ch05 Four Fundamental Forces of Nature

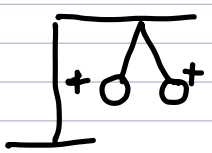
gravitation
electromagnetism
weak nuclear
strong nuclear

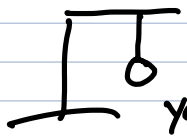
static electricity: rubbing socks on carpet, lightning

sl.html life saver demo

Electric charge fundamental property (like mass)

Demo w/ metallic-coated ping pong balls

2 balls 

1 ball? 

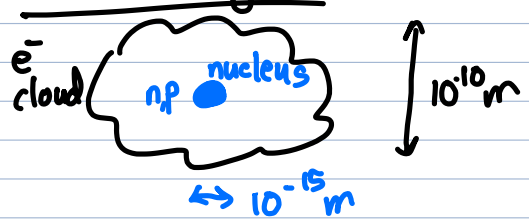
even if the ball is neutral you can get an induced separation of charges

caveat: though the number of charges involved can be huge, the net charge is typically small: $\frac{\text{net charge}}{\text{total charge}} \sim 10^{-12}$

lessons learned

- Two like-charged bodies repel
- A charged object and a neutral object attract
- Two oppositely-charged bodies attract (scotch tape demo)

Atomic building blocks



	mass	charge
proton	m_p	$+1\,q$
electron	$\sim m_p/1836$	$-1\,q$
neutron	$\sim m_p$	neutral

q: "unit charge" $\sim 1.60 \cdot 10^{-19}$ C

isolated charges only come quantized in units of q → can't observe fractional charges

but, we have evidence that protons and neutrons are comprised of "up" and "down" quarks

$+\frac{2}{3}q$ $-\frac{1}{3}q$

Some materials are conductors that transport charges

copper, gold, ~~pure~~ water, skin

A perfect insulator does not transfer charge : distilled water, tape, porcelain, rubber, glass

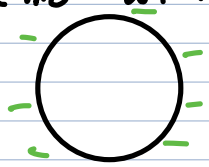
Example If $m_p \sim 1.67 \cdot 10^{-27}$ kg, compute # of e^-, p^+, n in an 80 kg person.

$N_p \approx N_{e^-} \approx N_n \equiv N$

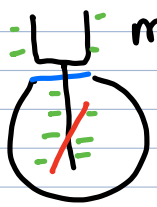
$M = N m_p + N m_n + N m_{e^-} \approx N 2 m_p$

$\rightarrow N = 2.4 \cdot 10^{28}$

Demo with electroscope



view from above

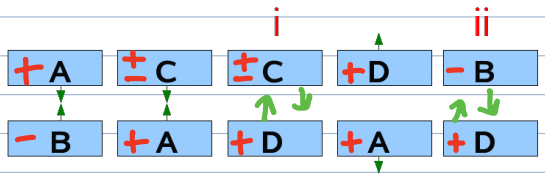


metal cap that is charged

e^- are green

ch05/s1.html concept Q

B



A,B,D are charged plastic plates.
C is an electrically neutral plate.
The electrostatic forces are shown in green for three pairs of plates.

How do the remaining two pairs interact?

A. i attractive, ii repulsive
B. i,ii both attractive
C. i,ii both repulsive
D. i repulsive, ii attractive
E. none of the above

ch05/s4.html Concept Q