

Physics 100 - February 5, 2007

- Make up class - plan to do this Friday ... will notify you once room is scheduled
- Presentation project

By end of week - if you want me to assign you to a group, send me an email requesting that along with top 3 topics of choice in descending order of preference

By Feb 15 - would like groups and topics settled

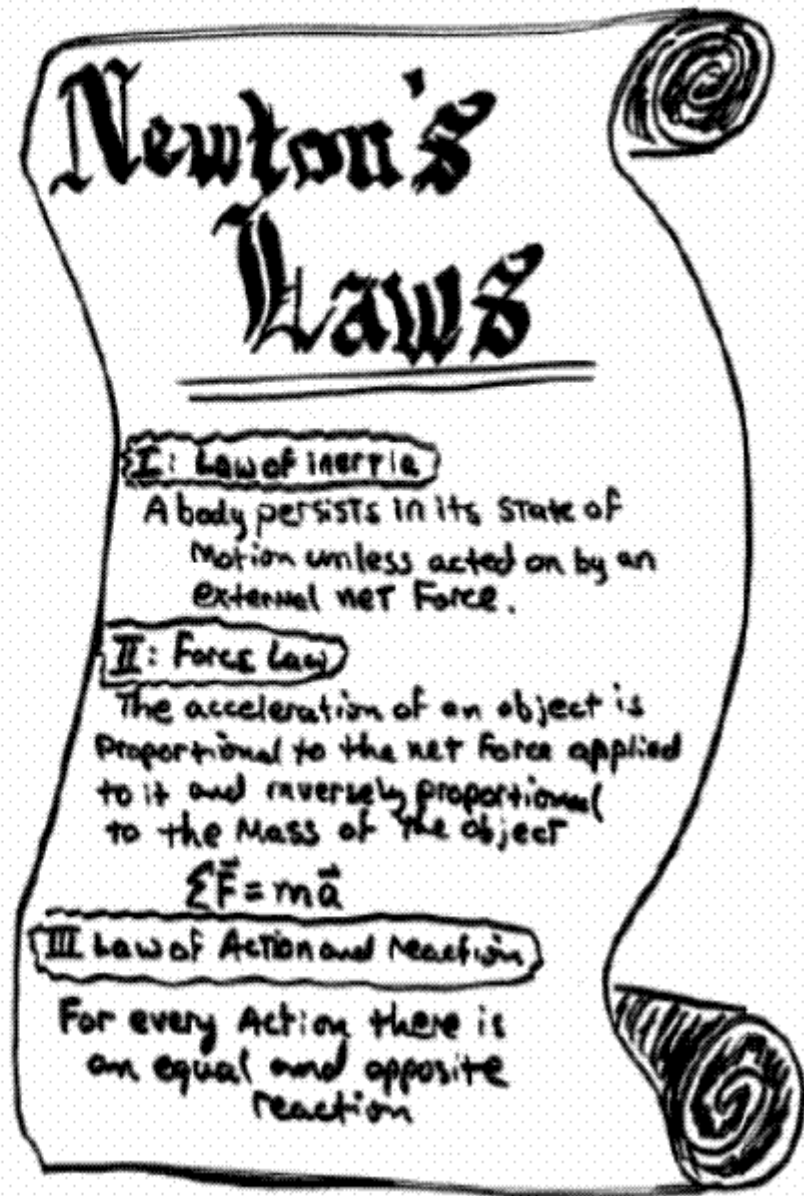
By March 8 - Have thought about presentation and either met as group w/ Prof. Manly or have set date to do so.

Last Time



Listen to the
Ballad of
Sir Isaac Newton

URL is on class
website



Newton's Laws

I: Law of Inertia

A body persists in its state of motion unless acted on by an external net force.

