PLTW Engineering

10-12/Advanced Series Circuit Calculations

April 23, 2020

10-12/DE

Lesson: **4/23/2020**

Objective/Learning Target: Students will be able to calculate unknown resistance, current, or voltage values in a SERIES 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

$$V = I \times R$$

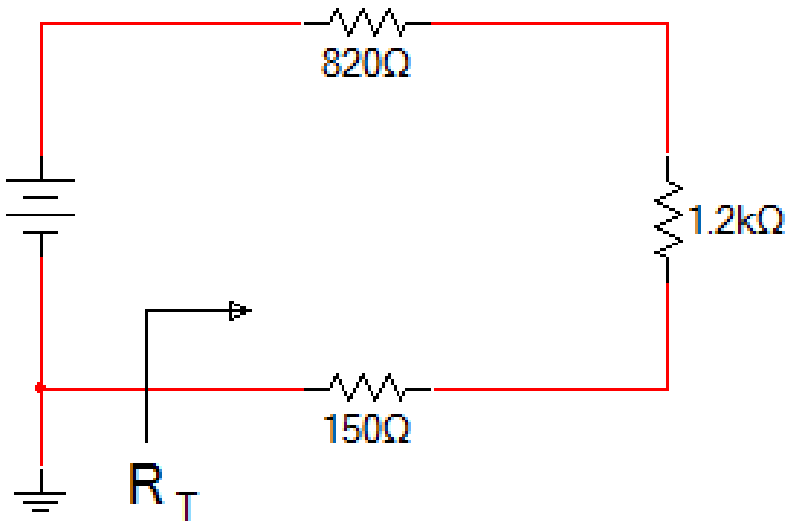
$$I = V / R$$

$$R = V / I$$

Ohm's Law Resistance in Series

In the circuit shown to the right, we see there are 3 resistors in SERIES. In a series circuit, the resistors are added together to determine the total resistance.

$$\begin{array}{r} 820\Omega \\ 1200\Omega \\ +\ 150\Omega \\ \hline 2{,}170\Omega \text{ or } 2.17k\Omega \end{array}$$



Ohm's Law Total Current

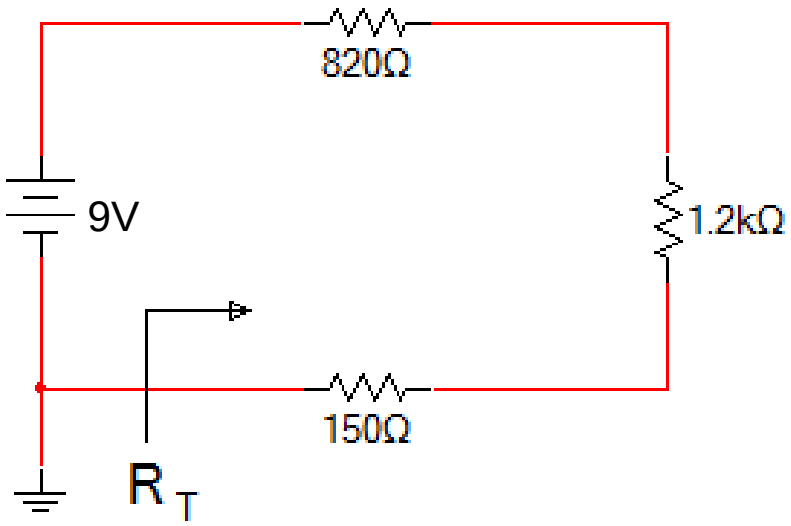
With the total resistance calculated, we can now use Ohm's law to find the remaining unknown values.

