Engineering

Parallel Circuits

April 15, 2020

9-12/ Engineering

Parallel Circuits: [April 15, 2020]

Objective/Learning Targets:

1. Discuss basic electricity relationships in parallel circuits
2. Build circuits from schematic drawings
3. Understand the attributes of Ohm's law in Parallel circuits
4. Calculate Ohm's law in Parallel circuits

Note: You must have done lessons for April 9, 10, and 13 at this point.

Relationships of Electrical Properties

Ohm's Law

- Ohm's Law is the mathematical relationship between current, voltage, and resistance.

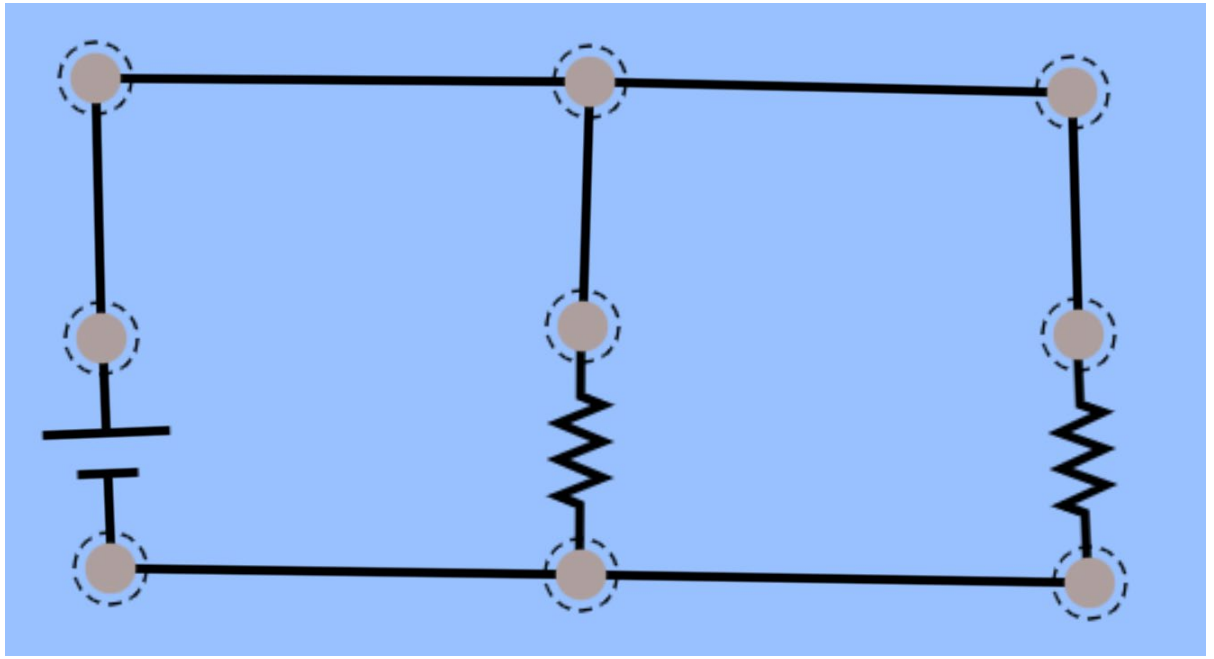
- If you know two of the three quantities, you can solve for the third quantity.

V=IR	I=V/R	R=V/I

Concept	Measurement	Symbol	Formula
Voltage	Volts	V	V
Current	Amperes	A	I
Resistance	Ohms	Ω	R