II: Force Law

The acceleration of an object is proportional to the net force applied to it and inversely proportional to the mass of the object

$$\sum \vec{F} = m\vec{a}$$

III Law of Action and Reaction

For every Action there is an equal and opposite reaction

Newton's Laws

+

Kinematical definitions

Inertia

$$v = \frac{\Delta x}{\Delta t}$$

$$F = ma$$

$$a = \frac{\Delta v}{\Delta t}$$

Action-reaction



Allows us to make detailed calculations/predictions of how objects respond/move under the influence of forces

Know x, v, a and Forces on all particles
→ Can predict the future!

Newton quotes - from Science Says by Rob Kaplan Stonesong Press, W.H. Freeman + Co., 2001.

If I have seen further it is by standing on the shoulders of Giants.
(in a letter to Robert Hooke, Feb. 5, 1675)

On how he made discoveries ...

By always thinking unto them. I keep the subject constantly before me and wait till the first dawnings of open little by little into the full light.

A scientist at play ...

I know not what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

Remember this one ...

That one body may act on another through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to be so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it.

(in letter to Richard Bentley, c. 1692)

The structure of Matter -

Is there a fundamental building block of matter?

If so, how do we get the variety in the world around us?

What forces govern interactions between building blocks?

How the forces change w/ Ambient conditions?

Greeks (Democritus) hypothesized such building blocks → ATOMS
(indivisible)



"Ronco
Ultratweezers"



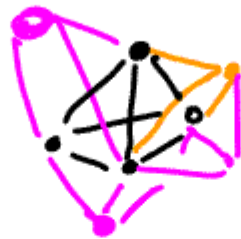
Carbon Atom

0.00000001 m

10^{-8} m

Diamond

clear crystals



Tetrahedron

Crystal lattice

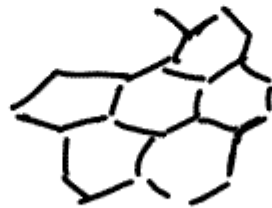
interlocking tetrahedrons

Hard substance

Tetrahedrons do not slide past one another easily

graphite

grey/black powder



lubricant

planar geometry
sheets slide past one another easily

SAME
Building blocks

→ very different
characteristics



Robert Brown
Scottish Naturalist
(1773 - 1858)

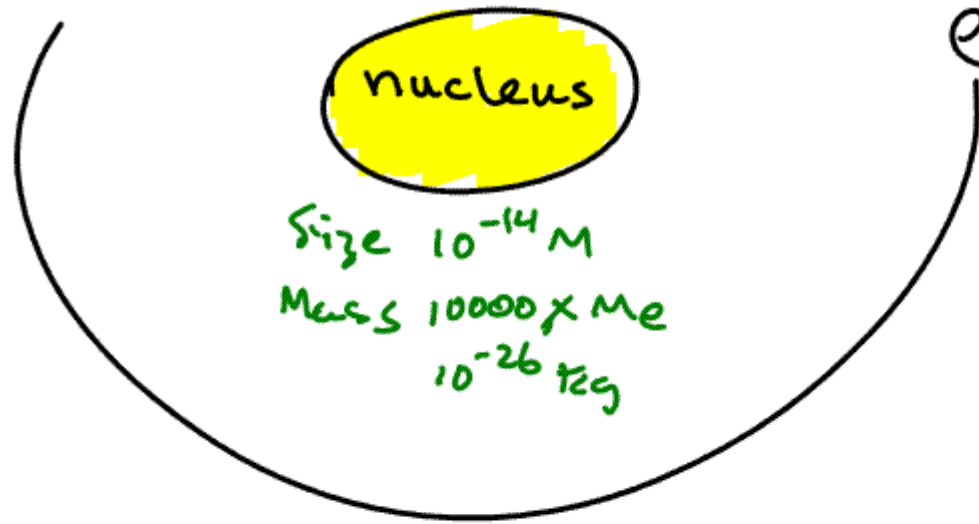


Brownian motion

Einstein (1905) explained this

Direct evidence for atoms

Random walk explained by atoms crashing into dust and move it around.



