SNC 2DI **UNIT 1 Chemistry**

**How Ions Form**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Element and Group Number** | | | | | | | | |
| **Bohr Rutherford Diagram** | | | | | | | | |
| **Gain OR Lose Electrons** | | | | | | | | |
| **Charge on the Ion** | | | | | | | | |

**Octet Rule:**

**Duet Rule**

**Period Number:**

**Group Number:**

**Ion:**

**Cation:**

**Anion:**

**Chemistry Basics Continued… SNC 2DI**

Remember…

*__Cations …__
-from when atoms lose electrons
-mainly occurs with metals
-atoms form an ion with a positive charge

*__Anions….__
-form when atoms gain electrons
-mainly occurs with non metals
-atoms form an ion with a negative charge

**Isoelectronic** – is the term used to describe two atoms with the same number of electrons, total number of electrons.

**Calculate the number of Electrons…**
***Remember if there is a charge on an atom, ie $Mg^{+2}$ the atom is an ion and therefore the number of electrons will not equal the number of protons.
-If there is a negative charge (anion) you must add the charge to the number of protons
-If there is a positive charge (cation) you must subtract the charge from the number of protons
***__Opposite to what the sign says__***
Examples:

Complete the chart below, with the aid of a periodic table, to determine which atoms or ions are isoelectronic with each other, ie have the same number of electrons.

| **Element** | **Mass #** | **Atomic #** | **# of Protons** | **# of Electrons** | **# of N** | **Atom / Ion** |
|---|---|---|---|---|---|---|
| Ne | | | | | | |
| $Br^{-1}$ | | | | | | |
| $Mg^{+2}$ | | | | | | |
| Kr | | | | | | |
| $K^{+1}$ | | | | | | |

Which atoms/ions are isoelectronic? List below

**Drawing Lewis Dot Diagrams (LDD)**
-Lewis dot diagrams show the element's symbol and the number of valence electrons only
-Remember Group # = # of Valence Electrons
-Valence electrons are placed singularly and then grouped in 2's

SNC 2DI **Ionic and Covalent Bonding and Their Properties**

**Ionic Bonds**
*Occur between…

**Remember:**
-metals tend to lose electrons and non metals gain electrons
-Therefore this combination is perfect the metals essentially give their electrons to the non metals

Ex. NaCl

Ex Mg and I

**Covalent Bonds**
*Occur between…

-Non metals gain electrons

-Therefore, since both elements want electrons, non metals are forced to share

Ex $Cl_2$

Ex C and H

**Properties…**

| **IONIC** | **COVALENT** |
|---|---|
| -strong attractive force, therefore are very hard and brittle | -weak attractive force compared to ionic, therefore are considered soft |
| -High melting points | -Low melting points |
| -Tends to be Solids at Room Temp | -Can be solid, liquid or gas at Room Temp |
| -Soluble in water | -Not very soluble in water |
| -Able to conduct electricity when dissolved in solution or in liquid form… WHY? | -Not very good conductors because |

**SNC 2DI Drawing the Bonds….**

**Rules:**

-Metals LOSE electrons…any element with less than 4 electrons will lose the electrons

-Non metals GAIN electrons… elements with 5 or more electrons will gain electrons

**Elements will either…**

1) Lose all the electrons in outer shell – therefore the previous energy level is full

   OR

2) Gain enough electrons to have 8 in outer shell OR share to have 8 in outer shell

Exception: Hydrogen will share/lose 1 electron

***CAN NOT have partially filled shells for any element, must use more atoms until the shells have 8 or 0 electrons in outer shell***

Examples:

IONIC: Mg and Br

COVALENT: C and Cl

SNC 2DI **Naming and Writing Chemical Compounds**

## Part 1 – Covalent or Molecular Compounds

-Molecules made up of 2 non-metals

| **Prefix** | **# of atoms** |
|---|---|
| mono | |
| di | |
| tri | |
| tetra | |
| pent | |
| hex | |
| hept | |
| oct | |
| non | |
| dec | |

