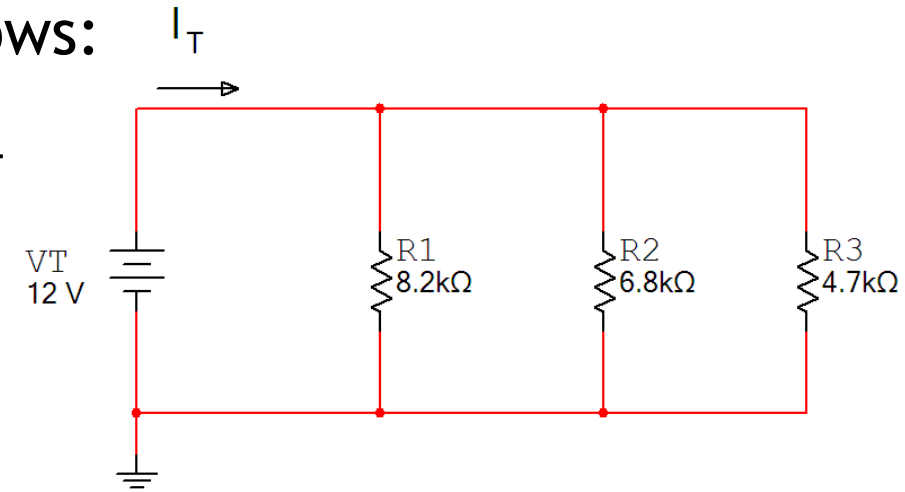
Now lets use Kirkchoff's current law we learned in the previous lesson to check our work. Remember, the total of all 3 current drops should add back up to current total – in this case approximately 2.72 mA.

$$
\begin{aligned}
& I_{R1} = 1.6 \text{ mA} \\
+\ & I_{R2} = 0.013 \text{ mA} \\
+\ & I_{R3} = 1.09 \text{ mA}
\end{aligned}
\qquad \boxed{= 2.703 \text{ mA}}
$$



Ohm's Law – Parallel Practice Problem

Here is a practice problem to try on your own. Remember the things you will need to calculate are as follows:



1. Resistance total (parallel) – R_T
2. Current total – I_T (mili Amps)
3. Current drops at each resistor
   I_{R1}, I_{R2}, I_{R3}
4. Check your Current drops using Kirkchoff's current law

Helpful links

Youtube video - Solving a Parallel circuit tutorial

All about circuits guide to solving parallel circuits