Chapter 2 (continued)

BCHEM 142

Winter 2013

Hanson Activity 2-3

- Discuss Key Questions 1-8 on pp 28-29 with your partner for five minutes.
- The clicker quiz will commence at 8:50 AM sharp.

Clicker quiz

- You may refer to your Hanson workbook
- Answer the questions individually
- In each case indicate the best answer

Hanson Activity 3-2

- Discuss Key Questions 1-6 on page 35 with your partner for five minutes.
- The clicker quiz will resume in five minutes.

Clicker quiz

- You may refer to your Hanson workbook
- Answer the questions individually
- In each case indicate the best answer

Problem 1, page 19, Hanson

- You started thinking about this in class on Thursday and should have finished it over the weekend.
- Refer to you notes on page 19 of the workbook

$$\%\text{mass of nucleus} = \frac{\text{mass of nucleus}}{\text{mass of atom}} \times 100$$

Discussion: Two approaches

$$\%\text{mass of nucleus} = \frac{\text{mass of nucleus}}{\text{mass of atom}} \times 100$$

- Subtract mass of electrons from atomic mass to get nuclear mass.
- Add masses of neutrons and protons to get nuclear mass.

Problem 2, page 20

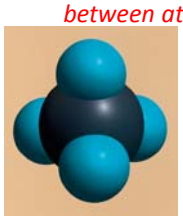
- What is a fm? *(where do you find this?)*
- What is a pm?

Problem 2, page 20

- What is a fm? *(where do you find this?)*
- What is a pm?
- How to begin?
  - Draw a sketch of the atom
  - Consider the ratio of the radii
- Work with your partner

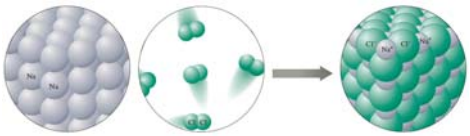
In Molecules,

- Atoms are held together by chemical bonds, which are *forces* between them
  - *Covalent bonds arise from sharing electrons between atoms: H_2O, CO_2, O_2, CH_4, etc*



In Molecules,

- Atoms are held together by chemical bonds, which are *forces* between them
  - *Ionic bonds arise from attraction between positive ions (cations) and negative ones (anions): NaCl, NH_4NO_3,*



Question

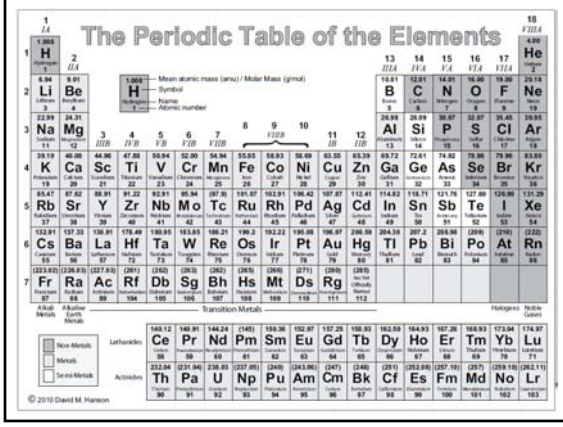
- What is it about an atom that determines its chemistry – the ability to form and rearrange chemical bonds?
- What are valence electrons?

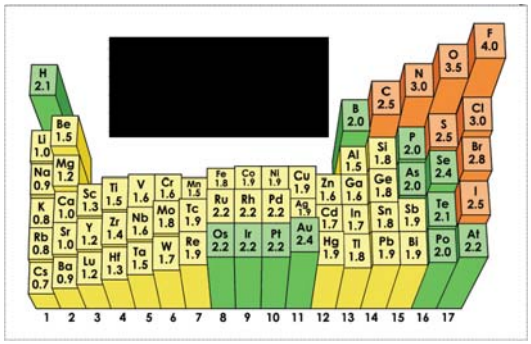
The Periodic Table

- Mendeleev
  - Mid 19th century
  - Atomic masses were at hand
  - Organized elements in rows and columns according to atomic mass and valency (how they combined with hydrogen and oxygen)
  - When properties of an element did not match its column, it would be shifted, leaving space for a new element.
  - Later, atomic number was seen to be organizing principle

Activity 2-3

- Are there questions about the Key Questions on pp 28-29?
- Exercise 1, page 29– at the overhead projector
- With your group, complete exercises 2-9 on page 29.





