Engineering

Parallel Circuits Practice

April 16, 2020

9-12/ Engineering

Parallel Circuits Practice: [April 16, 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

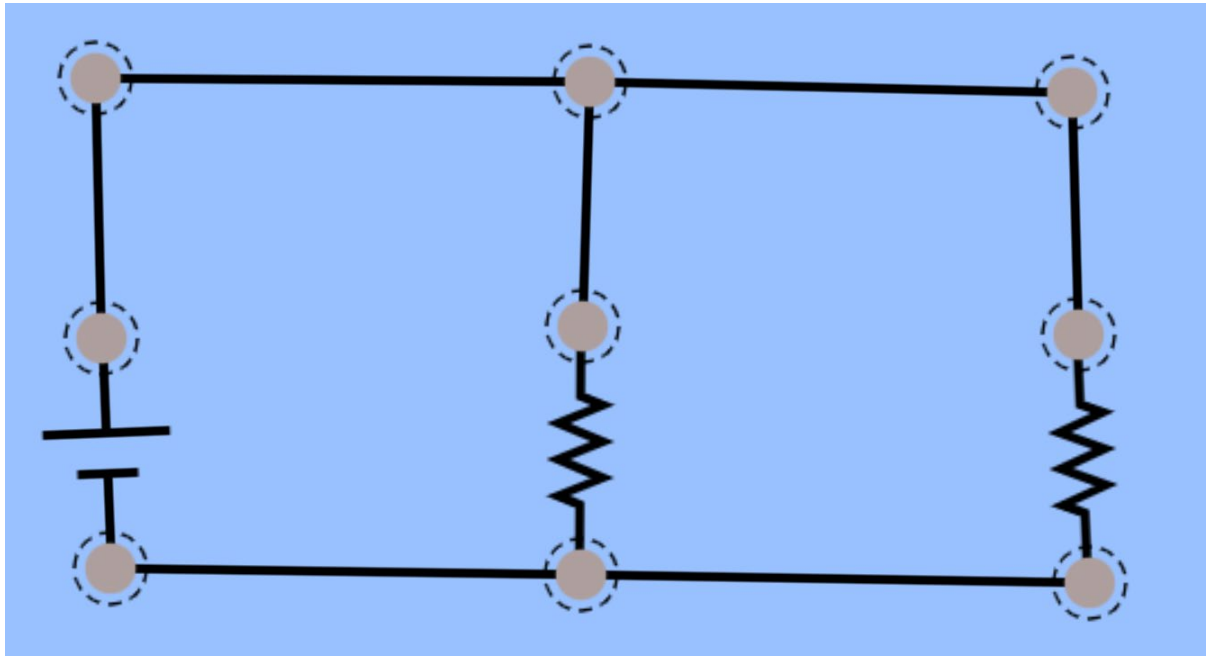
Note: You must have done lessons for April 9, 10, 13, & 14 at this point.

Ohm’s Law in Parallel Circuits

- Use lessons learned from April 9, 10, 13, & 14 to support you in this lesson.
- Use the simulation tool to build your circuits and check your work or you can use online ohm’s law and circuit calculators to check your work. I recommend tools from Digikey.
- Use the supports that follow to help you with calculating ohm’s law in parallel circuits. Read carefully for what the question is asking for and follow the steps.
- If you need assistance email your engineering instructor.

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.