- Prefix represents the _____

-**Exception**: Do not use mono on the first element

-**First element** is named as is

-**Second element**, the ending changes to **"ide"**

-**Example: _____**

**Practice:**

**Name the following:**

$CO_2$

$SCl_4$

NO

**Write the formula for the following**

-diphosphorous pentachloride

-carbon monoxide

-silicon diselenide

**Part 2 Ionic Compounds**

-Molecules composed of a metal and a non-metal

**Writing** the Formula: the charge on each element must be known
-refer to the "How Ions Form Note"

**Remember:**

| Group # | 1 | 2 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|
| # of Valence electrons | | | | | | | | |
| Charge | | | | | | | | |

**Note –** positive charged element is written first and the negative charged element is written second in the formula

**Criss Cross Rule and Zero Sum Rule…**

Ex. Calcium and Chlorine

Ex. Potassium and carbon

Ex. Magnesium and oxygen

**Naming IONIC**: -Metal is named as is
-Non-metal, ending changes to "ide"

**Part 3 Multivalent Metals**

**Multivalent metals**, have more than one charge, often these are the transition metals

Example Copper chloride

-Copper can have a charge of _____ and / OR _____

**ON** your periodic table, highlight any metals with more than one charge.

Write the formula for Copper chloride and Copper Chloride

Write the chemical formulas for chromium and bromine and name all possibilities.

| **Roman Numeral** | **Charge on metal** |
|---|---|
| I | |
| II | |
| III | |
| IV | |
| V | |
| VI | |
| VII | |
| VIII | |

More examples:

**Write the** formula for

-Iron (II) chloride

-Cobalt (II) oxide

Reverse criss cross **and name**

- $NiI_2$

- $V_3P_5$

**Part 4 Polyatomic Ions**

-are many atoms with an overall charge

-polyatomic ions have their own unique name

What is the formula for using reference sheet…

-Nitrate _____

-Sulphate _____

-Carbonate _____

**Naming**

- Name the metal as is
- Name the polyatomic ion as is

Practice:

**Name the following**

$NaNO_3$ _____

$Li_2SO_4$ _____

$CaCO_3$ _____

**Write the formula**

-if more than one polyatomic ion is needed must use brackets and write the number needed on the outside of the brackets.

Potassium chlorate

Aluminum sulphate

Magnesium carbonate

Ammonium oxide

**Advanced Naming** ... what is the name for the following?

a) $Pb(NO_3)_2$

b) $MnPO_4$

SNC 2DI **Law of Conservation of Mass**

Prior Knowledge: Define the terms **Physical Change and Chemical Change**

*What are the signs of a **Chemical Change?**

Antoine Lavoisier created the **Law of Conservation of Mass**, which states that….

Dalton's Atomic Theory also supports this law

**Dalton's Atomic Theory states**…

Therefore, in a chemical reaction atoms recombine with other atoms to form new substances

**Reactants → Products**

Example:

Silver nitrate reacts with copper to produce copper (II) nitrate and silver

**Law of Conservation of Mass Continued…**

*According to the Law of Conservation of Mass, the **mass of the reactants must equal** ….

This leads to …

*Chemical equations can be represented in a variety of ways

Remember:

*Reactants are always on the

*Products are always

*the arrow itself represents the term

**Word Equations**:

**Skeleton Equations**

**Balanced Chemical Equations:**

To balance an equation _____ can only be placed in front of chemical compounds, (NO fractions). These numbers are called _____

**SNC 2DI Types of Reactions…. Synthesis and Decomposition Reactions**

**Synthesis Reactions:**

**General Equation:**

Ex. Nitrogen gas and hydrogen gas combine to create ammonia gas, releasing Energy

**Balanced Chem Eq'n:**

Hydrogen gas and oxygen gas combine to produce water, releasing energy, enough energy to propel a space shuttle into space.

**Balanced Chem Eq'n**:

**Decomposition Reactions**:

**General Equation:**

Ex. $NH_4NO_3 \rightarrow H_2O + N_2O_{(g)}$

**Write the Word Equation**:

$N_2O_{(g)}$ is a very combustible gas … In 1947 a ship filled with ammonium nitrate had a fire on board and it caused ammonium nitrate to decompose and produce $N_2O$, as a result the ship exploded killing 600 and injuring 3500.

