Learning Guide 2C – Small Molecules
Chem 1010

Review

What are the two most common types of physical changes that we encounter in chemistry?

1)

2)

What are the three most common types of nuclear changes, and where do we encounter them?

1)

2)

3)

What are the clues that can indicate that a chemical reaction has occurred?

What does it mean to balance a chemical equation?

Why is it important to balance a chemical equation?

Balance the following equation:

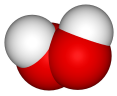
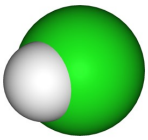
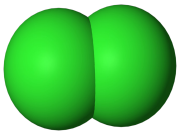
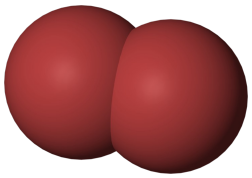
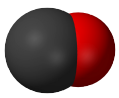
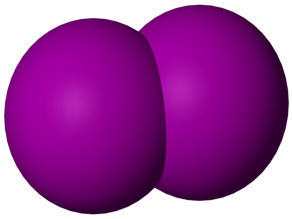
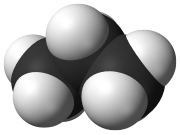
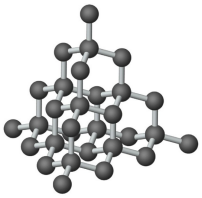
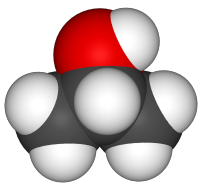
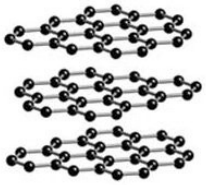
$$K + H_2O \rightarrow KOH + H_2$$

What if you get this?

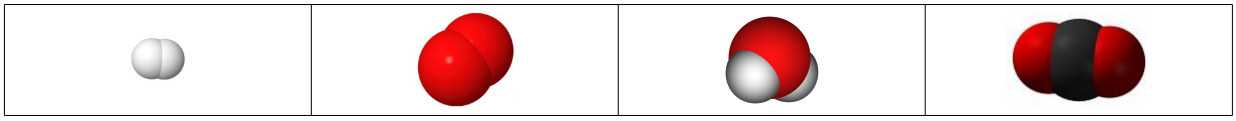
$$K + H_2O \rightarrow KOH + H_2$$

Introduction

Write in the formulas and descriptions for each molecule.

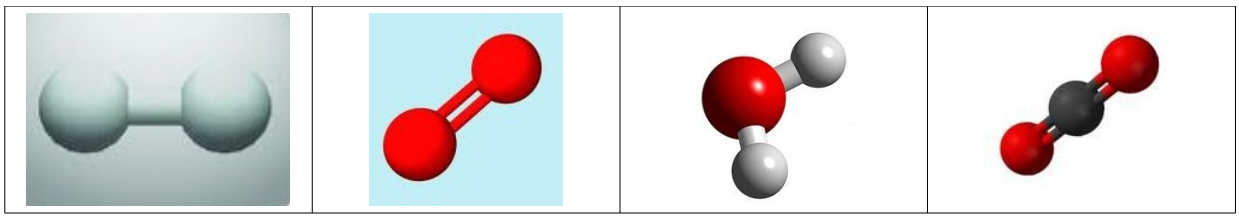
			
			
			
			
			
			
			
			

So far, we've been using space filling models to represent molecules.



What information can we get by looking at these models?

Space filling models give a pretty good picture. But something's missing. Here are some ball and stick models.



How are the ball and stick models different? What do they show that the space-filling models do not?

There are a number of questions that we haven't answered yet:

What holds these atoms together?

Why are some elements diatomic, and some are not?

Why is water bent, but CO2 straight?

Today we will find answers to these questions.

1 – How are electrons organized?

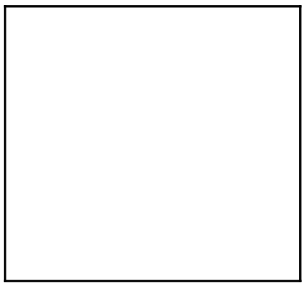
When atoms form chemical bonds, which of the elementary particles are involved? Why?

Are all of the electrons involved in forming bonds?

Which ones do we need to worry about?

To answer this question, we need to know how the electrons are organized in an atom.