Relationships of Electrical Properties

Ohm's Law

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

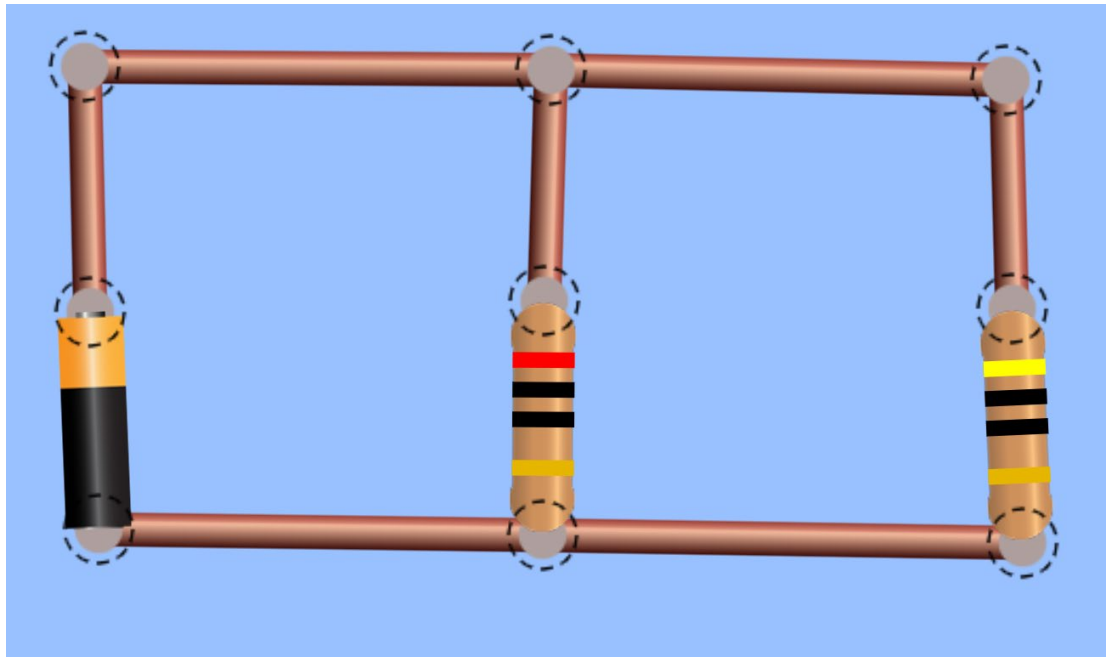
- If you know two of the three quantities, you can solve for the third quantity.

