Class Notes: **ATOMS Text Chp. 4 and a bit of Chp. 5**

BRING BOOKS TO CLASS UNTIL FURTHER NOTICE!!!

Syllabus 3 is on website (subject to some changes!)

Wed.,10/31 and Friday, 1/2

I. Inferring what you can't see!

Go over directions and emphasize that groups need to write up report as they go.

Once students have completed their observations, discuss why inference is so important in the study of atoms.

II. The History of the Atom: From Ancient Greece to the 20^{th} century!

Greek philosopher, Democritus (460 – 370 BP) first to suggest the existence of atoms: **Atoms were indivisible and indestructible.**

Greek word *atomos* which means indivisible.

Agreed with later theory but did not explain chemical behavior.

2000 years later…

1803 **John Dalton (English schoolteacher)** Studied the ratio at which chemicals combined in chemical reactions.
1804

This led to Dalton's Atomic Theory:

•All elements are composed of tiny, indivisible particles called atoms
•Atoms of the same element are identical
•Atoms of different elements can physically mix together or can chemically combine in simple whole-number ratios. Examples: H20, H202, C6H1206 etc.
•Chemical reactions occur when atoms are separated, joined, or rearranged. Recall: Decomposition, Synthesis, Single and Double Replacement Reactions

Example: Take pure copper penny and grind it into dust: each speck of shiny red dus would have the properties of copper. If you could continue to make the particles smaller and smaller, at some point you would come to a particle that could no longer be divided and still have the properties of copper: That would be the atom.

How many atoms does a pure copper penny contain? $2.4 X10^{22}$ atoms, or about $4 X 10^{12}$ more atoms in a single penny then there are people on the earth.

1 billion copper atoms lined up side by side = 1 cm.

Radii fall between $5 X 10^{-11}$ and $2 X 10^{-10}$ (you'll learn about diff. in atomic radii when we study the periodic table)

Scale 10^{-9} = *nano*

What is nano-technology?

1897: JJ Thompson discovers electrons using a cathode tube ray:

If the ray is attracted to a positively charged plate, then what can you infer about the charge of the particles making up the ray? What would you predict would happen to the ray with a negatively charged plate?

DEMONSTRATE CATHODE TUBE

JJ Thompson changed the model of the atom from indivisible to divisible: made up of at least 2 kind of particles: positive and negative

which leads to his Plum Pudding Model negative particles (raisins) are embedded in a positive sea of positive charges (the pudding!)

(1916 Robert Millikan reports that an electron has exactly 1 unit of negative charge.)

So what happens to an atom that has lost all of its electrons in a cathode ray? What does it become???

Consider: •Atoms have no net electric charge (electrically neutral)
• Electric charges are carried by particles of matter
•Electric charges exist in whole number multiples
•When an equal number of + charged particles combine with an equal number of - charged particles = neutral particle

If a hydrogen atom loses its one electron, what is left?

Positively charged particle we call a **proton.**

1911: Ernest Rutherford (New Zealand) discovers that atoms have a very dense, small positively charged nucleus.

SHOW VIDEO OF GOLD FOIL EXPERIMENT

alpha particles (2 protons and 2 neutrons) accelerated He atoms that have lost their electrons, leaving behind 2 protons and 2 neutrons!

If + charges were equally distributed, what would you expect to happen? Should pass easily through with only slight deflection.

What actually happened? Alpha particles passed straight through without any deflection! Furthermore, a small fraction bounced off the foil at very large angles. Some even bounced straight back!

Rutherford's famous quote: *This was as surprising as shooting a 15 inch shell at tissue paper and having it bounce back at you!*

1911 Rutherford Atomic Model: Is called the Nuclear Atom:
Atom is mostly empty space with all of the positive charge and most of the mass concentrated in a small, central nucleus and that electrons move around this nucleus. (This model had been suggested in 1904 by a Japanese scientist, Hantaro Nagaoka)

1932: Existence of neutrons confirmed

III. Atomic Spectra: Every element is unique!
Look at sunlight, incandescent light and then at fluorescent light. Talk about the difference.

Why might Ne be brighter than He? Greater energy released due to greater number of excited electrons!

IV. Laser/Slit: Wave/particle duality Doesn't hit at one point like point

IV. Identity of Elements: The Atomic Number Pass out Periodic Tables

Protons, neutrons and electrons
Mass number

neutrons: mass # - # protons = # of neutrons
#electrons = #protons

V. P. 112 – 113 Isotopes

Isotopes are the same element with a different number of neutrons and therefore a different mass #.

^{1}H	**^{2}H**	**^{3}H**
normal	**deuterium**	**Tritium**
Atomic Mass for each?	# protons? 1	# neutrons?

VI. Natural Percent Abundance of Isotopes and atomic mass

The atomic mass of an element is the *weighted average mass* of the atoms in a naturally occurring sample of the element.

Define atomic mass unit (amu): standard for this unit is
1/12 of the mass of a carbon-12 atom: most abundant (98.89% of carbon exists as C-12) and stable isotope!

C-12: 6 protons, 6 neutrons, 12 electrons What would be its atomic mass? 12 amu

Study Table 4.3 Note relative abundance of different isotopes

How do you calculate Percent Abundance of each isotope?

Conceptual Problems 4.3 p. 116:

21. Boron 10.81 amus Most abundant isotope is Boron- 11 Why?
22. Si 28.086 amus Most abundant isotope is Silicon-28 Why?

Sample Problem 4.2 Calculating Atomic Mass

Element X has two naturally occurring isotopes.
^{10}X = 10.012 amus relative abundance = 19.91%
^{11}X = 11.009 amus relative abundance = 80.09%

? atomic mass of Element X = 10.810 amu

^{10}X 10.012 amu x .1991 = 1.993 amu
^{11}X 11.009 amu x .8009 = +8.817 amu
10.810 amu

Does you answer make sense? Yes! Notice that the heavier isotope is far more abundant; therefore, your calculated value should be much closer to 11 than 10.

23. 63.5 amu
^{63}Cu 62.93 amu x .692 = 43.5 amu Note: Why only 3 sig. Figs.?
^{65}Cu 64.93 amu x .308 = +20.0 amu
63.5 amu

24. 79.90 amu
^{79}Br 78.92 amu x .5069 = 40.00 amu Note: Why 4 sig. Figs.?
^{81}Br 80.92 amu x .4931 = +39.90 amu
79.90 amu

Note, if you don't round until the very end of your calculation, you may have slightly different values: 63.6 amu and 79.91 amu

Chapter 25: Pages 798 – 819 Nuclear Chemistry! Thursday, November 9th Lesson

How do nuclear reactions differ from normal chemical reactions?

More notes to follow!!!