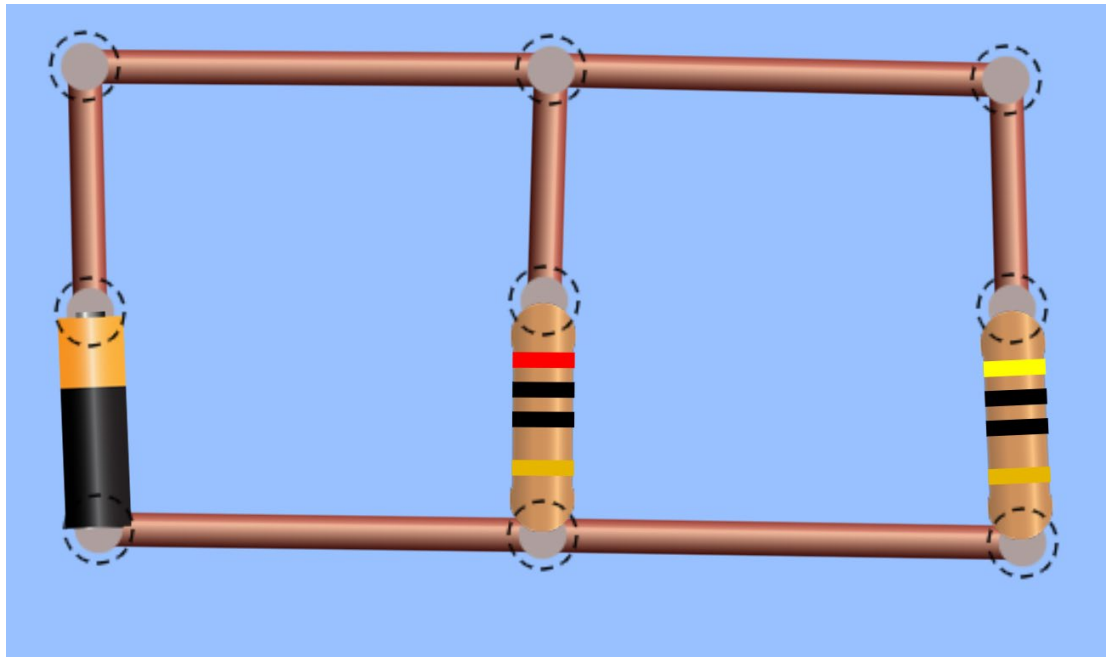
Learning tools for today

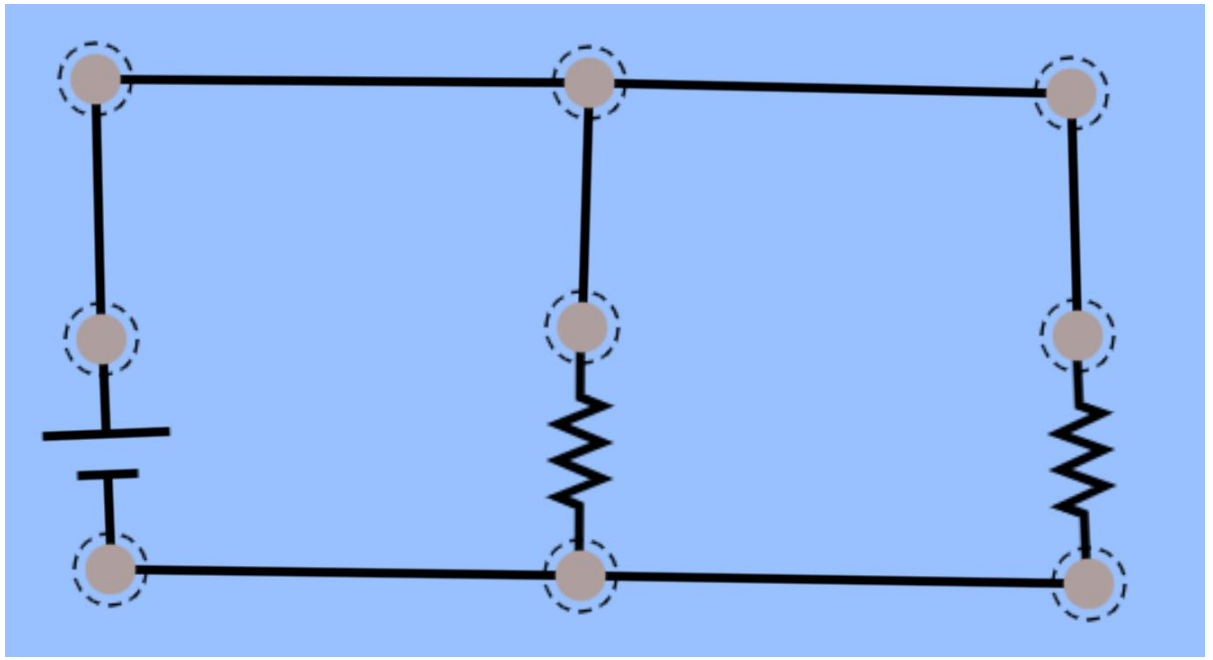
- Use this link and press play to enter a free simulator.
- Build this circuit, resistor values do not matter at this point.
- Click the selection in the top right for labels and values.
- You will also be calculating Ohm's law to understand how attributes of the law apply in Parallel circuits.



