Announcements – 9/8/00

- First Quiz: Today!
- Labs start next week!
- Solutions to PS#2 will be online early next week
- Reminder: questions for Tuesday problem session?

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The Same or Not the Same?

- Are all Cl_2 molecules the same?

  -3 possible combos *(isotopomers):*

  $^{35}Cl^{35}Cl$ or $^{35}Cl^{37}Cl$ or $^{37}Cl^{37}Cl$

  (56.5%) (37.3%) (6.2%)

- Ok, what about Hemoglobin?

  $C_{2954}H_{4516}N_{780}O_{806}S_{12}Fe_4$ - a BIG molecule!

  3 3 2 3 4 4 <- *isotopes (nat'l)*

-The chances of any two hemoglobin molecules in a drop of blood being isotopically IDENTICAL, is VERY VERY SMALL!

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How Big is an Atom?

Not too hard to calculate:

-use *molar mass (M)* and *density (d)* to obtain ***Molar Volume (V_m):*** **V_m = molar mass/density**

$cm^3/mol = (g/mol)/(g/cm^3)$

EXAMPLE: **Copper** (d= 8.96 g/cm^3, M = 63.55 g/mol)

V_m = 63.55/8.96 = 7.1 cm^3/mol

So, for ONE atom of Cu:

$(7.1\ cm^3/mol)/(6.022 \times 10^{23}\ atoms/mol) = 1.18 \times 10^{-23}\ cm^3/atom$

Constrained to a cube: $\approx 2.25 \times 10^{-8}$ cm (= ***2.25 Å***)

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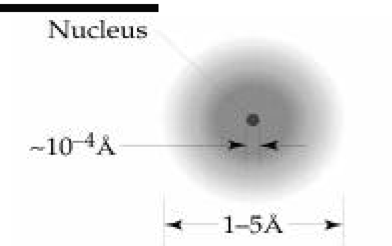
Atomic Size



They sure are small!

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Organizing the Elements

- Late 1800's: *Mendeleyev* arranges elements in order of **increasing atomic mass**

  -finds ***periodic trends in reactivity:***

- arranges so that *elements with similar reactivity* are **grouped**

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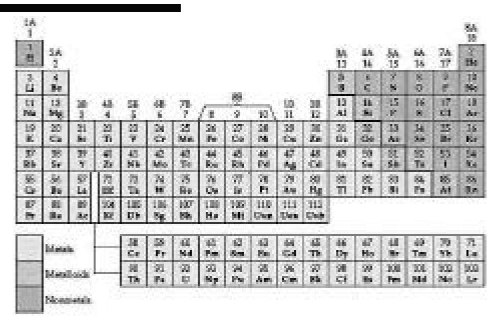
The Periodic Table



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Groups on the Periodic Table

- Group 8A (far right): ***Noble Gases***
  -***VERY*** unreactive
- Group 1A (far left): ***Alkali Metals***
  -Soft, low m.p. metals
  -***VERY*** reactive (they react with water to give off H_2)
- Group 2A: ***Alkaline Earth Metals***
- Group 7A: ***Halogens***
  -NON-metals (insulators, brittle, gaseous)
- Group 6A: ***Chalcogens***

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Molecules

- Definition: *Two or more atoms bound together*
- Identified by a ***Formula***:

  Molecular Formula – gives the *actual* numbers and types of atoms in molecule

  Empirical Formula – gives the *relative numbers* of atoms in molecule (smallest whole-number ratio)

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Mole-Based Calculations

- How many grams of Phosphorous are there in 0.010 mol P_2O_5?

Strategy: *mol P_2O_5 -> mol P -> g P*

$$0.010 \text{ mol } P_2O_5 \times \frac{2 \text{ mol P}}{1 \text{ mol } P_2O_5} \times \frac{30.974 \text{ g P}}{1 \text{ mol P}} = \mathbf{0.61948 \text{ g P}}$$

Round to: ***0.62 g Phosphorous***

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Empirical Formula from %-Composition

- **What is the empirical formula for a binary compound which is found to be:**
  56.4% Oxygen (by mass)
  43.6% Phosphorous (by mass)?

Strategy: *% -> grams -> mol*

(% is a *relative* measure, so DEFINE a sample size (100 g))

In a 100-g sample:

$$56.4 \text{ g O} \times \frac{1 \text{ mol O}}{15.999 \text{ g O}} = 3.525 \text{ mol O}$$

$$43.6 \text{ g P} \times \frac{1 \text{ mol P}}{30.974 \text{ g P}} = 1.4076 \text{ mol P}$$

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Emp. Form. - continued

This gives: $P_{1.4076}O_{3.525}$

Dividing: $\mathbf{PO_{2.50}}$ **->** $\boldsymbol{P_2O_5}$

•***What about a MOLECULAR formula?***

-need a molecular mass of the compound

Example: MW of $\boldsymbol{P_2O_5}$ cmpd is 284 g/mol

Empirical Formula Mass ≈ 2x31 + 5x16 = 142

MW/Emp Form Mass = 284/142 = 2

So: 2 X P_2O_5 = $\mathbf{P_4O_{10}}$

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