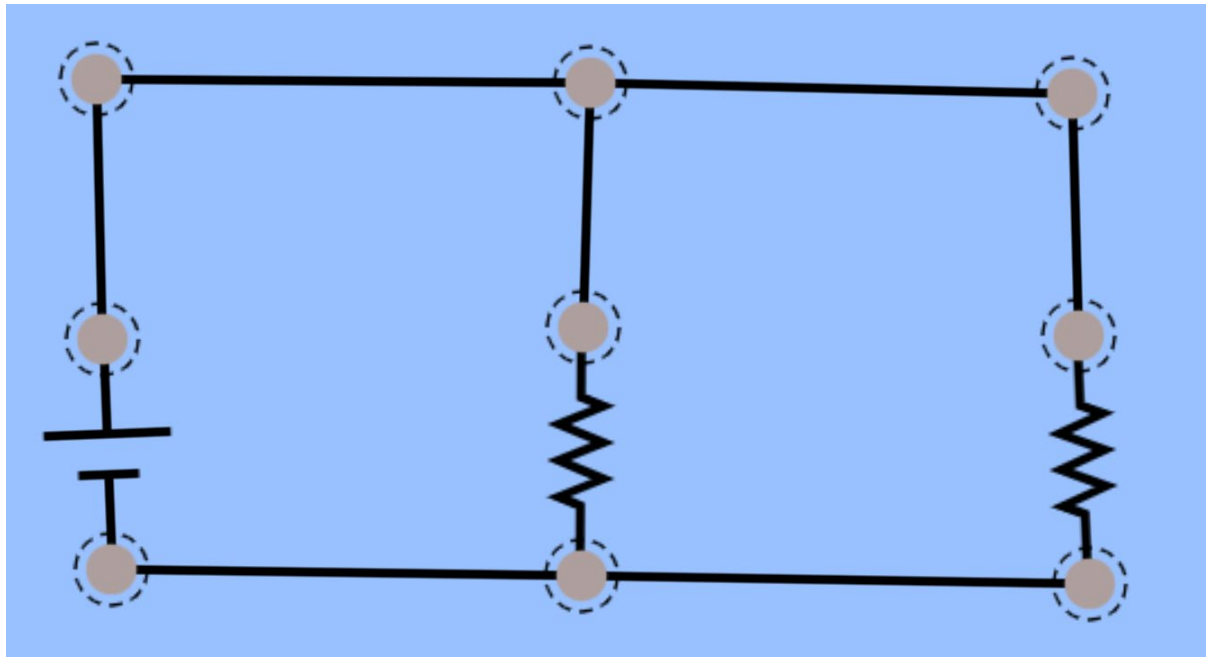
V=IR	I=V/R	R=V/I

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

Parallel circuits

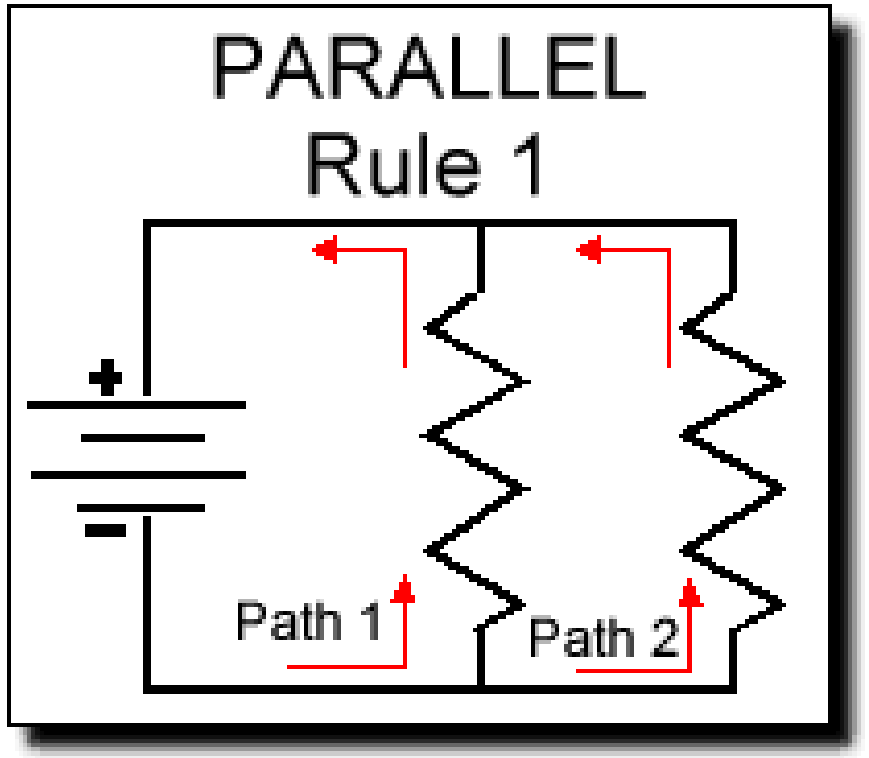
- **Build this circuit, turn on labels and values, use sliders to change the values to match the schematic. Each version is the same circuit. We can now make some observations. Watch all videos in this lesson.**





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.

