① Phys 1402 2017-07-10 Lec 4

HW2 - posted for Next Sunday
Quiz 2 Next Monday Chap 17-18

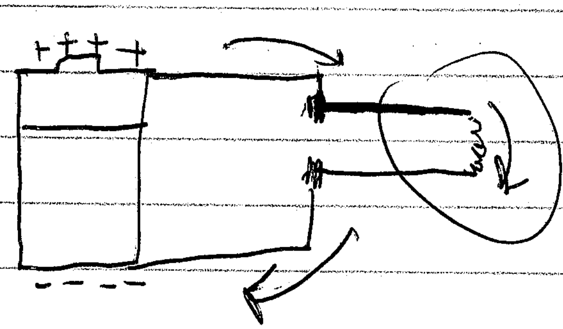
Electric Current - Flow of Charge

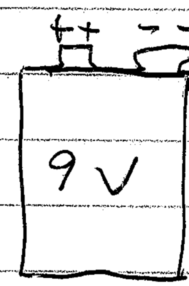
Current (I) in amperes (A)

$$I = \frac{\Delta Q}{\Delta t}$$ Charge per unit time

What makes current flow? Voltage.

A battery gives charges voltage





Bulb gives ⊕ charges a path to get away.

All currents flow in circuits.
"Dead ends" don't carry current.

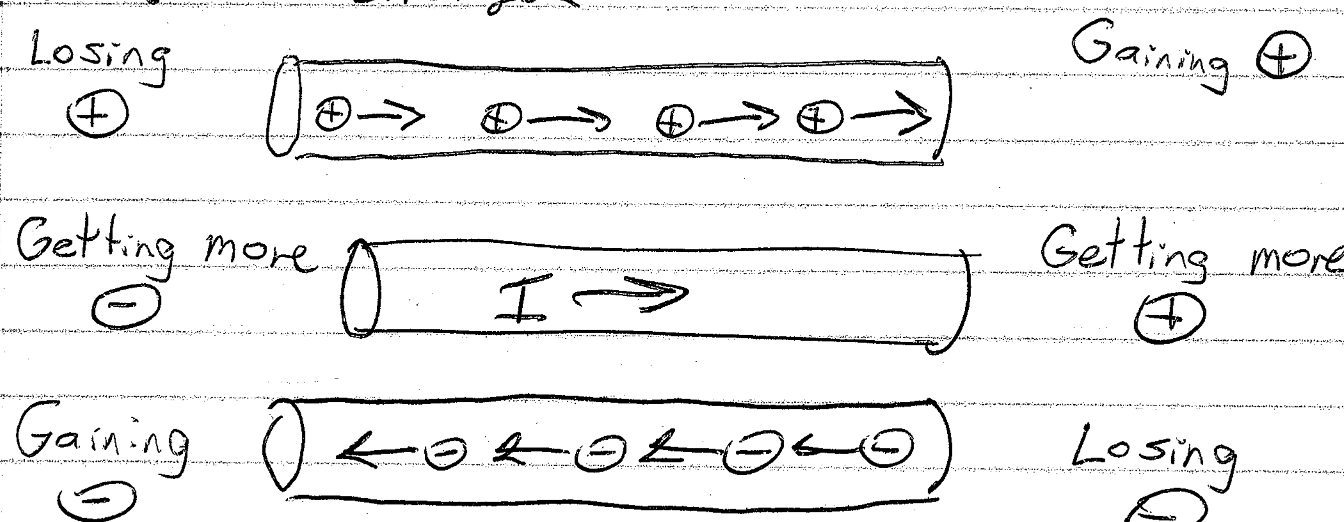
(2)

What are typical current values?

μA, mA	in small electronics
100 mA, A	small LED's
200 A	whole house max
kA	supply city

For all of these, building a few nC occurs almost instantly. Yet we have steady flow in many devices.

⊕ vs. ⊖ charges



Leftward I could be:
- ⊕ moving left
- ⊖ moving right

In metals, only ⊖ move. (All solids)

③

<u>Resistance</u> (R) in ohms (Ω) is the difficulty of pushing current.

$$V = I R$$

Voltage — Current — Resistance

Ex: Flashlight w/ 3.0 v Battery
Bulb w/ 15 Ω resistance

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

Recall: Energy = q V

$$\frac{\text{Energy}}{\Delta t} = \frac{q}{\Delta t} V$$

$$\text{Power} = P = I V$$

For the Flashlight: $P = (0.2A)(3.0\ V)$
$= 0.6\ W$

& $1\ J/s = 1\ W$

$$\text{Energy} = P \Delta t$$

- $1\ J = (1\ W)(1\ s)$
- $1\ kWh = (1\ kW)(1\ hr)$

(4)

Cost of Energy $1\ kWh = \$0.12$

$$1\ kWh = (1000\ W)(3600\ s)$$
$$= 3.6 \times 10^6\ J = 3.6\ MJ$$

$$\left(\frac{100}{12}\right) \$0.12 = 3.6\ MJ \left(\frac{100}{12}\right)$$
$$\$1.00 = 30\ MJ$$

Ex: Gallon of Gasoline Equivalent
$1\ GGE = 33\ kWh = 119\ MJ$

If we could extract all energy, it would be about \$4.00 of electricity.
But Heat is inefficient.
Only ~33% is kept.
So only ~ \$1.33 of electricity