Activity 3-2

- Are there questions about the Key Questions 1-4 on page 35?
- Are there questions about the Key Questions 5-9 on page 36?
- Exercise 1-2: look in Zumdahl and find a few entries for each
- Work Ex 3, line 1 at the projector
- With your group, complete exercises 1-3 on pages 36-37.

Activity 3-2

- Are there questions about the Key Questions 10-12 on page 37?
- Are there questions about the Key Questions 13-14 on page 38?
- Exercise 4, page 38– at the overhead projector for sulfuric acid.
- With your group, complete exercise 4 on page 38 for all other acids Model 3.

Problem 41c $^{59}_{27}Co^{2+}$

- What is the atomic number?
- How many protons?
- What is the mass number?
- How many neutrons?
- How many electrons?

Problem 45: which ion forms?

- Ra
- Te
- Rb

Problem

- Sample contains: 2.02 g hydrogen, 32.07 g of sulfur, and 64.00 g of oxygen.
- How much sulfur and oxygen are present in a sample containing 7.27 g of hydrogen?
- Problem 61

Problem

- Element forms XBr_2 (ionic cmpd)
- The ion of X has mass number of 230 and 86 electrons
- What is X?
- How many neutrons in X?
- Problem 65

Problem

- Indium oxide contains 4.784 g of In for every 1.000 g of oxygen. The atomic mass of O is assumed to be 16.00.
- If the formula is InO, what is the atomic mass of indium?
- If the formula is In_2O_3, what is the atomic mass of indium?
- Which is correct?
- Problem 69

Chapter 3

To Begin on Thursday, January 17, 2013

Hanson Activity 2-2

- Discuss Key Questions 1-8 on page 123 with your partner for five minutes.
- The clicker quiz will commence at 8:50 AM sharp.

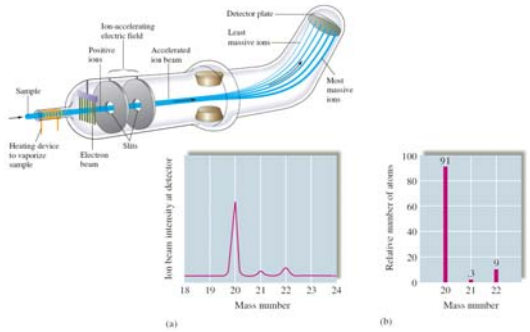
Clicker quiz

- You may refer to your Hanson workbook
- Answer the questions individually
- In each case indicate the best answer

Hanson Activity 2-2

- Work Exercise #1, page 24, at the projector.
- With your partner(s), complete exercises 2-6, pages 24-25.

Mass Spectrometer



Atomic Masses

- By definition, the mass of a C-12 atom is *exactly* 12.00 amu.
- All other atomic masses are defined relative to C-12
- The average atomic mass (or atomic weight) of carbon is 12.01 amu. Why?
- 98.89% C-12 and 1.11% C-13.
- What about carbon-14?

The Mole – Why?

- Need to know how many atoms (or molecules) are in a sample.
- Experiment (carefully done) shows that in 12.0 g of C-12, there are 6.022137×10^{23} atoms of carbon-12.
- Since the average atomic mass of natural carbon is 12.01 g, it contains 6.022137×10^{23} atoms of natural carbon.

The Mole – Why?

- Since the average atomic mass of nitrogen is 14.01 g, a 14.01 g sample of nitrogen contains 6.022137×10^{23} atoms of naturally occurring nitrogen.
- This number (Avogadro's Number) keeps occurring and is very large and awkward to use.

The Mole – Why?

