

Ohm's Law

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Batteries & Circuits

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February 7, 2025

Alessandro Volta, André-Marie Ampère, & Georg Ohm



Alessandro Giuseppe Antonio Anastasio Volta ([US: /'vɒlta/](#); 18 February 1745 – 5 March 1827) was an Italian [chemist](#) and [physicist](#) who was a pioneer of [electricity](#) and [power](#), and is credited as the inventor of the [electric battery](#)...



André-Marie Ampère ([US: /'æmpjər/](#); 20 January 1775 – 10 June 1836)^[2] was a French [physicist](#) and [mathematician](#) who was one of the founders of the science of classical electromagnetism, which he referred to as [electrodynamics](#).

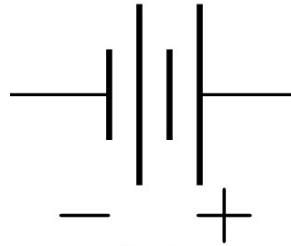
Georg Simon Ohm ([/oʊm/](#); 16 March 1789 – 6 July 1854) was a German [mathematician](#) and [physicist](#). As a school teacher, Ohm began his research with the new [electrochemical cell](#) [battery]...



Voltage - Alessandro Volta



- **Voltage:** difference in electric potential
 - Symbol: V
 - Units: Volts (V)
- Relevant Component: **Battery**



Batteries

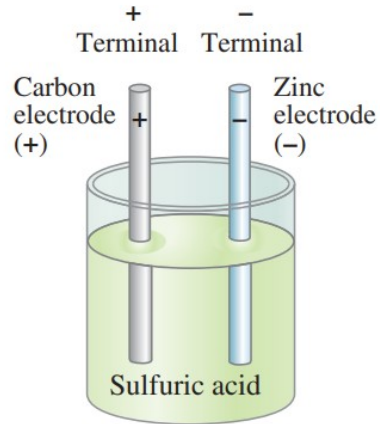
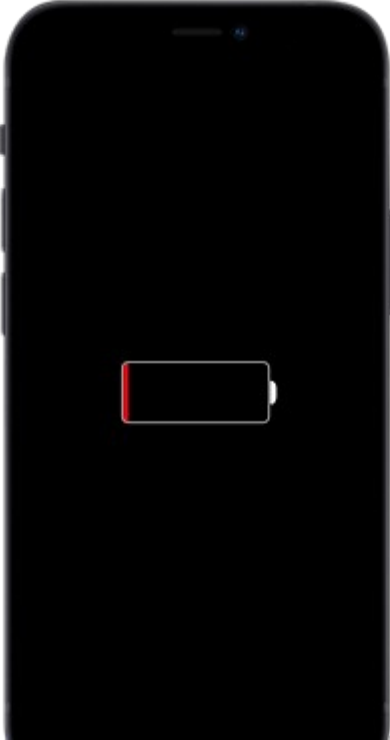
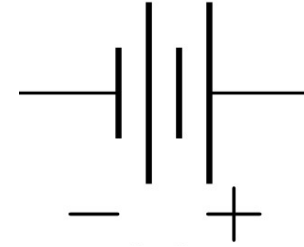


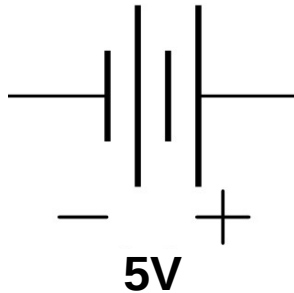
FIGURE 18-3 Simple electric cell.



- Batteries 2 main elements:
 - Electrodes (w/ terminals)
 - Electrolyte
- Electrons flow from (-) terminal to (+) terminal externally
 - If the circuit is *completed*
- A battery does not create charge

Battery: a *voltage* source

- A battery supplies a constant potential (*voltage*)
- An ideal battery can supply any amount of *current* (positive or negative)



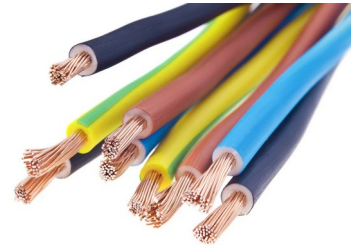
Current - André-Marie Ampère



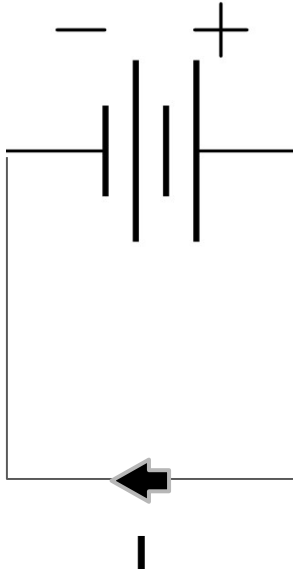
- **Current:** flow of charge (electrons)
 - Symbol: I
 - Units: Amps (A)
- Relevant Component: **Wire**