$R_T = 2.17k\Omega$

$I_T = V / R$

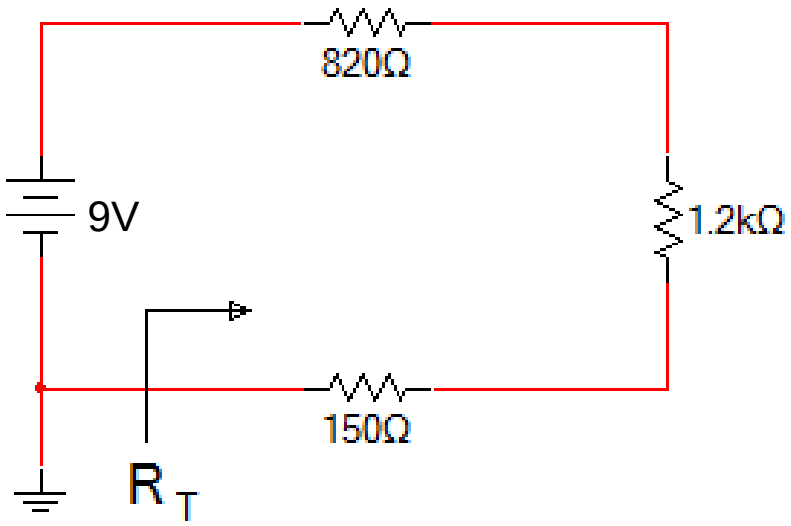
$I_T = 9v / 2{,}170\Omega$

$I_T = 4.14\ mA$



Ohm's Law Advanced

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



$R_T = 2.17k\Omega$

$I_T = 4.14\ mA$

Ohm's Law Voltage Drops

$V = I_T \times R_1$

$V = 4.14\ mA \times 820\Omega$

$V_{R1} = 3.39\ V$

$V = I_T \times R_2$

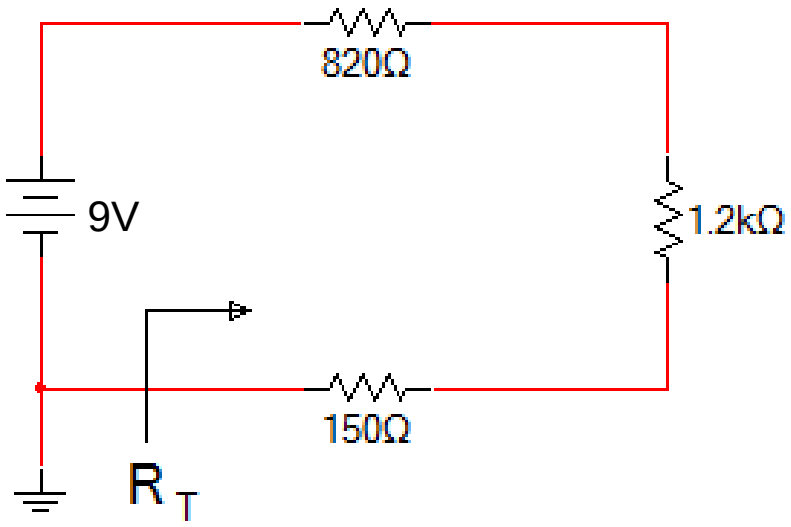
$V = 4.14\ mA \times 1.2k\Omega$

$V_{R2} = 4.99\ V$

$V = I_T \times R_3$

$V = 4.14\ mA \times 150\Omega$

$V_{R3} = 0.621\ V$

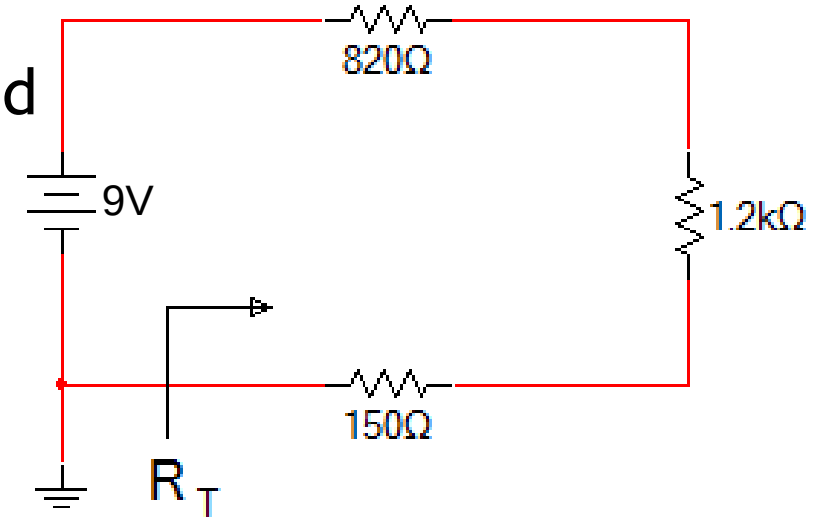


Kirkchoff's Voltage Law

Now lets use Kirkchoff's voltage law we learned in the previous lesson to check our work. Remember, the total of all 3 voltage drops should add back up to source voltage – in this case 9v.

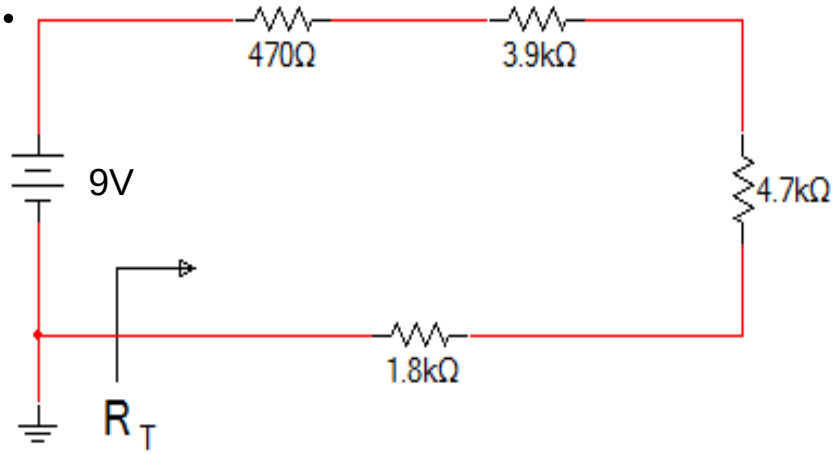
$$V_{R1} = 3.39\ V$$
$$+\ V_{R2} = 4.99\ V$$
$$+\ V_{R3} = 0.621\ V$$

$$= 9.001\ V$$



Ohm's Law – Series 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 (series) – R_T
2. Current total – I_T (mili Amps)
3. Voltage drops at each resistor
   V_{R1}, V_{R2}, V_{R3}
4. Check your Voltage drops using Kirkchoff's voltage law

Helpful links

Youtube video – Series Circuit Calculation tutorial

All about circuits – Series Circuit Calculation exampels