- What to do? The distance by train from Seattle to Chicago is 3.55×10^{8}cm or 1.40×10^{8} in.
- *What do we do to simplify?*
- If I bring donuts to the final in this class, I will need approximately 120 donuts. Do I order 120 donuts from the coffee shop?
- *What do we do to simplify?*

Define a convenient unit: the mole

- 1 mole (of anything) = 6.022137×10^{23} of those things (atoms, molecules, donuts, etc)
- What is the mass of 1 mole of naturally occurring carbon?
- How many nitrogen atoms are in 2 moles of nitrogen atoms?

Fixes the amu in grams

- 12.01 g of carbon atoms contains 1 mole of carbon atoms.

$$(6.022\times10^{23}\,\text{C atoms}) = 12.01\text{g}$$

- One carbon atom has an average atomic mass of 12.01 amu.

$$(6.022\times10^{23}\,\text{C atoms})\left(\frac{12.01\text{amu}}{\text{C atom}}\right) = 12.01\text{g}$$

$$(6.022x10^{23})(\text{amu}) = 1\text{g}$$

Fixes the amu in grams

- 12.01 g of carbon atoms contains 1 mole of carbon atoms.
- One C-12 atom has an average atomic mass of 12.01 amu.

$$1\,\text{amu} = 1\text{g}/(6.022\text{x}10^{23}) = 1.66\,\text{x}\,10^{-24}\,\text{g}$$

You would never waste your time memorizing this, would you?

What about molecules?

- Each molecule of ammonia NH_3 has three atoms of hydrogen and one atom of nitrogen.
- Each *mole of NH_3 has three moles of hydrogen and one mole of nitrogen.*
- *Mass is conserved: the mass of one mole of ammonia is equal to the mass of three moles of hydrogen plus the mass of one mole of nitrogen.*

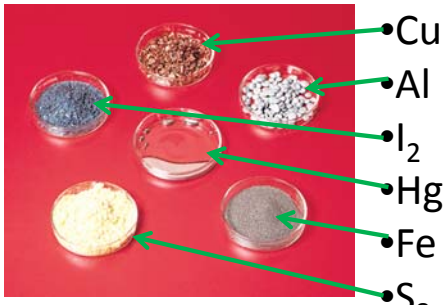
What about molecules?

- The *atomic weight* of hydrogen is 1.008 g/mol
- The *atomic weight* of nitrogen is 14.01 g/mol
- Therefore, the *molecular weight* of NH_3 is:

$$\text{mol wgt } NH_3 = (1\,\text{mol N})\left(\frac{14.01\text{g}}{\text{mol}}\right) + (3\,\text{mols H})\left(\frac{1.008\text{g}}{\text{mol}}\right) = 17.03\text{g/mol}$$

How many molecules of NH_3 in a 5.4 g sample?
1.9×10^{23} molecules (or 0.317 mole)

What does a mole look like?



How large is a mole?

- Depends on element's density and atomic weight.
- For example: 1 mole of Cu has mass 63.55 g
- The density of Cu is: 8.94 g/cm^3
- Volume of 1 mole of Cu is ?
  7.11 cm^3
- 29.6 cm^3/oz , what is the volume in oz?
- Mole of Cu is about 0.24 oz or 0.03 cup.

Problem

- Suppose the mass spectrum of the Br atom consists of two peaks (Br-79 and Br-81), each with about 50% abundance.
- What would the mass spectrum of the bromine molecule, Br_2 look like?

What amount in moles is represented by 1.50 g of CO_2

- Molecular Weight of CO_2 = ?
- Number of moles = ?
- Number of molecules = ?
- Number of oxygen atoms = ?

Chloral hydrate $C_2H_3Cl_3O_2$ is a drug.

- **What mass of chloral hydrate would contain 1.0 g of Cl?**
- **Molecular weight of chloral hydrate?**
  165.39 g/mol
- **How many grams of Cl per gram of chloral hydrate?**
  0.643 g Cl/g chloral hydrate
- **What mass of chloral hydrate would contain 1.0 g of Cl ?**
  1.6 g chloral hydrate

Problem 3-33