

CHEMISTRY 111 LECTURE
EXAM I Material
REVIEW

Part 1 NOMEMCLATURE

I. COMPOUNDS- Two or more elements chemically combined in definite proportions.

COMPOUNDS

IONIC COMPOUNDS

Metal - Nonmetal

MOLECULAR COMPOUNDS

Nonmetal-Nonmetal

II Naming Ionic Compounds

BACKGROUND:

A. Metallic Cations - (+ charge)

1. Fixed Charged cations

2. Variable charged cations

B. Nonmetal Anions (-) charge

C. Polyatomic Ions

Naming compounds

Key: Compounds are neutral \rightarrow no net charge

III Naming Molecular compounds

Nonmetal - Nonmetal

Variable combinations

Ex.

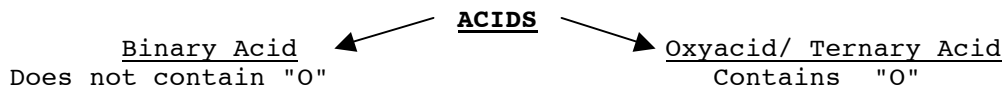
1. Know prefixes: Di, tri, tetra...etc
2. Naming formula:
Prefix element #1 + prefix stem of element #2 + ide

Ex.

IV ACIDS AND BASES

Formula starts with a "H" + (aq)
[H₂O is excluded]

Ex. HCl (aq) "Dissolved in water" The HCl must be in H₂O to have the properties of an acid.



A. Binary Acids (no "O")

Naming: Hydro + stem of element + ic Acid

Ex.

Exception: H₂S \rightarrow

B. OXYACIDS/TERNARY ACIDS (contains "O")

Naming Formula:

Ion name But Change ite → ous + Acid
 Ate → ic

KEY: Recognize the ion part of the Acid

ACID _____ ION

EXCEPTION:

PRACTICE:

Name or give the chemical formula for the following:.

oxalic acid

mercurous nitride

silver nitrate

plumbic acetate

calcium peroxide

potassium phosphide

nickelous permangante

CS₂

Ni(NO₂)₂

Ba₃N₂

Ca(OH)₂

magnesium hydrogen carbonate

ammonium carbonate

aurous iodide

iodine tribromide

hydrobromic acid

sulfurous acid

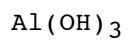
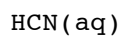
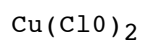
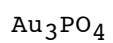
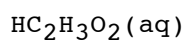
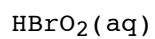
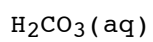
cobaltous sulfide

Co₂O₃

Bi(NO₃)₃

HClO₃(aq)

N₂O₅



Part 2 CHEMICAL FORMULA CALCULATIONS

I. THE MOLE

$$1 \text{ mole} = 6.02 \times 10^{23} \text{ Particles}$$

Avogadro's number \rightarrow memorize!!

Conversions

$$\frac{1 \text{ mole H atoms}}{6.02 \times 10^{23} \text{ atoms}} \quad \text{or} \quad \frac{6.02 \times 10^{23} \text{ H atoms}}{1 \text{ mole atoms}}$$

II. MOLAR MASS (molecular wt.)

1 mole = AMU weight numerically in grams

26
Fe
55.85

Atomic wt.
55.85 AMU
{1 atom}

Molar mass
55.85 g
= 1 mole of Fe atoms
= 6.02×10^{23} Fe atoms

IV. MOLES AND CHEMICAL FORMULAS



2 atoms N
5 atoms O
= 1 molecule N_2O_5

2 mole N
5 moles O
= 1 mole of N_2O_5

Ratios:

Problem:

How many moles of N in 13.5 moles of N_2O_5 ?

V. MOLES AND CHEMICAL CALCULATIONS:

1. How many grams of Zn will combine with 34.00 g of nitrogen?

2. How many atoms of O are needed to produce 32 kg of phosphoric acid?

VI Empirical and Molecular Formulas:

A. Empirical formula shows the smallest ratio of atoms in a compound.

Examples:

B. Calculation of Empirical and Molecular Formula

The percentage composition of a compound is 63.133% C, 8.831% H, and 28.04% O.

The Molar mass = 171.21 g/mol

What is its empirical formula? What is its molecular formula?

STEP 1. Calculate the Empirical Formula

STEP. 2 Calculate the Empirical Formula weight.

STEP. 3 Determine the number of E.F. units in the molecular formula
{ Divide the molar mass by the E.F. wt. }

Part 3 CHEMICAL REACTIONS

A chemical reaction occurs when there is a change in chemical composition.