(wire drawn as a line)

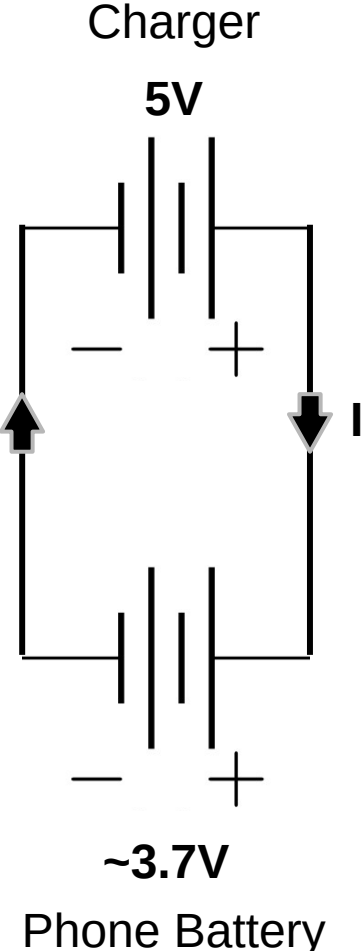
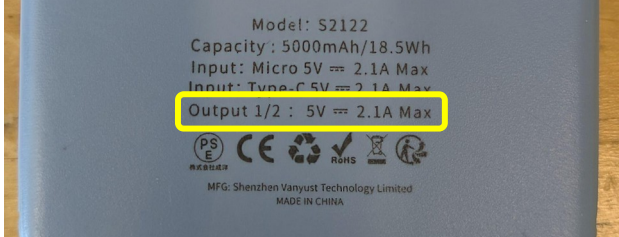


Wires - carrying *current*



- Wires: good electrical conductors
 - Theoretically have constant electrical potential throughout
 - An ideal wire can carry infinite *current*
- Current flows (+) to (-) during *discharging*
- Electrons flow opposite current
- Current/charge are *not* “used up” but simply move between electrodes

Portable charger - a circuit



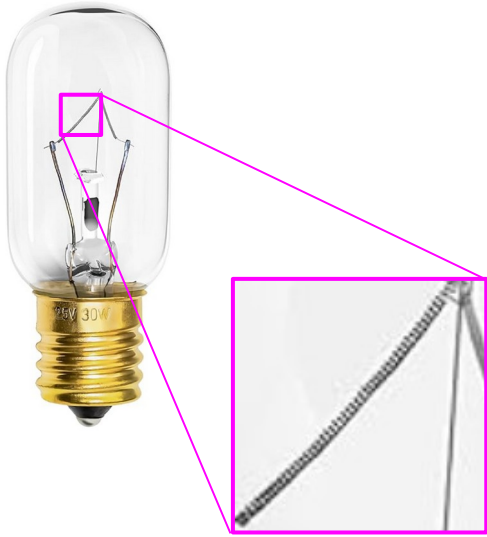
Resistance - Georg Ohm



- **Resistance:** opposition to flow of charge
 - Symbol: R
 - Units: Ohms (Ω)
- Relevant Component: **Resistor**



What else has resistance?



