Welcome to day 2!

- Announcements
- Periodic table
- Significant Figures
- Atomic Theory
- Atomic Structure
- Isotopes
Chemistry is?

<table>
<thead>
<tr>
<th>25%</th>
<th>1. The greatest class on earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>2. Why I get up in the morning</td>
</tr>
<tr>
<td>25%</td>
<td>3. The study of the properties and interactions of matter</td>
</tr>
<tr>
<td>25%</td>
<td>4. The science that ties all other sciences together</td>
</tr>
</tbody>
</table>
Announcements

• Chem/Bio picnic today
• CAPA tutors available!
  – Sun night 6-8 pm
  – Wed night 8-10 pm
  – Room SC3031 (computer lab SE corner)
• Turn in the ‘hand-in’ problem to room SC3067 (student resource room in NE corner)
  – This is also where you can pick up graded CAPA
• Any after-class questions in atrium – not in classroom
The Periodic Table

Your Best Friend

- Arranged in order of increasing mass, the periodic table looks like this.
  - Because rows 6 and 8 are quite long, 14 of these elements are separated from the rest.
- Elements in the same column (group) have similar chemical properties
Unit Conversions

• We frequently need to convert a measurement from one unit to another.

• When multiplying numbers we also multiply units and when dividing numbers we also divide units

• Never forget units!
For Example

- The density of water is 1.0 g/mL
- What is the density in lbs/Gal?

\[
1.0 \frac{g}{mL} \times \frac{1kg}{1000g} \times \frac{1lb}{0.4536kg} = 0.0022046 \frac{lbs}{mL}
\]

\[
0.0022046 \frac{lbs}{mL} \times \frac{1000mL}{1L} \times \frac{3.785L}{1Gal} = 8.3 \frac{lb}{Gal}
\]

\[
1.0 \frac{g}{mL} = 8.3 \frac{lbs}{Gal}
\]
Significant Figures

• The number of digits expressed in a numerical value is called the number of significant figures.

• How to determine “sig figs”
  – Read the number from left to right and count all the digits starting with the first non-zero digit
    • 34.023  has 5 sig figs
    • 0.068   has 2 sig figs
    • 0.0680  has 3 sig figs
  – Place a decimal point after the value when its trailing zeros are significant
    • 110     has 2 sig figs
    • 110.    has 3 sig figs

• See pp. 22-23 for rules on math and sig figs
Atomic Theory

- Developed early 1800’s by John Dalton
- He observed?

Fixed proportions can only result from indivisible matter
Summary of Atomic Theory

- All matter is made up of tiny particles called atoms.
- All atoms of a given element have identical chemical properties that are characteristic of that element.
- Atoms form chemical compounds by combining in whole-number ratios.
- Atoms can change how they are combined, but they are neither created nor destroyed in chemical reactions.
  - A.K.A. Conservation of Mass
Conservation of Mass

How many oxygen atoms (red) must appear in the products of this reaction?

1. One
2. Four
3. Nine
4. Two-thousand five
Conservation of Mass

$\text{CH}_4 \quad 4 \text{ H atoms} \quad 2 \text{ O}_2 \quad \text{CO}_2 \quad 1 \text{ C atom} \quad 2 \text{ H}_2\text{O} \quad 4 \text{ H atoms}$

$1 \text{ C atom} \quad 4 \text{ O atoms} \quad 4 \text{ O atoms} \quad 4 \text{ H atoms}$
Dynamic Equilibrium

- Atoms (and therefore molecules) are ALWAYS in motion
  - Recall simulation from end of last lecture
- Leads to many critical aspects of chemistry, e.g. Diffusion
- Equilibrium in chemistry is dynamic
  - Particles are constantly moving/exchanging at molecular level
  - Overall, there is no net change
  - Like the Hope College dating pool

*Dynamic Equilibrium*
Dane Rudhyar, 1947
Atomic Structure

- Nucleus contains protons and neutrons
- Protons determine identity
- Protons + neutrons determines mass
- Protons – electrons determines charge
- Held together by variety of forces (see text)
Isotopes

- Atoms with different number of neutrons
- Same element, but different mass

\[ ^A_Z X \]

- A is atomic mass
  - # of protons + # of neutrons
- Z is atomic number
  - # of protons
- X – element symbol
  - Redundant with atomic number

Note that mass in periodic table is average atomic mass from all isotopes

- Typo on electron mass p.42 (Table 2-1 is OK)
Atomic Notation Example

- Chlorine 35 and Chlorine 37 are both common
- How many protons, neutrons, and electrons in each?

$^{35}_{17}\text{Cl}$
- 17 Protons
- 17 Electrons
- 18 Neutrons

$^{37}_{17}\text{Cl}$
- 17 Protons
- 17 Electrons
- 20 Neutrons
Before 4:00 TODAY

• Turn in index card
• Complete trial post to chemboard
• Make plans to attend Chem/Bio picnic
• Pick up CAPA sheets from shelf outside room
• Attend cool physics seminar (3:00 VDW 102? – the big room)

By Monday

• Sleep
• Try to finish CAPA set #1
• Finish reading Chapt 2

Remember: You are done with the homework when you understand it!