ELECTRIC CIRCUITS

TWO CRUCIAL IDEAS

① VOLTAGE = DIFFERENCE IN ELECTRIC POTENTIAL

② CURRENT = FLOW OF ELECTRIC CHARGE

CURRENT

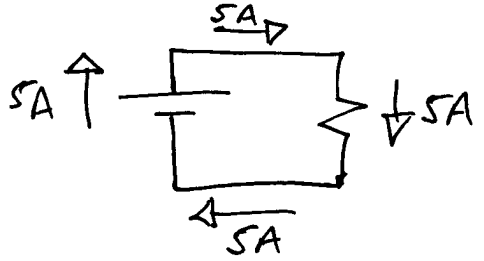
SYMBOL I

UNITS: AMPS (A), $1\,A = 1\,C/s$

MECHANICAL ANALOGY

VOLTAGE IS LIKE PRESSURE

CURRENT IS LIKE FLOW RATE



CURRENT DOESN'T GET USED UP.

Circuits Elements

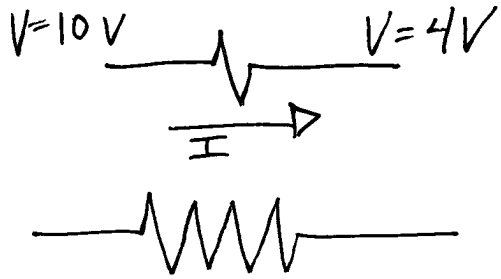
- Wires
- Resistors
- Batteries

Wires

- Wires are made of metal (like copper)
- Metals have free electrons that can move easily
- Our wires are modelled by perfect conductors
- Perfect conductors have $\vec{E} = 0$ inside.
- A perfect conductor has the same electric potential at all points. (V is uniform.)
- Each wire in a circuit can be assigned a single value of electric potential.

Resistors

- Resistors are things that "use" electricity.
- In a linear resistor, the voltage across the resistor is proportional to the current through the resistor.



- Linear resistors obey Ohm's law

$$V = IR$$

- V: Voltage across resistor (6V in our example)
- I: Current through resistor
- R: Resistance

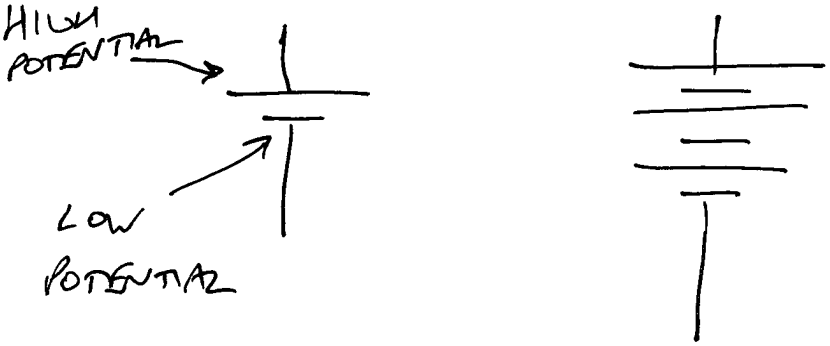
- Resistance is measured in ohms (Ω)

$$1\,\Omega = 1\,V/1\,A$$

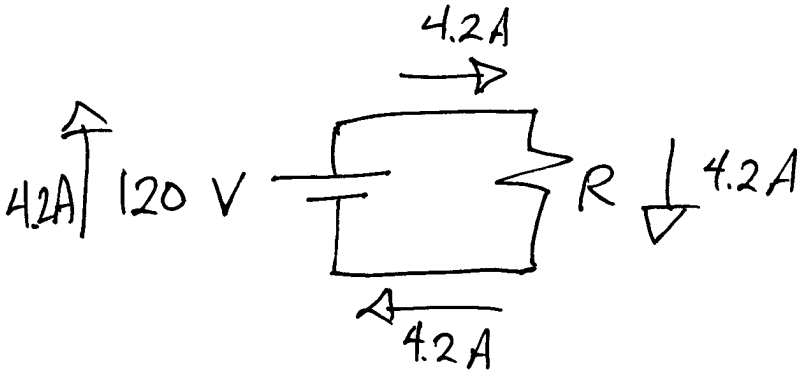
Batteries

- Batteries have a voltage rating.
- Ideal batteries can supply any amount of current.

Warning: Remember to use ideas of voltage and electric potential.

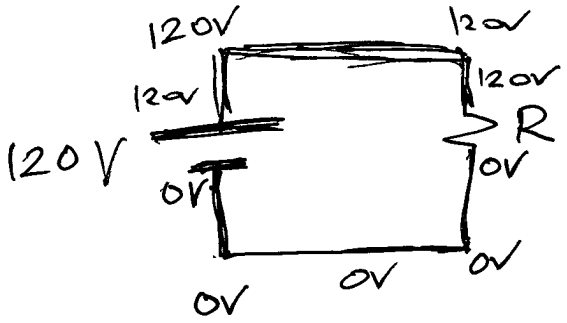


- A battery enforces a difference of electric potential



Circuit Analysis Technique #1

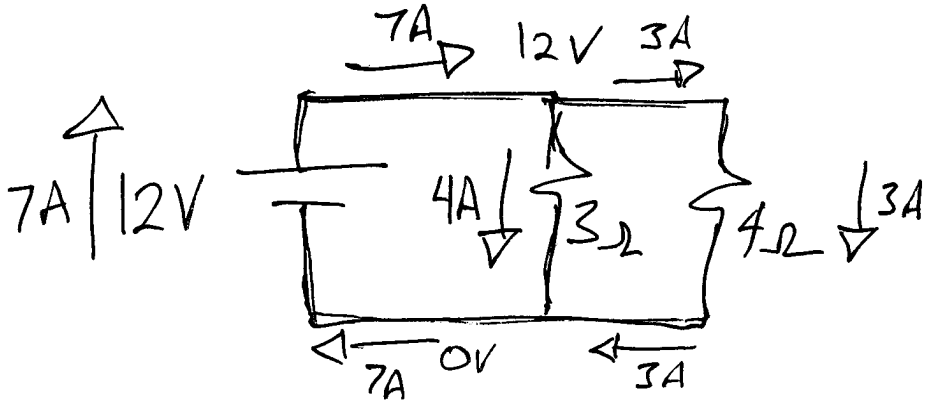
- Label the wires with electric potentials
  - Choose one wire to have $V = 0V$.
  - Label as many wires as you can with numerical electric potentials.
  - Label remaining wires with variables (V_A, V_B, etc.)



$$V = IR$$

$$(120V - 0V) = (4.2A)R$$

$$R = \frac{120V}{4.2A} = 28.5\,\Omega$$



$$(12V - 0V) = I_{3\Omega}(3\Omega)$$

$$I_{3\Omega} = 4A$$

$$(12V - 0V) = I_{4\Omega}(4\Omega)$$

$$I_{4\Omega} = 3A$$

Circuit Analysis Technique #2:

Kirchhoff's Current Law

Current flowing into a junction equals the current flowing out.