Parallel circuits

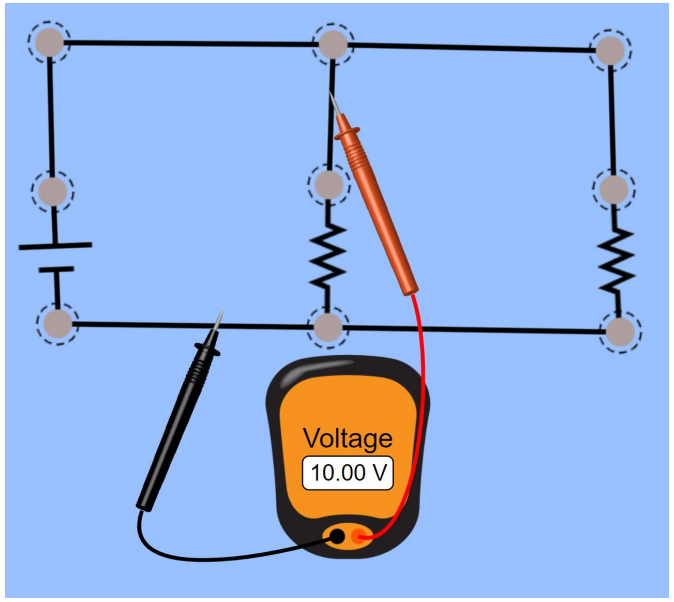
- **Build this circuit, turn on labels and values, use sliders to change the values to match the schematic. Each version is the same circuit. We can now make some observations. Watch all videos in this lesson.**



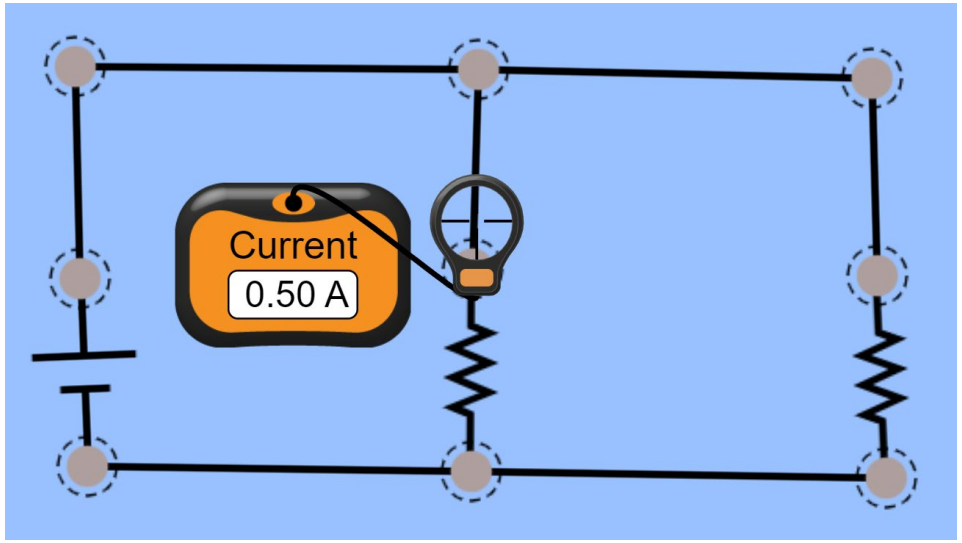


Investigate Parallel circuits

- Use the multi-meter to make measurements around each resistor as shown.
- What are you measuring for?
- What did you notice?



- Use the ammeter to make measurements in different spots, you should find 3 values.
- What are you measuring for?
- What did you notice?