I. Evidence of a reaction- One of the following would be observed:

- a. A precipitate is formed or dissolved
- b. A change of color
- c. Effervescence occurs (gas formation)
- d. Energy in the form of heat, light, or electricity is released

II Types of Chemical Reactions--> Know and complete

A. Combination Reactions - One product is formed:

1. Metal + Nonmetal combines to form ► an Ionic compound

2. Metal Oxide + H₂O combines to form ► a Base

3. Nonmetal Oxide + H₂O combines to form ► an Acid

B. Decomposition-A single reactant will form two or more products

1. Carbonates (CO₃²⁻) decomposes ► to oxides and CO₂(g)

2. Sulfites (SO₃²⁻) decomposes ► to oxides and sulfur dioxide gas

3. Metal oxides decomposes ► to metal + Oxygen gas

4. Ionic Compounds decomposes ► to Metal + Nonmetal

5. Hydroxides decomposes ► to Metal oxides + water

6. Nitrates decomposes ► to Nitrites + Oxygen gas

7. Peroxides decomposes ► to Oxides + Oxygen gas

8. Chlorates decomposes ► to chlorides + Oxygen gas

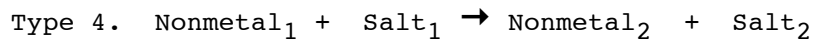
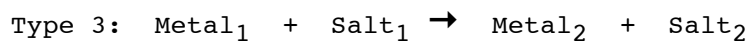
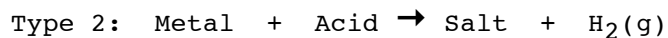
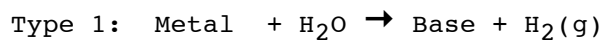
C. Combustion Reactions involves organic compounds:



D. Single displacement Reactions/ Replacement Rxns.

A more active element displaces a less active element

TYPES:



SOLUBILITY RULES FOR IONIC COMPOUNDS

<u>Ion contained in the Compound</u>	<u>Solubility</u>	<u>Exceptions</u>
Group IA	Soluble	
NH_4^+	Soluble	
$\text{C}_2\text{H}_3\text{O}_2^-$	Soluble	
NO_3^-	Soluble	
Cl^- , Br^- , and I^-	Soluble	Ag^+ , Pb^{2+} , Hg_2^{2+}
SO_4^{2-}	Soluble	Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+}
CO_3^{2-} , PO_4^{3-} , CrO_4^{2-}	insoluble	group IA and NH_4^+
S^{2-}	insoluble	group IA, IIA, and NH_4^+
OH^-	insoluble	group IA, Ca^{2+} , Ba^{2+} , Sr^{2+}

STRONG BASES

LiOH	CsOH
KOH	$\text{Sr}(\text{OH})_2$
RbOH	$\text{Ba}(\text{OH})_2$
NaOH	$\text{Ca}(\text{OH})_2$

STRONG ACIDS

HNO_3	HCl
HClO_4	HBr
H_2SO_4	HI

E. Double Exchange (Ion Exchange) Reactions

1. In a double displacement (ion exchange) reaction, the positive end and negative end of compounds "change partners" to form new products:

a. Precipitate

*Note: A ppt **must** form for the rxn to occur. (if it doesn't...Then NR!)

b. Less Ionized Substance.(Molecule formation)

(1) Gas

(2) Neutralization

(3) A weak acid or base is formed

Part 4 STOICHIOMETRY: CHEMICAL REACTION CALCULATIONS:

The numerical relationship among the reactants and products in a balanced equation (Chemical reaction)

The Balanced equation

A balanced equation shows a chemical reaction in shorthand:

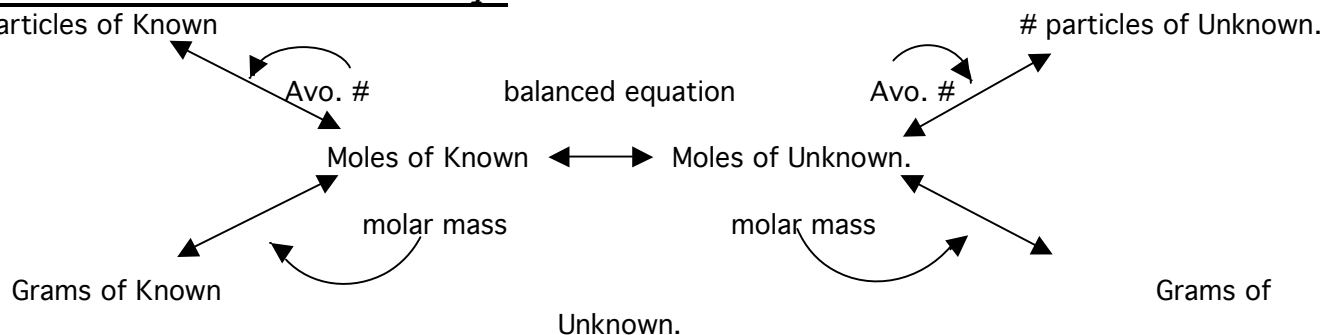
For example: Two magnesium atoms (a solid) when ignited, reacts with oxygen atoms to form solid magnesium oxide

The meaning of a balanced Chemical Equation: A bookkeeping system

The balanced equation - mole to mole ratios

These mole to mole ratios are exact numbers.