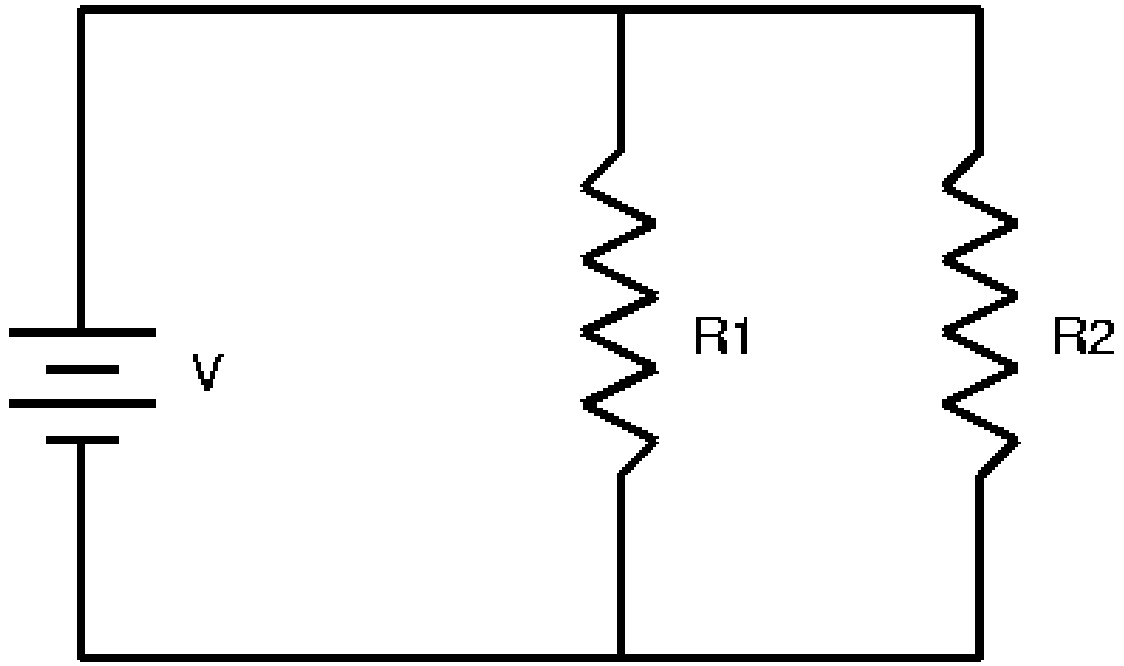


Parallel Circuit Rules and Calculations

- 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

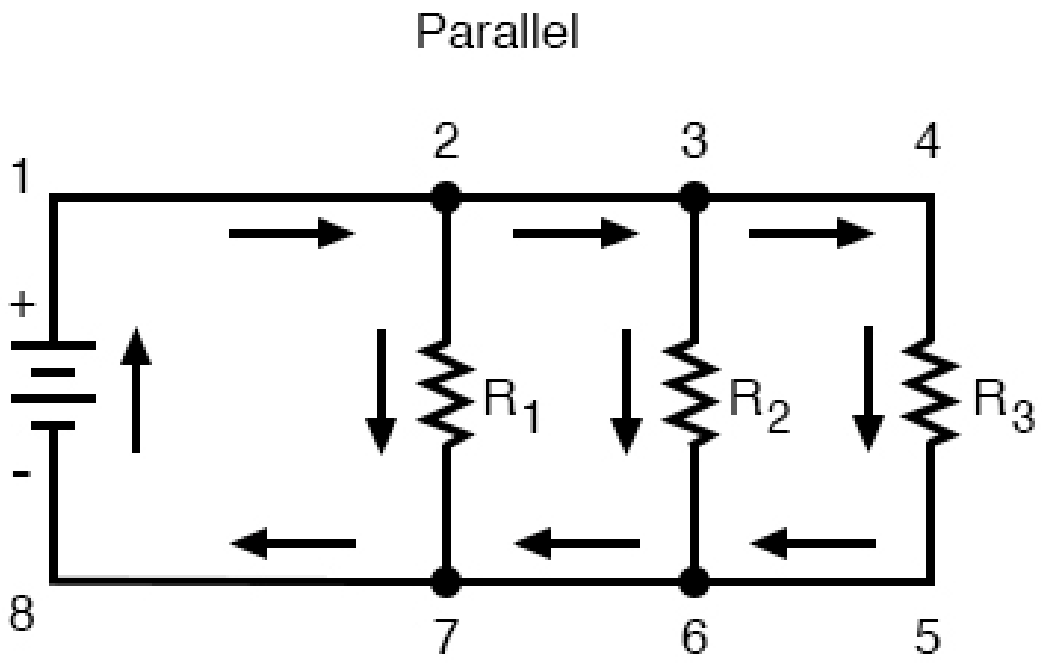
1 Parallel circuit practice problem