***Synthesis Reactions are the opposite to Decomposition reactions***

-Carbonic acid, $H_2CO_3$ is the component of pop that gives pop it's fizz

**-$H_2CO_3$ → $CO_{2(g)}$ + $H_2O_{(l)}$**

-When a can or bottle is opened, carbonic acid decomposes releasing carbon dioxide, hence if a bottle is left open for a long period of time the pop goes flat

*Write the **synthesis reaction** for the formation of carbonic acid:

**Reactions Continued… Single Displacement and Double Displacement**

**Single Displacement Reactions:**

**General Eq'n:**

Examples:

*sodium metal reacting with water…

*solid copper reacting with silver nitrate ….

NOTE: Not all SD reactions occur, for example;

*$Sn_{(s)} + FeCl_{3(aq)} \rightarrow$ NR …. No Reaction

***Must look at activity series …

**Double Displacement Reactions:**

**General Equation**:

Signs that a DD reaction has occurred are …

Ex. $HCl + NaOH \rightarrow$

$PbCl_2 + KI \rightarrow$

SNC 2DI **Intro to Acids and Bases**

**Common Acids**
-Vinegar, sour patch kids candy
Oranges, lemons, grapefruit all contain citric acid

*Acids taste _____

*Acids do not feel _____

**Common Bases**
-tonic water contains quinine which is a base

*Bases taste _____

*Bases feel _____

**Svante Arrhenius …**

-**defines acids** as substances that produce …

-**defines bases** as substances that produce …

Examples:

-Acids and bases produce ions in solution therefore they are both considered to be electrolytes.

-Electrolytes are solutions that ….

The concentration or the amount of hydrogen ions indicates how acidic an acid is, the hydrogen ion is also the component responsible for acids acidic properties.

An easy way to show the concentration of hydrogen ions is to use **a pH scale**. The pH scale ranges from 1-14, where 1 is considered very acidic and 14 is very basic.

**Metal oxides** react with water to produce

**Non-metal oxides** react with water to produce acids…

**SNC 2DI Acids and Bases con't… pH – A Powerful Scale**

Remember …

- pH scale ranges from?
- Which pH value is considered very acidic?
- Which pH value is considered very basic?

Indicators and litmus paper can indicate if a solution is acidic or basic but it can not indicate exactly how acidic or how basic a solution actual is

*How acidic a solution is, is dependent on the amount, or concentration of _____

*How basic a solution is, is dependent on the amount, or concentration of _____

*Water itself dissociates or breaks up to some degree forming $H^+$ and $OH^-$

-water contains equal amounts of hydrogen ions and hydroxide ions, therefore pure water is neutral with a pH of _____

-Acids produce $H^+$ ions, therefore

-Bases produce $OH^-$ ions, therefore

*the pH scale is a _____ scale,

which means the higher **the pH value the lower the concentration of $H^+$** ions and vice versa,

*The logarithmic scale has a base of **10,** therefore each value on the scale differs **by 10**

*Therefore a pH value of 1 will have a concentration of $H^+$ that is 10X that of pH of 2

*pH of 1 is _____ more concentrated than pH of 3 … ie 10 X 10 = _____

-**Alternatively, the difference between pH = # of zeroes, then place a 1 in front**

SNC 2DI **Acids Con't… Strong and Weak Acids and Bases, Neutralization Reactions**

**Self Quiz:**

**-Identifying the following as an Acid or a Base**

a) $HF \rightarrow H^+ + F^-$

b) pH = 8

c) $NaOH \rightarrow Na^+ + OH^-$

d) Turns bromothymol blue, yellow

e) Produces ammonia smelling odour

f) Turns red litmus paper blue

g) Phenolphthalein turns pink

h) MgO added to water

i) pH = 3

**Remember…**

-Concentration is the amount of a substance
-Acid has a high concentration of hydrogen ions
-Base has a high concentration of hydroxide ions

**Strong Acids** are acids that **completely** ionize Examples

**Weak Acids** are acids that **do NOT** completely ionize Examples

Strong Bases, therefore also completely ionize and a weak base does not completely ionize

Examples of Strong Bases Weak Bases

Remember
-pH refers to concentration Strong and Weak Acids/Bases refer to amount of ionization

**Neutralization Reactions…**

Water sometimes dissociates into ions…this is called ionization, breaks up forming ions

The reverse reaction can also occur… neutralization

A neutralization reaction is also a double displacement reaction;

**Acid + Base → water + Salt**

Salt forms from the **anion of the acid** and the **cation of the base**

-By adding base to acid, OR acid to base, the pH is altered

-When neutralizing an acid or a base a pH of 7 is the desired goal most often