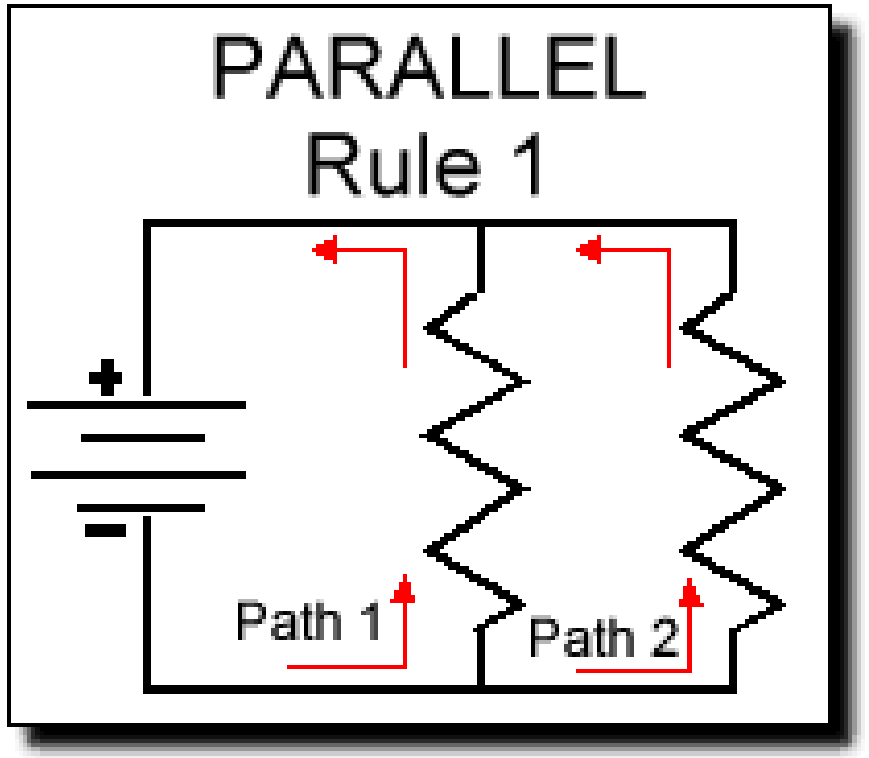


Key differences between series and parallel

- See resource video VERY IMPORTANT
- What did you learn?
- What things are the same?
- What things are different?

Parallel circuits Rules

- **Voltage**: Voltage is equal across all components in a parallel circuit.
- **Current**: The total circuit current is equal to the sum of the individual branch currents.
- **Resistance**: Individual resistances *diminish* to equal a smaller total resistance rather than *add* to make the total.



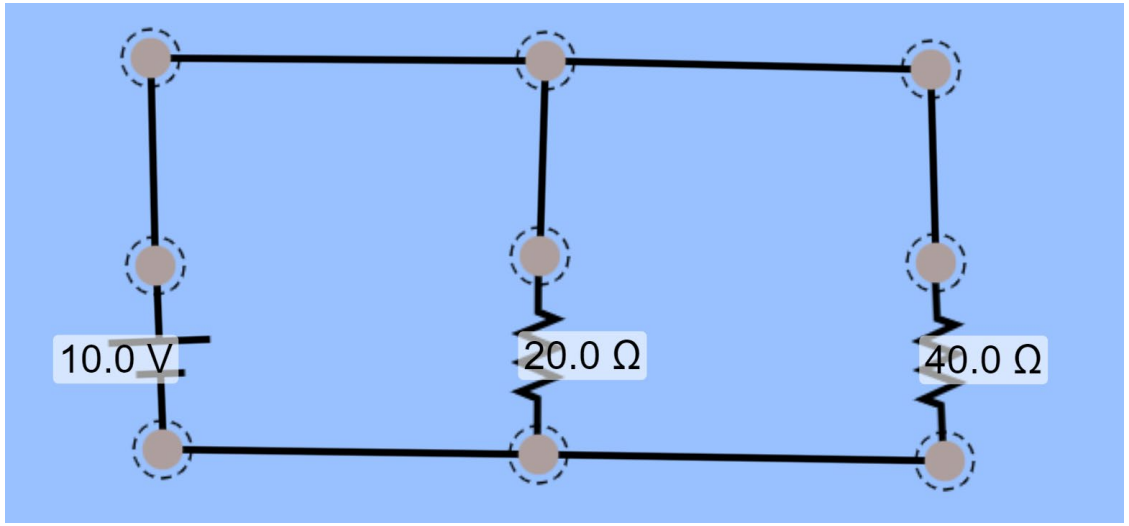
Parallel Circuit Rules and Calculations

- Ohm's law in Parallel circuits
- Components in a parallel circuit share the same voltage:
  - $V_{Total} = V_1 = V_2 = \ldots V_n$
- Total resistance in a parallel circuit is *less* than any of the individual resistances: Resistor Resource watts are not relevant for this activity, but still important.
  - $R_{Total} = 1 / (1/R_1 + 1/R_2 + \ldots 1/R_n)$
- Total current in a parallel circuit is equal to the sum of the individual branch currents:
  - $I_{Total} = I_1 + I_2 + \ldots I_n$.
- Additional Resources

