

1
Homework will be posted
on Blackboard; use
those links to visit

McGraw-Hill Connect.

Create an account if you
don't have one already.

Also/ fill out survey on
Blackboard.

They said I can't grade thw
on completion. n

No labs this week

Forces

normal

friction

air resistance

buoyancy

tension

gravity
↑

noncontact
force

magnetic force

electric force

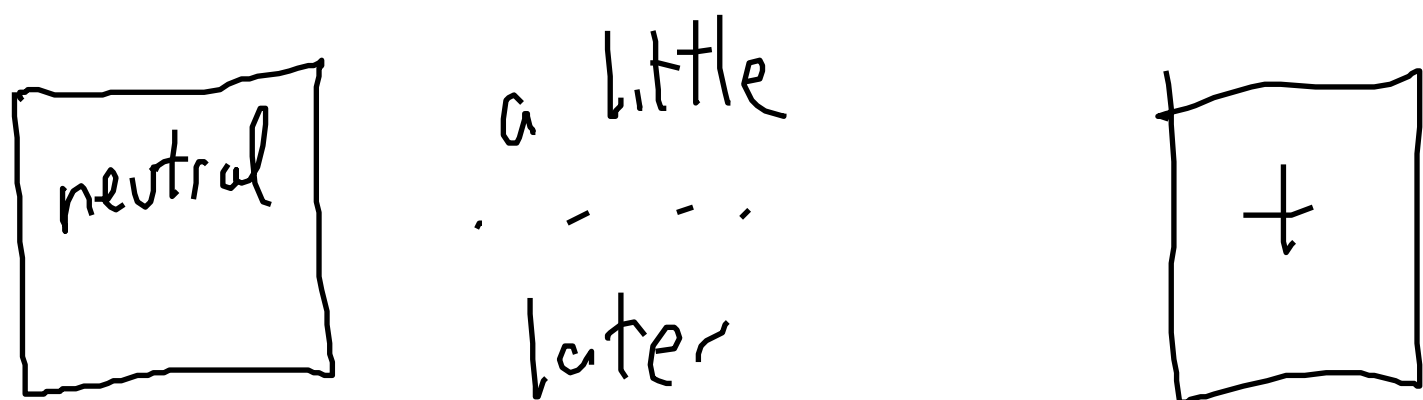
Two Types of Electric Charge

positive $\oplus$ and
negative $\ominus$

A "charged" object has an excess of one or the other

Charged objects are attracted to neutral objects

"Neutral" object has a balance of $+$ & $-$ charges



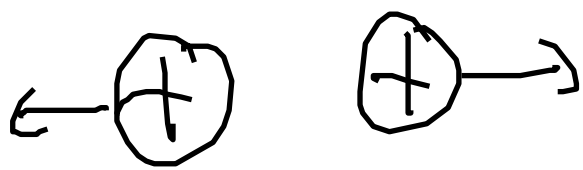
- it lost negative charge
- it gained positive charge

Charge is conserved

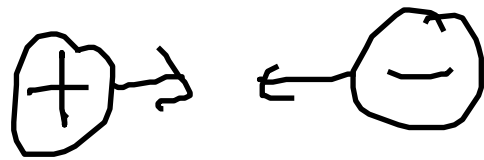
- it cannot be created or destroyed but must flow from one object to another



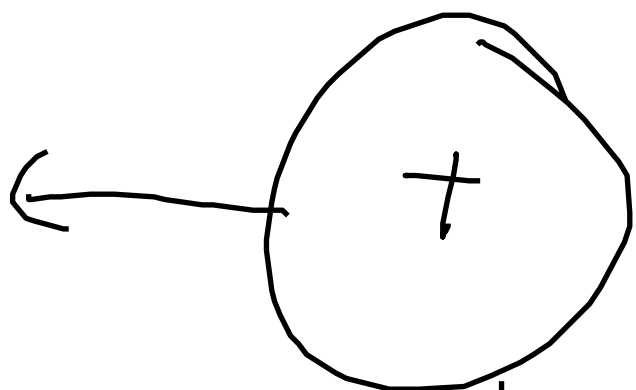
Like charges repel



Opposite charges attract

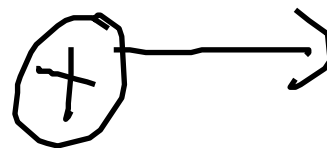


This force decreases with
distance



big charge

feel the
same
force



small
charge

7
All macroscopic charge is
due to protons and electrons

Proton

Electron

charge $+e$

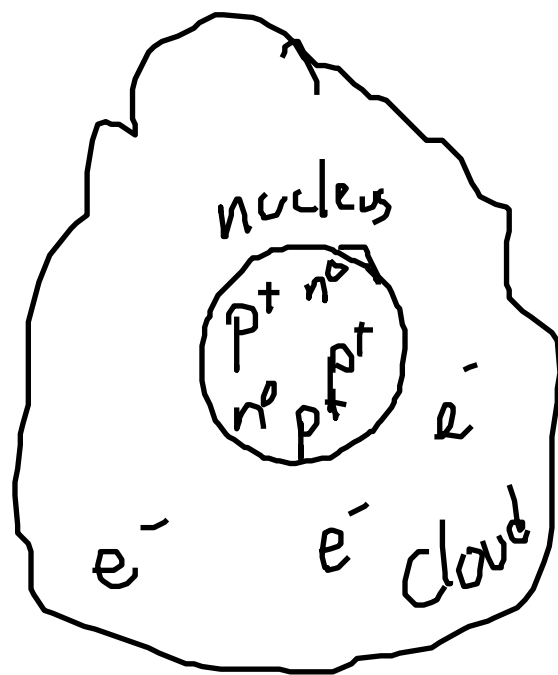
charge $-e$

Protons have 1836 times
mass of electrons

protons play a different role
in atoms than electrons

Protons have internal structure
Electrons are point particles.