$e^- \equiv \text{electron}$

Mass

$$9.11 \times 10^{-31} \text{ kg}$$

$$2 \times 10^{-30} \text{ lb}$$

Size e^- 

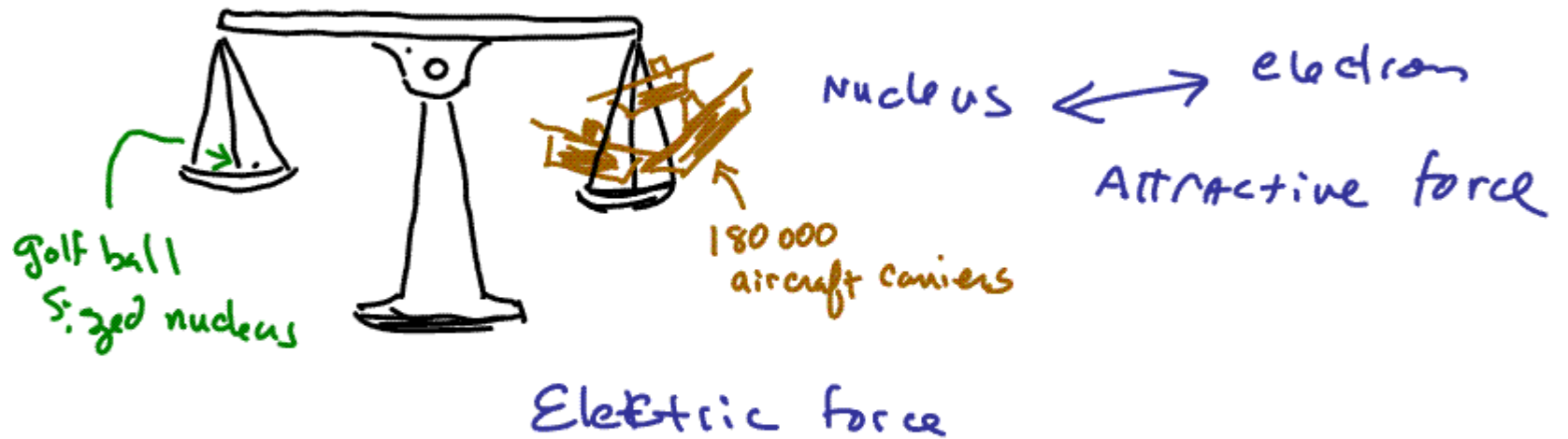
Too small to be measured to date

... maybe Someday

$$\frac{\text{Size Atom}}{\text{Size Nucleus}} = \frac{10^{-8} \text{ m}}{10^{-14} \text{ m}} = 1 \text{ million}$$

$$\text{Mass density} = \frac{\text{Mass}}{\text{Volume}}$$

- golf ball of Atomic Nuclear material would weigh as much as 180,000 Nimitz class Aircraft carriers

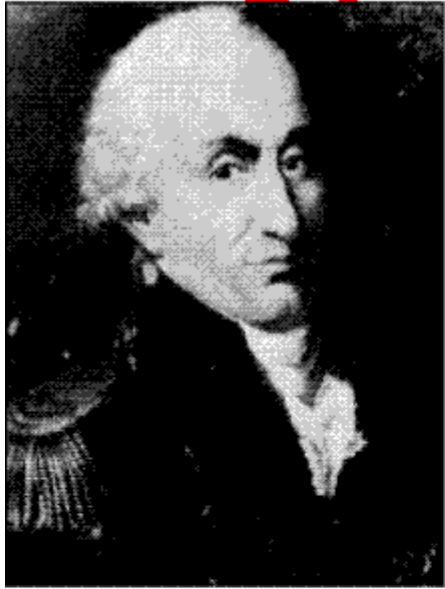


gravity

$$F_{\text{grav}} = \frac{GM_1M_2}{r^2}$$

Newton

Electric force



Charles Coulomb
(1736-1806)

French military engineer

⇒ Coulomb's Law

$$F_{\text{electric force}} = k \frac{q_1 q_2}{r^2}$$

$q \equiv$ electric charge

$$q_{1,2} = \pm \#$$