- Solve for all unknown values
- Known Values
- VT=12V
- R1=16Ω
- R2=32Ω



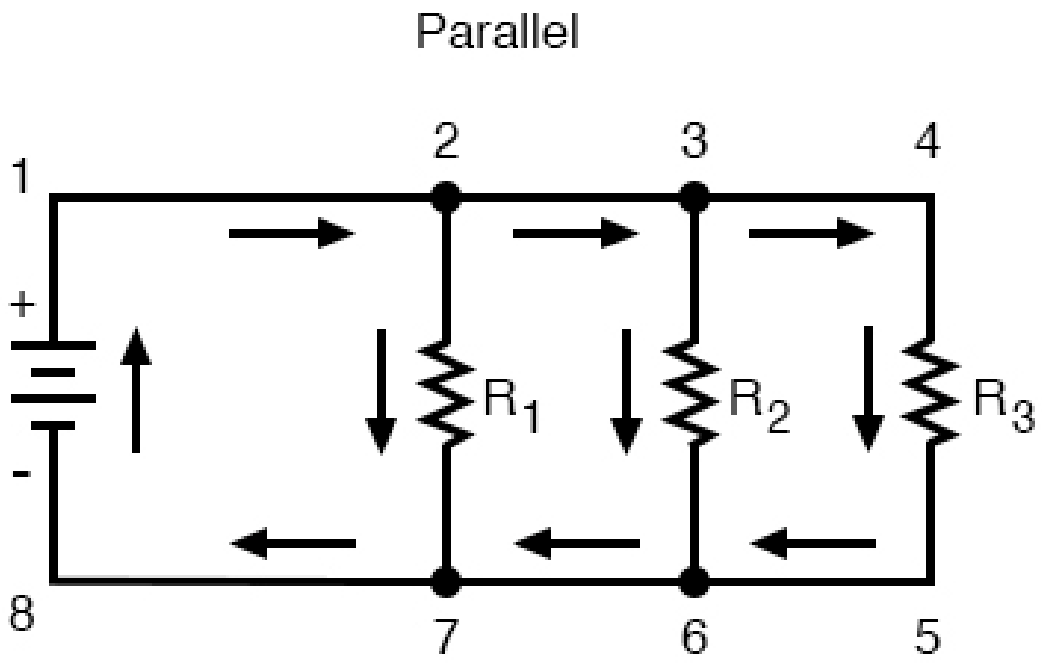
2 Parallel circuit practice problem

- Solve for all unknown values
- Known Values
- VT=18V
- R1=30Ω
- R2=100Ω
- R3=70Ω



