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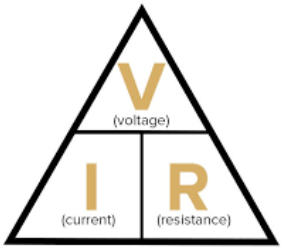
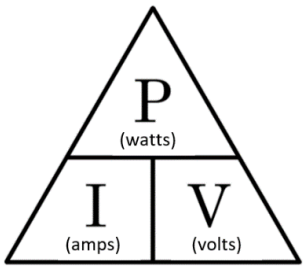
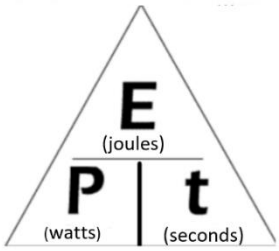
Learning Guide 9

Power, Energy, and Complex Circuits Notes

We have learned about Voltage, Current, and Resistance so far. However, electricity is a type of energy, and we have yet to see a way to measure energy or how fast we use it. Therefore, we will look at two more equations, each with a new math triangle.

		
I=V÷R Where: • **I is current**, the speed of electrons (**Amps** or **milliamps**) • **V is voltage** (potential difference), the pushing power (**Volts**) • **R is resistance**, the force against the flow of electrons (**Ohms**)	**I = P÷V** Where: • **I is current**, the speed of electrons (**Amps or milliamps**) • **V is voltage** (potential difference), the pushing power (**Volts**) • **P is power**, the speed/rate that energy is being used/transferred (Watts)	**P=E÷t** Where: • **P is power**, the speed that energy is being used/transferred (**Watts**) • **t is time**, the amount of time a circuit runs or electricity is transferred (**seconds**) • **E is energy**, the amount of energy that has or is being used based on quick it is being used and the time (**Joules**)

These three triangles can help use determine how much energy is being used. For example:

1) If a circuit has 5 Ω of **resistance** and 3 A of **current**, how much energy is used when the circuit is live for 5 **seconds**?

Let's use the first triangle to find the voltage:

Now that we have voltage, let's use the second triangle to find power:

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Now that we have power, let's use the third triangle to find energy:

Please note: a **Joule** is really small, as it is **Watts times Seconds**. Electric companies charge in **Kilowatts times Hours**, as that unit is much bigger can be used to describe large usage of energy, such as the amount of energy used in a home over 2 months.

2) A circuit runs using 110 V and 500 mA of current. When used for 2 minute, what is the total amount of energy used?

We need to start by converting mA to A:

Then, find the power:

Then, find the energy used in 2 minutes. 1 minute has 60 seconds.

3) If a circuit has 2000 mA of current and uses 800 J of energy in 10 seconds, what is the total resistance in the circuit?

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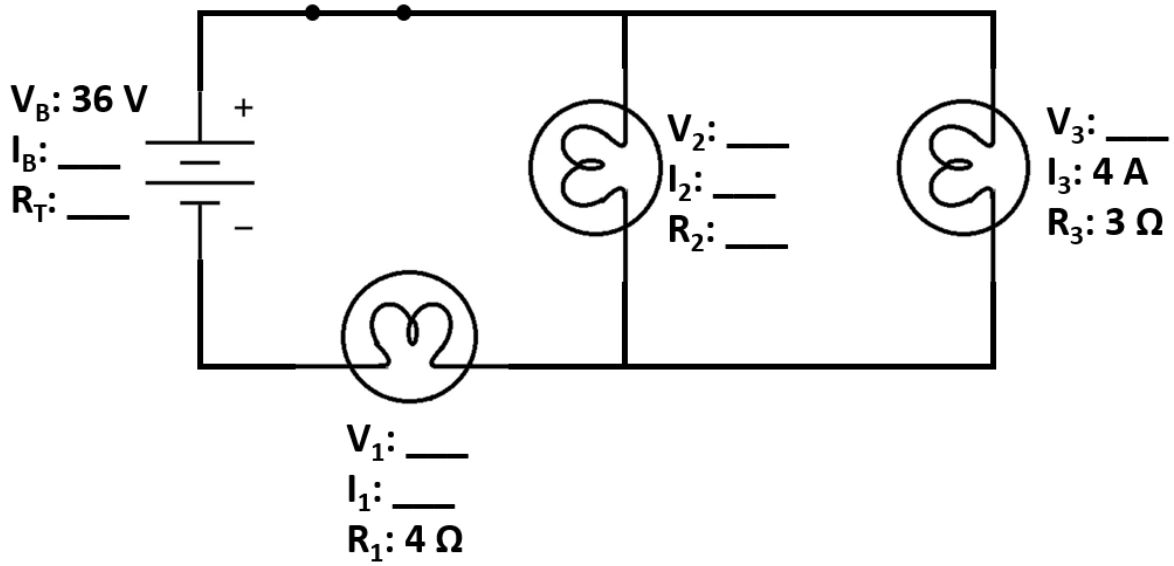
Extending: <u>Complex circuits</u> <u>are circuits that have both parallel and series components</u> to them. If 1 resistor leads to another on the same path, the resistors are in parallel. If 1 resistor is on a separate path compared to another resistor, they are in parallel.