II. The Stoichiometric Pathway:



III. Stoichiometric Calculations

1. The reaction: Chromium metal is reacted with copper (II) chloride
Key: You must have a balanced equation!!

How many grams of chromic chloride reacts with 6.0 mole Cr?

2. How many grams of oxygen gas are required for the complete combustion of 694 g of methane $\text{CH}_4(\text{g})$ in a sample of natural gas?

IV. LIMITING REACTANTS

When most reactions are performed, some of the reactants is usually present in excess of the amount needed. If the reaction goes to completion, then some of this *excess reactant* will be left-over. The **limiting reactant** is the reactant used-up completely and it "limits" the reaction.

For example:

PROBLEMS:

1. Zinc nitrate is reacted with sodium hydroxide.
 - a. How many grams of Zinc hydroxide is produced when 13.0 grams of zinc nitrate and 17.0 grams sodium hydroxide are mixed? How much excess reactant is left?

METHOD: Find the L.R. → Calculate the moles of product that each reactant may produce.

BALANCED EQUATION:

(1) Find the L.R.

(3.) Determine the MASS of product made from the L.R.

(4.) Calculate the grams of excess reactant

VI. PERCENT YIELD

The amount of product that has been previously calculated from chemical equations show the maximum yield (100%). However, many reactions fail to give a 100% yield of product.

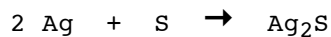
The theoretical yield is the calculated amount of product.

The Actual yield is the amount of product actually obtained

$$\text{Percent Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$$

PROBLEM:

5.000 g of Ag₂S was produced from 5.000 g of Ag and an excess of sulfur according to the reaction:



What is the percent yield?

Stoichiometry Problems

1) A mixture consists of 22.0 % Cu(NO₃)₂ and 78.0 % Fe(NO₃)₃ by mass. What is the total number of nitrate **ions** in 25.00 g of mixture?

2) A certain alloy of Au, Cu, and Ni contains these elements in the atomic proportions 3: 2: 1, respectively. What is the mass, in grams, of this alloy containing a total of 1.00×10^{24} atoms?

3) Treatment of 10.00 g of XCl_2 with excess chlorine forms 12.55 g XCl_4 . Calculate the molar mass of the element, X.

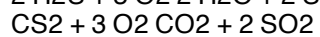
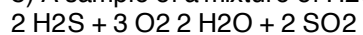
- 4) A 7.221 g sample of a compound containing only C, H, and S is burned completely in oxygen. The products are CO₂, H₂O and SO₂. If the mass of CO₂ is 6.601 g and that of H₂O is 5.406 g :
- Calculate the mass of SO₂ produced.
 - What is the empirical formula of the compound?
 - Balance the equation for the above reaction.

- 5) A carbon containing compound is treated chemically to convert all its carbon into CaC_2O_4 (s). A 17.88 g sample of the compound gave 15.04 g CaC_2O_4
- What is the percent of carbon in the compound?
 - Calculate the molar mass of the compound, if there are 7 carbon atoms in each molecule of the compound. (Molar mass : $\text{CaC}_2\text{O}_4 = 128.08$ g/mole) .

- 6) Suppose that 50.32 g of a metal nitride, M_3N_5 , reacts with H_2 to produce the metal, M, and 9.550 g NH_3 only.
- Write a balanced equation for the reaction.
 - Calculate the molar mass of the metal, M.

7) By analysis, a compound with the formula, AsH_3O_x , is found to contain 52.78 % by mass arsenic. What is the value of the integer, x ?

8) A sample of a mixture of H_2S and CS_2 is burned in oxygen. The equations for the reactions are:



7.32 g of SO_2 , and 0.577 g of CO_2 are produced along with some H_2O .

a) What percentage, by mass, of the original sample is H_2S ? b) What is the percent CS_2 in the mixture?

9) A certain compound contains only lead, carbon and hydrogen. if it contains 64.07 % lead by mass, and if there are **two** carbon atoms present for every **five** hydrogen atoms, what is the empirical formula ?

10) A compound contains 42.85 % chlorine. If it is found that **each** molecule of the compound contains **four** atoms of chlorine, what is the molar mass of the compound?