Ohm's Law in Parallel circuits

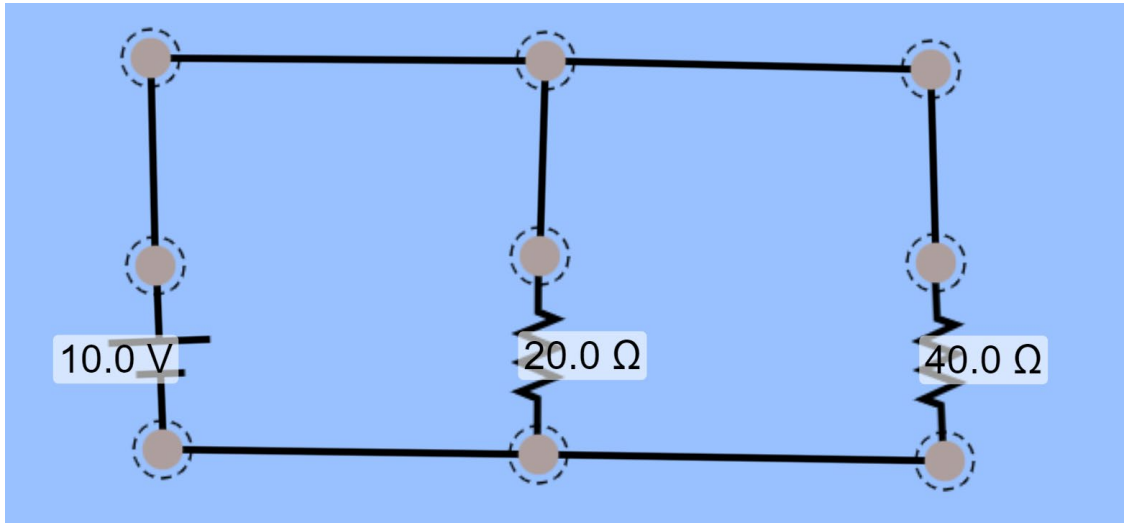
- Step 1
- Identify all knows and unknowns
- All known values are in bright blue
- All unknown values need to be calculated for.
- Voltage is the same in all parts of a parallel circuit.
- T = total, R1= Resistor etc., R_T=Resistance total, I_T = Current total

V_T 10V	V_{R1} 10V	V_{R2} 10V
I_T	I_{R1}	I_{R2}
R_T	R_1 20Ω	R_2 40Ω



Ohm's Law in Parallel circuits

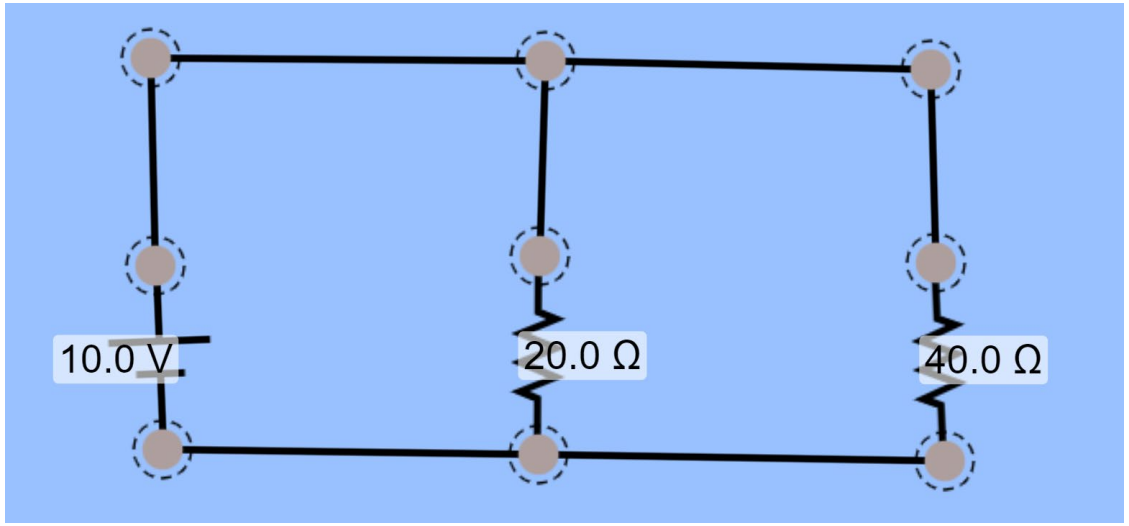
- Step 2
- In Parallel circuits solve for the easiest problem, Current of $\boldsymbol{I_{R1}}$ & $\boldsymbol{I_{R2}}$
- I_{R1}=$\boldsymbol{V_T}$ 10V / R_1 20Ω
- I_{R2}=.5A
- Solve for $\boldsymbol{I_{R2}}$