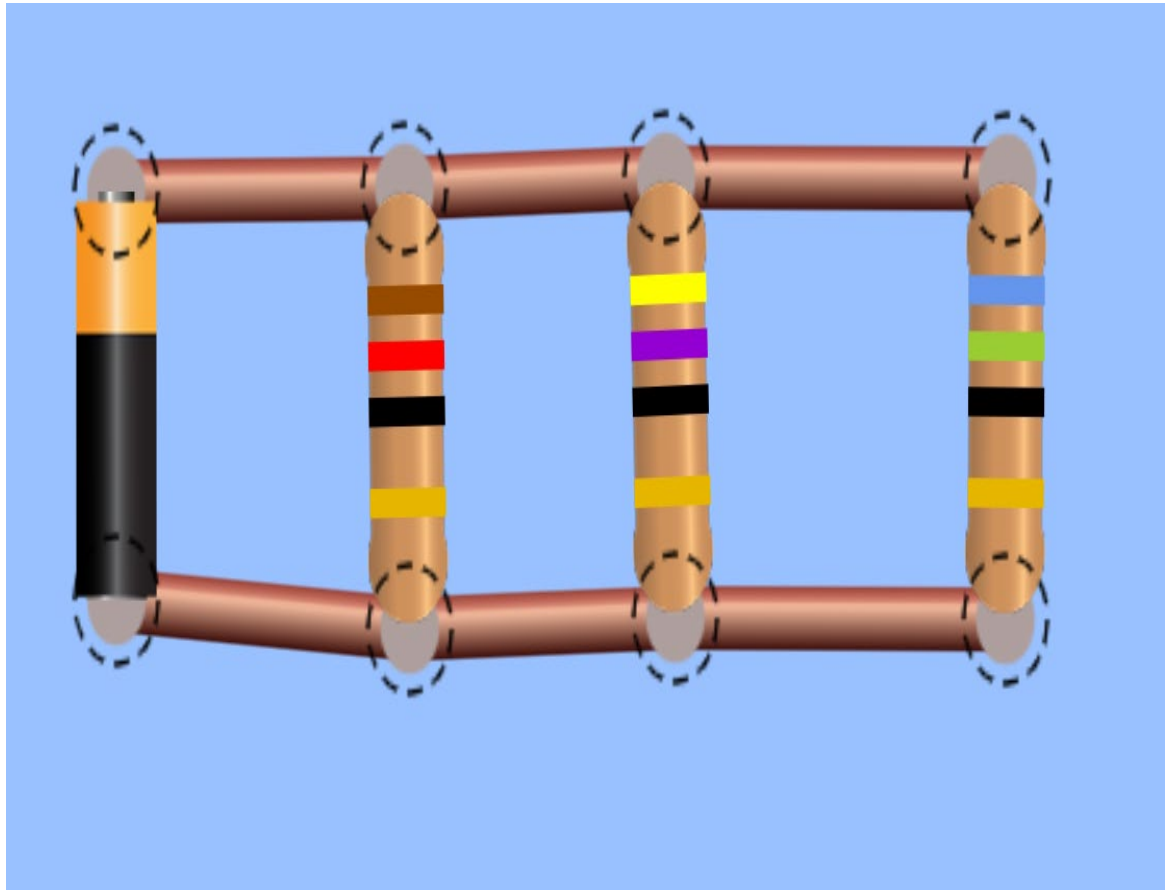
3 Parallel circuit practice problem

- Solve for all unknown values
- Known Values
- VT=120V
- R1=20Ω
- R2=120Ω
- R3=40Ω



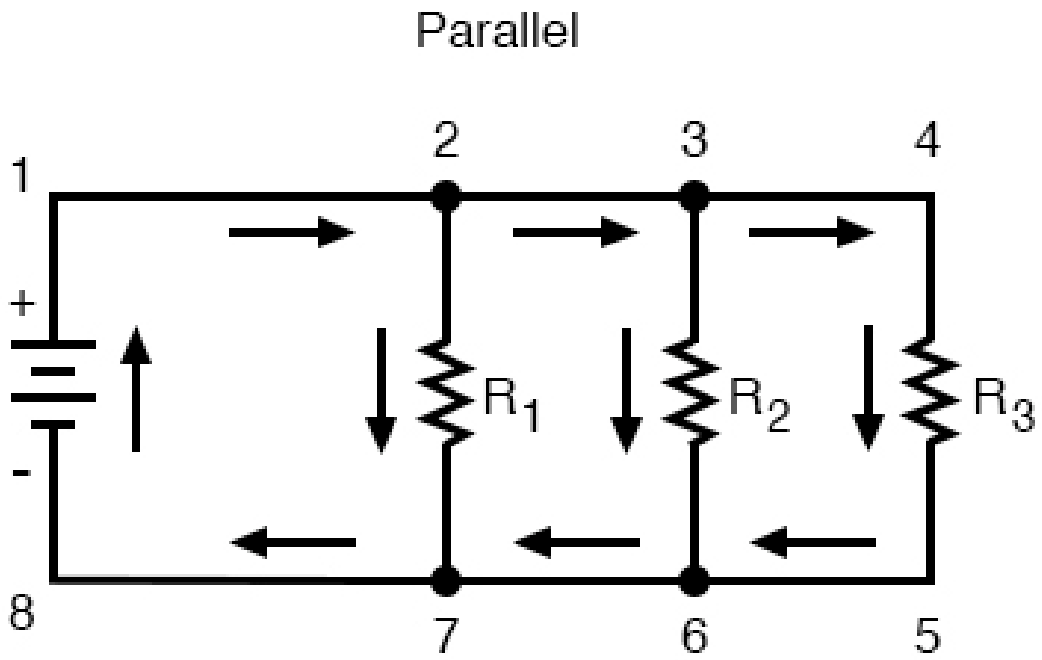
4 Parallel circuit practice problem

- For this circuit you will need to determine the resistance of the resistors by resistor color code. Use this simulator to determine the resistance.
- Do you see a pattern to the color code (Chart Here)?
- What are the resistance values?
- Watch this to learn more about resistor color codes. You only need to watch to the 3:10 minute mark.
- For our purposes we will only use 4 band resistors.



