Essential Circuits Notes

Basic Terms:

* **Circuit** – a path for charge to flow
* **Current** – any flow of charge. Abbreviated “I.” Measured in Amperes (A). Conventional current flows positive to negative, left over from Ben Franklin’s experiments. Real current, we know, is made of electrons flowing from negative towards positive.
* **Resistance** – the amount that a circuit element slows or “resists” current flow. Abbreviated “R.” Measured in Ohms (Ω).
* **Voltage** – an electrical “potential.” Similar to how an E-field tells you how strong a force something could exert all around it, a voltage tells how much work could be done (energy used) all around. Abbreviated “V.” Measured in Volts (V).
	+ **Voltage Drop**: this refers to the amount of voltage taken up by a circuit element when the current flows past it
* **Capacitance** – an amount of stored charge, or ability to store charge. Abbreviated “C.” Measured in Farads (F).

Most important rules!

**Ohm’s Law V = IxR**

Voltage = Current x Resistance

**Kirchoff’s Loop Rule:** All voltage drops from resistors or devices in a path MUST add up to the original voltage

 \*Because of this rule, every branch of a parallel circuit has the same Voltage.

**Kirchoff’s Junction Rule:** Current always splits up at a branch in the circuit. If it comes back together, you have the full current again. (This one is common sense.)

Series and Parallel: Differences

* Adding more resistors/devices
	+ In a series circuit, the total resistance goes up and current goes down
	+ In a parallel circuit, total resistance goes down and current goes up
* Finding total resistance (Rtot)
	+ Series: Add them all up.
	$$R\_{tot}=R\_{1}+R\_{2}+R\_{3}+…$$

	Parallel: Add the fractions, do reciprocal at end to find Rtot.
	$$\frac{1}{R\_{tot}}=\frac{1}{R\_{1}}+\frac{1}{R\_{2}}+…$$
* Voltages
	+ Series: Voltage drops with everything in a series that the current passes.
	+ Parallel: Voltage is equal at the start of every branch path
* Currents
	+ Series: Current is the same for an entire series circuit
	+ Parallel: Current gets split up at the beginning of a branch, more going down the path with less resistance

Wrap it all together!

Find the total resistance, the voltage drop over every resistor, and the current in every part of the path.

I

I1

I2

V44

V3

V2

V1

1. Resistance first. Add the parallel part, then add that in series with the others:
	1. $\frac{1}{R}=\frac{1}{150}+\frac{1}{75} \frac{1}{R}= \frac{3}{150} R= \frac{150}{3}=50$
	2. Rtot = 50 + 125 + 175 = **350 Ω**
2. Find the main current with that resistance, the battery, and Ohm’s Law:

$$V=IR 70=Ix350 I=0.2 A$$

1. The current will be the same through the 125 and 175 resistors, but it splits for the parallel part. We need the voltages first.
2. The voltage at the parallel part will be what’s left after subtracting the two series resistors. Do Ohm’s Law to find those voltages.
	1. **V1** = (0.2x125) = **25 V**
	**V4** = (0.2x175) = **35 V**
	70 – 25 – 35 = 10 V left for V2 and V3
3. Because of the loop rule, both paths of the parallel part get the whole 10 V.
	1. **V2 = V3 = 10 V**
4. Use Ohm’s Law to find the current in the two branches.
	1. 10 = I1x150 10/150 = **I1 = 0.067 A**
	2. 10 = I2x75 10/75 = **I2 = 0.13 A**