$\boldsymbol{V_T}$ 10V	V_{R1} 10V	V_{R2} 10V
I_T	$\boldsymbol{I_{R1}}$ .5A	$\boldsymbol{I_{R2}}$ .25A
R_T	R_1 20Ω	R_2 40Ω

Ohm's Law in Parallel circuits

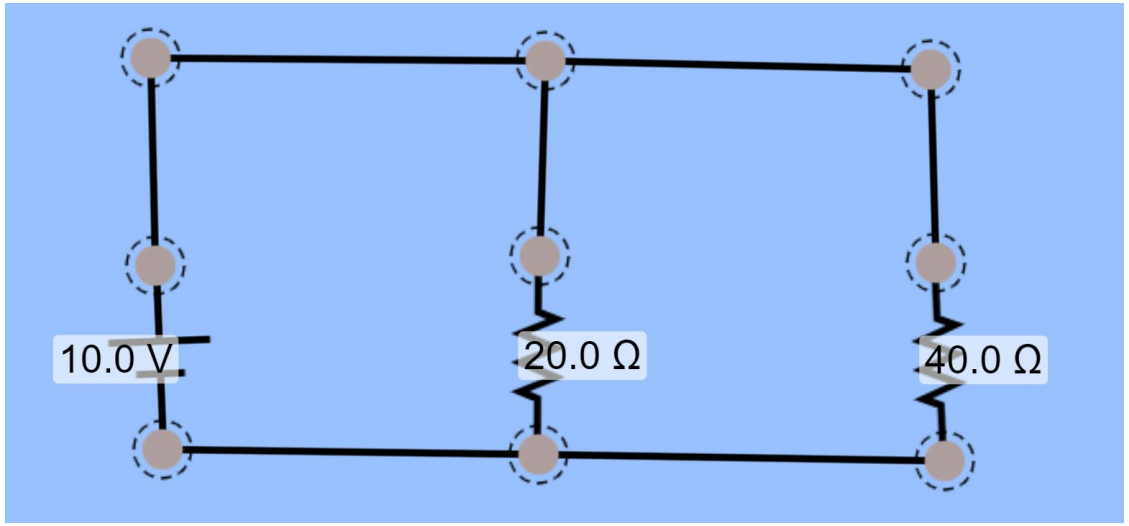
- Step 3
- In Parallel circuits solve for total resistance I_T using kirchoff's current law of parallel circuits
- I_T=I_{R1} .5A+I_{R2} .25A
- I_T=.75A



