Gems 160 - January 20, 2004
• Homework for Chapter 2 due Wednesday
• Show work where appropriate
• Will be posted by tonight
• Chem news Monday (info by 8:00 pm Saturday)
• Andrew Weigl
• Next week in lab
• Report for ions in solution - Dr. Brown said good work this week
• Posters for elements - all know assignment?
• Today
• Ch. 2 - structure of atoms

Plants Revealed as Methane Source
Sarah Roeschley
• Large clouds of methane have been observed from space above the areas of tropical forests.
• The Max-Planck Institute in Heidelberg, Germany has performed controlled experiments on plants and leaves in labs with similar conditions to outside.
• They have discovered there is a rise in methane emissions from plants and leaves when there are increasing temperatures and exposure to sunlight.
• It was thought that methane was usually released in conditions with low levels of oxygen and in city dumps, mines, and swamps.

• Methane is a greenhouse gas that has the ability to trap heat from sunlight and contributes to global warming.
• The amount of methane in the atmosphere has tripled over the past 150 years. (Max-Planck)
• Scientists are still trying to figure out why and how plants are producing these increasing clouds of methane.
• Question: How does Methane a greenhouse gas contribute to global warming?

Symbolic structure for the atoms

- X is the element symbol
- Z is the number of protons
- Z determines X - periodic table
- A is the sum of protons + neutron (mass number)

Write the notation for the following:
- Carbon with 6 neutrons
- Carbon with 8 neutrons

Chlorine with 18 neutrons is

- 21% 1. $^{35}_{17}$Cl
- 7% 2. $^{36}_{18}$Cl
- 81% 3. $^{35}_{18}$Cl
- 11% 4. $^{37}_{18}$Cl

Hydrogen with 0 neutrons is

- 82% 1. $^{1}_{1}$H
- 18% 2. $^{0}_{1}$H
- 0% 3. $^{0}_{1}$H
- 0% 4. $^{1}_{1}$H
Symbolic structure for the atoms

- Write the notation for the following:
  - Chlorine with 18 neutrons
  - Chlorine with 19 neutrons
  - Hydrogen with 0 neutrons
  - Hydrogen with 2 neutrons
  - Atoms with the same number of protons but different numbers of neutrons are called **isotopes**

Isotopes and the real world

- A careful study of Cl atoms shows that 75.8% have a **mass number** of 35 and 24.2% have a **mass number** of 37.
- What is the average mass for Cl atoms?
- The average mass is the **atomic weight** that is found on the periodic table.
- Most chemical calculations are based on the atomic weight, because any sample of atoms will be an average of all the isotopes.

Describe the relation between the following symbols and each term in the list

0.5% $^{84}\text{Sr}$, 9.9% $^{86}\text{Sr}$, 7.0% $^{87}\text{Sr}$, 82.6% $^{88}\text{Sr}$

- Atomic mass unit (amu)
- Atomic number
- Mass number
- Atomic weight
- Isotope
- Protons
- Neutron
Periodic table and atomic structure

• All protons and neutrons add to the nucleus in an equal manner
• Electrons add to outer orbitals, but not all the orbitals are equal
• Going to the right one element
  – corresponds to an increase in one proton
  – corresponds to an increase in one electron
  – may or may not increase the neutron count

Electrons, periodic table and atomic structure

• Each row in the table describes an orbital
  – A place where electrons are found
  – The orbital is also called a quantum shell
• For our purposes
  – Row 1 = shell 1, holds up to 2 electrons
  – Row 2 = shell 2, holds up to 8 electrons
    (a set of 2 and a set of 6)
  – Row 3 = shell 3, holds up to 18 electrons
    (a set of 2, a set of 6 and a set of 10)
  – Row 4 = shell 4, holds up to 32 electrons

Electrons add to outer orbitals, but not all the orbitals are equal

For our purposes:
- Row 1 = shell 1, holds up to 2 electrons
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- Row 4 = shell 4, holds up to 32 electrons
• How are the shells different from each other
  – 1 is closest to the nucleus, lowest energy
  – 2 is further away from nucleus, more energy
  – 3 is further away than 2, more energy than 2
  – Etc
• The elements as found in the periodic table are neutral in charge. # of protons = # of electrons

Chemical reactions can cause elements to gain or lose electrons. Which of the following is true when a sodium cation is formed in a reaction.

1. It has 23 protons and 24 electrons
2. It has 23 protons and 21 electrons
3. It has 11 protons and 12 electrons
4. It has 11 protons and 10 electrons

Chemical reactions can cause elements to gain or lose electrons. Which of the following is true when a chlorine anion is formed in a reaction.

1. It has 17 protons and 16 electrons
2. It has 17 protons and 18 electrons
3. It has 35 protons and 36 electrons
4. It has 35 protons and 34 electrons
Evidence for this electron structure

- Light is a form of energy
  - Ultraviolet and blue are higher energy
  - Red is lower energy
- Electrons moving from one level to another involve the gain or release of energy
  - Electrical voltage is one way to add energy
  - Emission of light is one way to release energy
- Observe the emission of light from different elements that have been “excited” by voltage

Why are electrons so important?

- It is through the loss, gain or sharing of electrons that elements combine to form compounds.
- With a set of simple rules we can quite reliably predict and understand how many of the elements, especially the 1st 20, combine to form compounds.
- First rule - the important electrons in a chemical reaction are only those in the outer shell.
- Why?

Why are electrons so important?

- Second rule - elements in the same column have the same type of electron structure in their outer shells.
- What does this mean for Li and for K?
- What does this mean for Ne and Ar?
- This also means that you can predict reactions and formulas for groups of elements, not every element needs to be treated separately.
Why are electrons so important?

- Third rule - for rows 2 and 3 (and the left and right “blocks” of row 4), the most stable combination of elements will be one where the outer shell contains eight electrons. This can be accomplished through the loss, gain or sharing of electrons.