30W Lightbulb
~ 520 Ω

Note: not LEDs



Small stove coil
~ 25 Ω

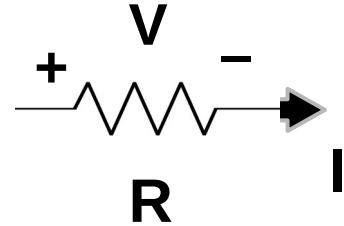
Large stove coil
~ 45 Ω



5V DC Motor
~ 4 Ω

Ohm's Law

$$V = I R$$

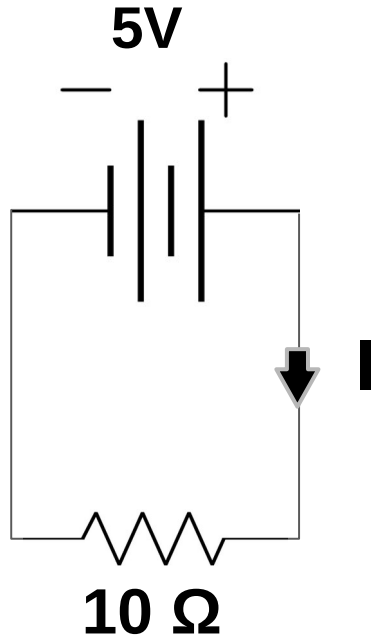


V: Voltage across the resistor

I: Current flowing through the resistor

R: Resistance of the resistor

Ohm's law with a battery

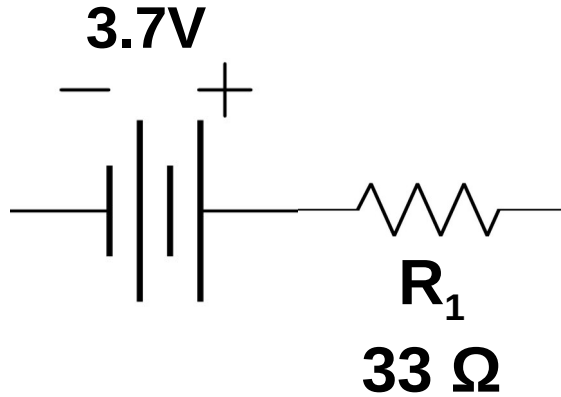


$$V = I R$$

$$5 \text{ [V]} = I * 10 \text{ [\Omega]}$$

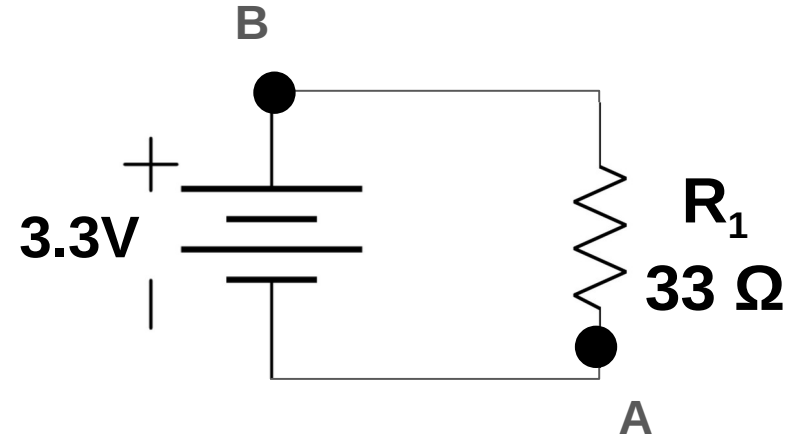
$$5/10 \text{ [V/\Omega]} = I = 0.5 \text{ A}$$

Example Problem 1



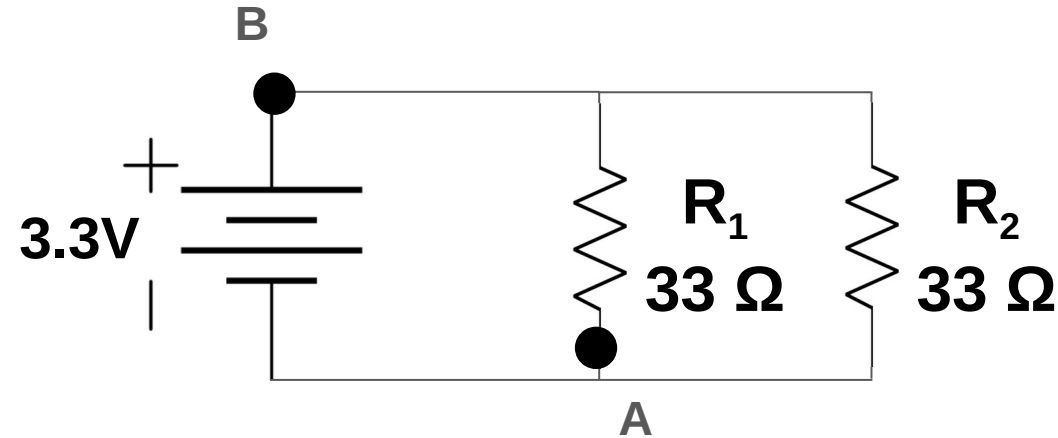
1. What direction is current running through resistor R_1 ?
2. What is the magnitude of current ?

Example Problem 2



1. What is the potential difference across resistor R_1 ?
2. What is the magnitude & direction of current at point A (bottom of resistor)?
3. What is the magnitude & direction of current at point B (positive terminal)?

Example Problem 3



1. What is the voltage across resistor R_1 ? Across R_2 ?
2. What is the magnitude & direction of current at point A (bottom of resistor R_1)?
3. Is the magnitude of current at point B more or less than in Problem 2?