V_T 10V	V_{R1} 10V	V_{R2} 10V
I_T=.75A	I_{R1} .5A	I_{R2} .25A
R_T	R_1 20Ω	R_2 40Ω

Ohm's Law in Parallel circuits

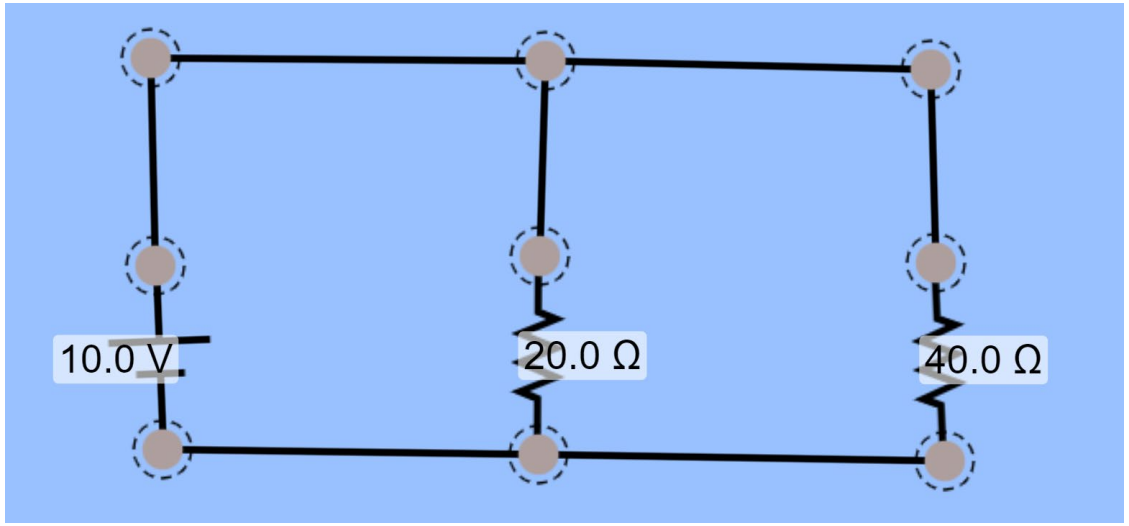
- Step 4
- Solve for resistance total, the total should be less than the smallest resistor.
- R_T =V_T 10V / I_T=.75A
- R_T =13.33Ω



V_T 10V	V_{R1} 10V	V_{R2} 10V
I_T=.75A	I_{R1} .5A	I_{R2} .25A
R_T =13.33Ω	R_1 20Ω	R_2 40Ω

Ohm's Law in Parallel circuits

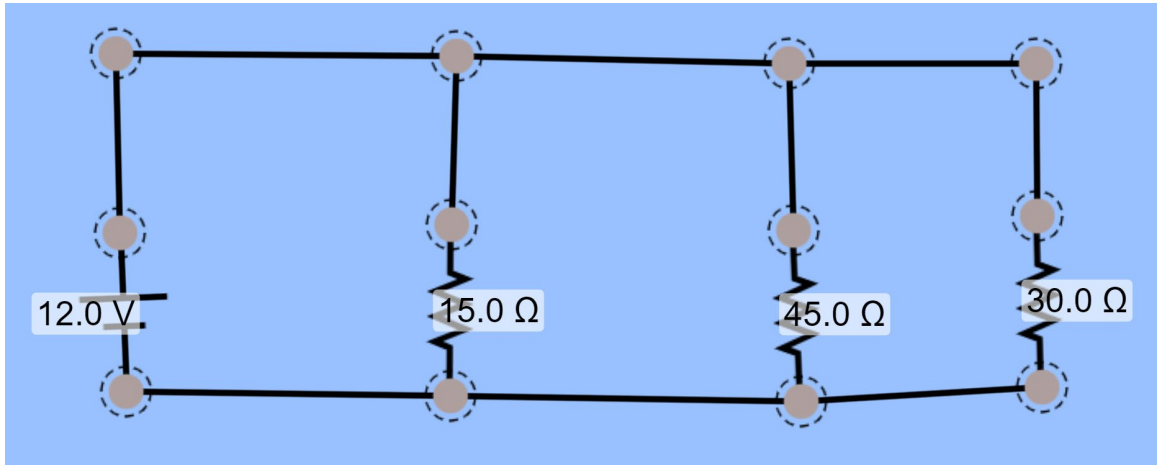
- Resistance total can also be calculated other using this formula, your rounding may differ.
- $1/R_{Total} = 1/R_1 + 1/R_2$
- I try not to use this method, the common denominator is often difficult to find.



V_T 10V	V_{R1} 10V	V_{R2} 10V
I_T=.75A	I_{R1} .5A	I_{R2} .25A
R_T =13.33Ω	R_1 20Ω	R_2 40Ω

Ohm's Law in Parallel circuits

- Your turn
- Solve for all of the unknown circuit values.
- Follow the steps to find each value.
- Use the simulation and other online tools to check your work.



V_T	V_{R1}	V_{R2}	V_{R3}
I_T	I_{R1}	I_{R2}	I_{R3}
R_T	R_1	R_2	R_3

Ohm’s Law in parallel circuits

- More practice and review will be available in the next lesson.