Electrons are organized into:



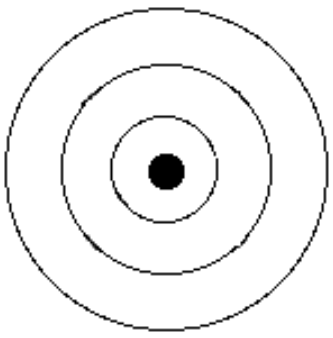
Each energy level holds a certain number of electrons.

1st energy level:

2nd energy level:

and so on….

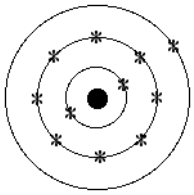
Electrons fill up the lowest energy level first, then go to the next, and so on.

	example: number of electrons in a neutral atom: electrons in the 1st energy level: electrons in the 2nd energy level: electron in the 3rd energy level: the rest of the energy levels:

So, which of these electrons are involved in forming chemical bonds?

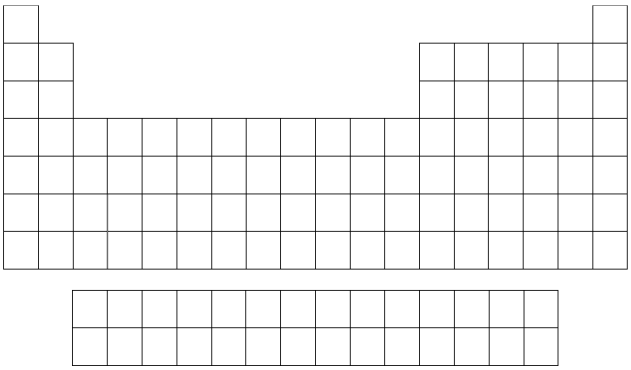
these are called the:

Which are the valence electrons in a sodium atom?



In order to predict how an atom will react, we need to know how many valence electrons it has.

You can determine the number of valence electrons for nonmetals and main group metals by counting across on the Periodic Table.



What pattern do you see here?

(The number of valence electrons in the transition and inner transition metal atoms is harder to predict. We will worry about them later.)

oxygen	_____	neon	_____
potassium	_____	hydrogen	_____
fluorine	_____	nitrogen	_____
aluminum	_____	bromine	_____
carbon	_____	sulfur	_____
magnesium	_____	bismuth	_____

An American chemist named _____ proposed an easy way to represent the valence electrons. They are called:

lithium beryllium boron carbon

nitrogen oxygen fluorine neon

2 – How do atoms form bonds?

Now we are ready to talk about why atoms form bonds. The key to understanding how atoms behave is...

Atoms are most stable when they have:

This is called the:

If atoms don't have this, they can:

Using this information, can you explain why noble gases are always found as individual atoms?

We will first be looking at covalent bonds, which always involve nonmetal atoms bonding with other nonmetal atoms.

What do the nonmetal atoms have in common?

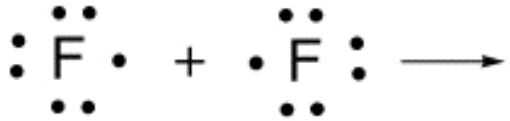
To solve this problem, atoms can share their electrons with each other.

Example:

Lewis structure of a fluorine atom:

A fluorine atom all by itself has:

If two fluorine atoms get together, they can share two of their electrons between them.



Now each fluorine has 8 valence electrons around it, and satisfies the octet rule.

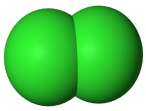
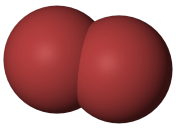
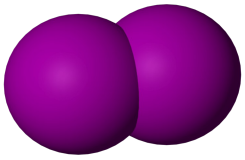
A pair of electrons shared between two atoms is called a:

It holds the atoms together because:

To show this, the shared electrons are replaced with _____, linking the two atoms together.

Lewis structure for F_2:

Why are all of the halogens diatomic?

model	formula	Lewis structure of the atom	Lewis structure of the molecule
	F_2		
	Cl_2		
	Br_2		
	I_2		

Example:

Lewis structures for two H's and one O:

Hydrogen is an exception to the octet rule. It only needs __ electrons to be stable.

How could you put these atoms together so that the oxygen has 8 electrons and the two hydrogens have 2 electrons?

Lewis structure for water:

Every time there is a single electron on a side, it must be joined with a single electron on another atom to form a bond.