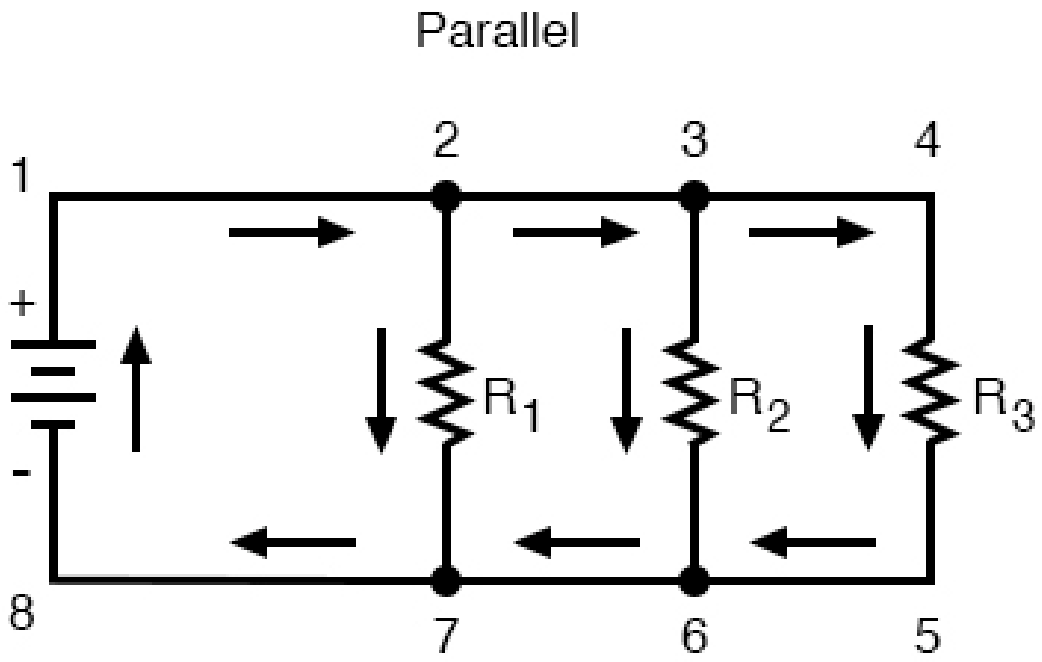
4continued-Parallel circuit practice problem

- Solve for all unknown values
- Known Values
- VT=24V
- R1=?Ω
- R2=?Ω
- R3=?Ω



5 Parallel circuit practice problem

- Solve for all unknown values and write out the band colors for each resistor.
- Use the simulator to check your work. You will need to find your own resource to check parallel resistance total.
- Known Values
- VT=48V
- R1=89Ω
- R2=47Ω
- R3=32Ω



RESISTORS IN PARALLEL

Question

In the following schematic diagram, find the total current, I.

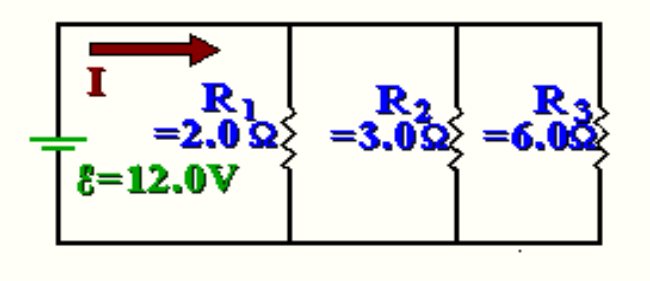


Figure 1 *Example Problem: Resistors in Parallel*

Hints

1. You will need Ohm's Law.
2. How are resistors related when connected in parallel?
3. What is the potential drop across each resistor?
4. How does current behave in parallel branches?

Solution
We know the total potential of this circuit,

$\mathcal{E} = 12.0\ V$

So, between points A and B, the potential must drop 12.0V. Also, the potential drop across branches of a circuit are equal. That is,

$$V_1 = V_2 = V_3 = \mathcal{E} = 12.0V$$

We can use Ohm's Law
E = IR
or
I = E/R
to find the current across each resistor.

$$I_1 = \frac{V_1}{R_1} = \frac{12.0V}{2.0\ \Omega} = 6.0A$$

$$I_2 = \frac{V_2}{R_2} = \frac{12.0V}{3.0\ \Omega} = 4.0A$$

$$I_3 = \frac{V_3}{R_3} = \frac{12.0V}{6.0\Omega} = 2.0A$$

Recall that the currents through branches of a parallel circuit add to give the total current. That is, the total current 'splits up' so that part of the total current travels down each

branch. Because of the conservation of charge, the sum of the currents in each branch must equal the amount going into the branch. (This is Kirchhoff's Current Law.)
So, adding up the three currents, we get:

$$I = I_1 + I_2 + I_3$$
$$= 6.0 + 4.0 + 2.0 = 12.0\text{A}$$

So, the total current is **I = 12.0A**.