Neutral atom has
equal numbers of p^+ and e^- .



atom

Ion: atom with charge



9

Total charge of object

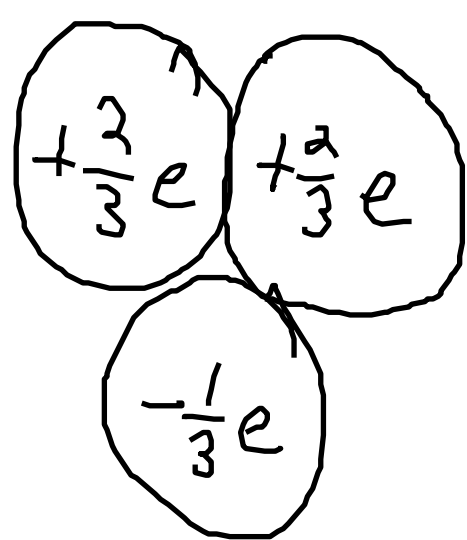
$$Q \underset{\text{charge}}{=} \underbrace{\left(\overset{\#}{\text{protons}} - \overset{\#}{\text{electrons}} \right)}_{\text{integer}} e$$

Charge Quantization

Charge is always integer $\times e$
for free objects

Some subatomic particles have charge but are not related to protons or electrons $W^- \pi^+ \mu^-$
these charges are quantized too

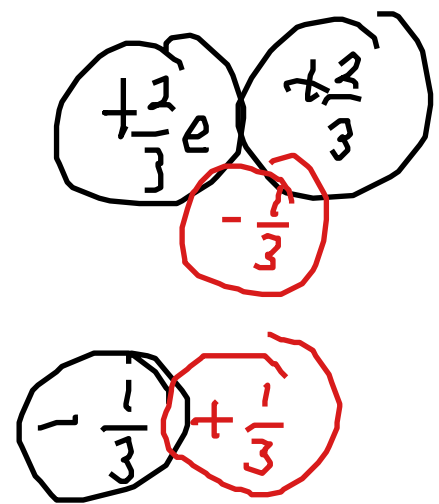
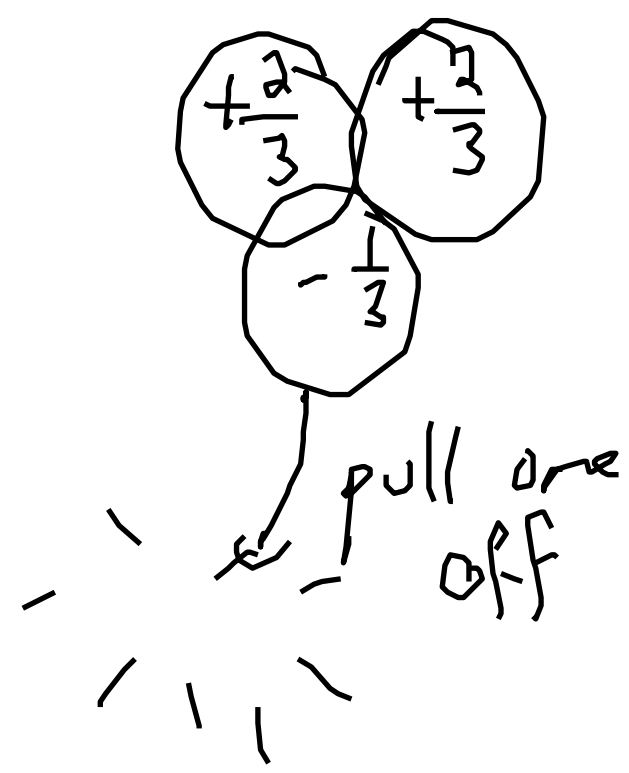
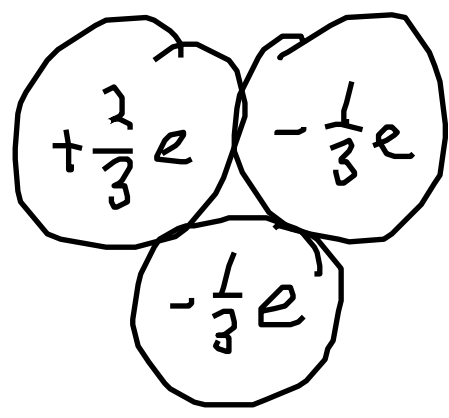
Protons are made of three quarks



Quarks have charge

$$\pm \frac{1}{3}e \quad \text{or} \quad \pm \frac{2}{3}e$$

neutron



Charge Carriers

In a medium, usually
only one charge^{type} is mobile



Electrons are
charge carriers

