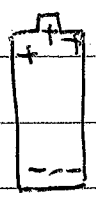
 Phys 1402 2016-09-13 Lec 6

Up to now: Electrostatics - charges didn't move.

Electric Current - flow of charges

A battery is like a pump that pressurizes the charges.

By itself:



← ⊕ charges pressurized w/ ⊕ voltage

Given the opportunity, the ⊕ charges will flow away from the ⊕ end. As they flow, they give us energy. Conductive wires allow flow of charge.

How do we measure flow of charge?

$$\text{Flow} = \frac{\text{Amount of stuff}}{\text{Time Interval}}$$

$$\text{Current} = I = \frac{\Delta Q}{\Delta t} = \frac{\text{Charge}}{\text{Time}}$$

$$1.0\ A = 1.0\ C/s$$

How big is an amp?

Cell Phone: uses 0.1 A → 1.0 A

100 mA → 1000 mA

Household Motor: 2.0 → 10.0 A

Electric shock: 1.0 mA to just feel

What determines the amount of water coming out of a hose?

- Pressure, Valve

With electricity:

$$\text{Current} = I = \frac{V}{R} = \frac{\text{Voltage}}{\text{Resistance}}$$

Note: High R ⇒ Low I

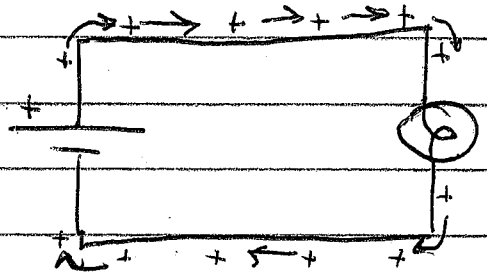
Ex: Flashlight w/ 3.0 V battery and a bulb w/ 15 Ω resistance.

$$I = \frac{V}{R} = \frac{3.0\,V}{15\,\Omega} = 0.2\,A$$

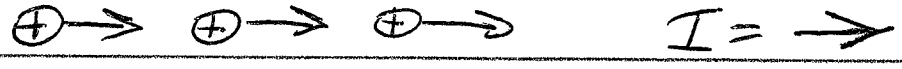
Change the bulb or battery and the current change

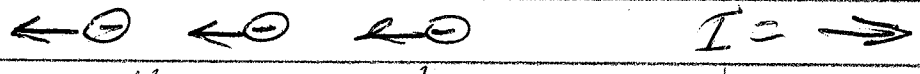
Weird Facts about electricity:

- Seems to be instantaneous.
- Wires are <u>always</u> filled with charges, but they're not always pressurized with voltage.
- The actual charges move slowly. (~1 mm/s in a cell phone charger)



- The instant the circuit is connected, the entire top wire is instantly pressurized w/ voltage. The charges touching the light bulb go thru it & lose energy. The energy is turned into light.
- ⊕ charges going one way have the same effect as ⊖ charges going the other way.





- With ⊖, the current is opposite to the velocity.

- Current always flows in loops, going through things along the way.
- Voltage sits in place, motivating the current to flow.

~~Def~~ Voltage = $\frac{\text{Energy}}{\text{Charge}}$

Current = $\frac{\text{Charge}}{\text{Time}}$

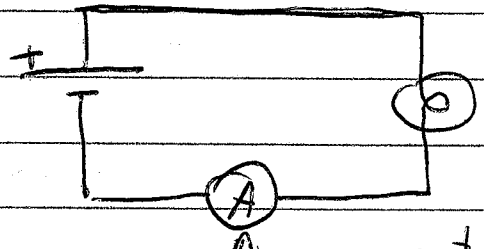
$V \cdot I = \frac{\text{Energy}}{\text{Charge}} \cdot \frac{\text{Charge}}{\text{Time}} = \frac{\text{Energy}}{\text{Time}}$

= Power = flow rate of energy

Ex: $V = 3\,V \quad R = 15\,\Omega \quad I = 0.2\,A$

$P = VI = (3\,V)(0.2\,A) = 0.6\,W$

Measuring Current: Current must flow <u>thru</u> our meter.



Hope this is equiv to previous circuit

↑ current meter measures amps, ammeter