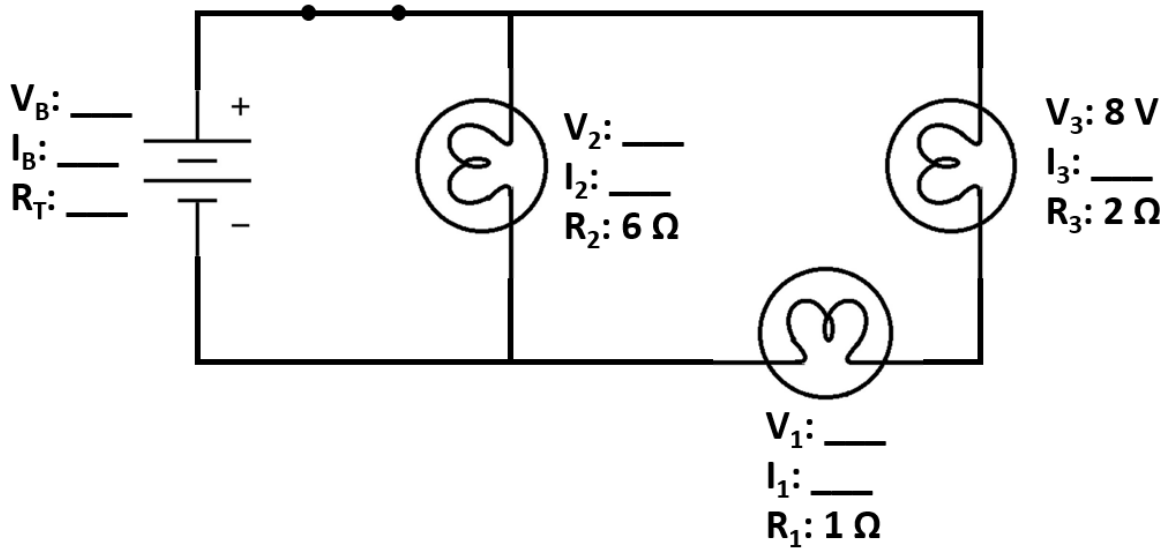
Your parallel circuit rules apply to resistors/batteries in parallel, and your series circuit rules apply to resistors/batteries in series.

Sometimes it helps to redraw a circuit diagram in a way that pretends two resistors are acting like a single resistor. That way, you can more easily visualize that resistors are acting in series or parallel.

Example 1:



Example 2:



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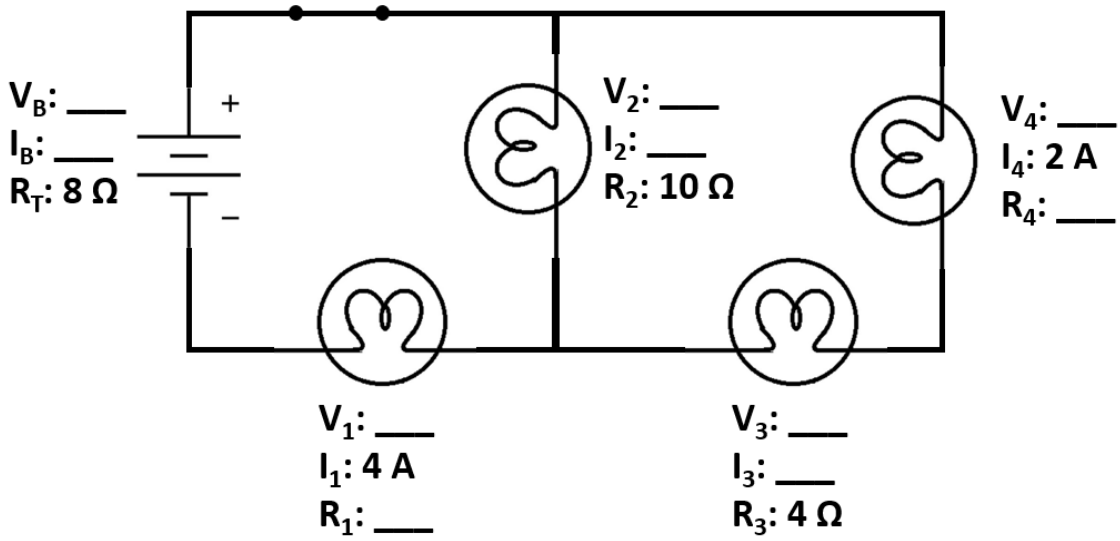
Example 3:



Example 4: