UNIT 4 Identifying and Balancing Reactions

Reference this section of your reference packet

Guidelines for Predicting the Products of Selected Types of Chemical Reaction

Key: **M** = Metal
NM = Nonmetal

1. **SYNTHESIS:**
   a. Formation of binary compound: $A + B \rightarrow AB$
   b. Metal oxide-water reactions: $MO + H_2O \rightarrow$ base
   c. Nonmetal oxide-water reactions: $(NM)O + H_2O \rightarrow$ acid

2. **DECOMPOSITION:**
   a. Binary compounds: $AB \rightarrow A + B$
   b. Metallic carbonates: $MCO_3 \rightarrow MO + CO_2$
   c. Metallic hydrogen carbonates: $MHCO_3 \rightarrow MO + H_2O_{(l)} + CO_{2(g)}$
   d. Metallic hydroxides: $MOH \rightarrow MO + H_2O$
   e. Metallic chlorates: $MClO_3 \rightarrow MCl + O_2$
   f. Oxyacids decompose to nonmetal oxides and water: acid $\rightarrow (NM)O + H_2O$

3. **SINGLE REPLACEMENT:**
   a. Metal-metal replacement: $A + BC \rightarrow AC + B$
   b. Active metal replaces H from water: $M + H_2O \rightarrow MOH + H_2$
   c. Active metal replaces H from acid: $M + HX \rightarrow MX + H_2$
   d. Halide-Halide replacement: $D + BC \rightarrow BD + C$

4. **DOUBLE REPLACEMENT:** $AB + CD \rightarrow AD + CB$
   a. Formation of a precipitate from solution
   b. Acid-Base neutralization reaction

5. **COMBUSTION REACTION**
   Hydrocarbon + oxygen → carbon dioxide + water

Select the coefficients that balance the equation and then identify the type of reaction.

$$\_\_\_ C_4H_{10} + \_\_ O_2 \rightarrow \_\_ CO_2 + \_\_ H_2O$$

Type of reaction: _____

$$\_\_\_ Al(OH)_3 \rightarrow \_\_ H_2O + \_\_ Al_2O_3$$

Type of reaction: _____

$$\_\_\_ Rb + \_\_Al_2O_3 \rightarrow \_\_ Al + \_\_ Rb_2O$$

Type of reaction: _____

$$\_\_\_ SrCl_2 + \_\_NaNO_3 \rightarrow \_\_ Sr(NO_3)_2 + \_\_ NaCl$$

Type of reaction: _____

$$\_\_ N_2 + \_\_ H_2 \rightarrow \_\_ NH_3$$

Type of reaction: _____

UNIT 4 Solubility Rules

Reference this section of your reference packet

SOLUBILITY RULES

Soluble:

- All Nitrates, Acetates, Ammonium, and Group 1 (IA) salts
- All Chlorides, Bromides, and Iodides, except Silver, Lead, and Mercury(I)
- All Fluorides except Group 2 (IIA), Lead(II), and Iron(III)
- All Sulfates except Calcium, Strontium, Barium, Mercury, Lead(II), and Silver

Insoluble (0.10 *M* or greater):

- All Carbonates and Phosphates except Group 1 (IA) and Ammonium
- All Hydroxides except Group 1 (IA), Strontium, Barium, and Ammonium
- All Sulfides except Group 1 (IA), 2 (IIA), and Ammonium
- All Oxides except Group 1 (IA)

If the compound is soluble, that means that it _____ **(will, will not)** dissolve in water and that the state of matter of the compound will _____ **(remain solid, dissociate into aqueous ions).**

If the compound is insoluble, that means that it _____ **(will, will not)** dissolve in water and that the state of matter of the compound will _____ **(remain solid, dissociate into aqueous ions)**.

In some cases, aqueous ions will recombine to form a new solid product. We say these products precipitate out of solution meaning that they form an _____ **(insoluble solid precipitate, soluble spectator ion)**.

The soluble ions that don't take part in the reaction to form an insoluble product are called our _____ **(insoluble solid precipitate, soluble spectator ions)**. We see these as the _____ **(soluble, insoluble)** compound on the product side of our reaction.

For the following compounds, use your solubility rules and state whether each compound would be soluble or insoluble. If the compound is soluble, write (aq) for the state of matter. If the compound is insoluble, write (s) for the state of matter.

Calcium Sulfate _____ **Ammonium Nitrate** _____

Barium Hydroxide _____ **Sodium Carbonate** _____

Aluminum Carbonate _____ **Lead (||) Chloride** _____

For the double replacement reactions below, two soluble compounds will dissociate in solution to make two new products.

Use your solubility rules to determine if each product is either soluble or insoluble. If the compound is soluble, write **aqueous (aq)** for the state of matter. If the compound is insoluble, write **solid (s)** for the state of matter to indicate that the product is a solid precipitate.

SOLUBILITY RULES

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- All Chlorides, Bromides, and Iodides, except Silver, Lead, and Mercury(I)
- All Fluorides except Group 2 (IIA), Lead(II), and Iron(III)
- All Sulfates except Calcium, Strontium, Barium, Mercury, Lead(II), and Silver

Insoluble (0.10 *M* or greater):

- All Carbonates and Phosphates except Group 1 (IA) and Ammonium
- All Hydroxides except Group 1 (IA), Strontium, Barium, and Ammonium
- All Sulfides except Group 1 (IA), 2 (IIA), and Ammonium
- All Oxides except Group 1 (IA)

$$CaCl_{2\,(aq)} + 2\ AgNO_{3\,(aq)} \rightarrow Ca(NO_3)_{2\,(\_\_)} + 2\ AgCl_{\,(\_\_)}$$

- The product $Ca(NO_3)_2$ is _____ (insoluble, soluble) meaning that they would contain our _____ (spectator ions, precipitate)
- The product AgCl is _____(insoluble, soluble) meaning that it would be our _____ (spectator ions, precipitate)

The Net ionic equation for the reaction above would be

_____ (aq) + _____ (aq) → _____ (s)

$$Li_2CO_{3\,(aq)} + CaS_{\,(aq)} \rightarrow Li_2S_{\,(\_\_)} + CaCO_{3\,(\_\_)}$$

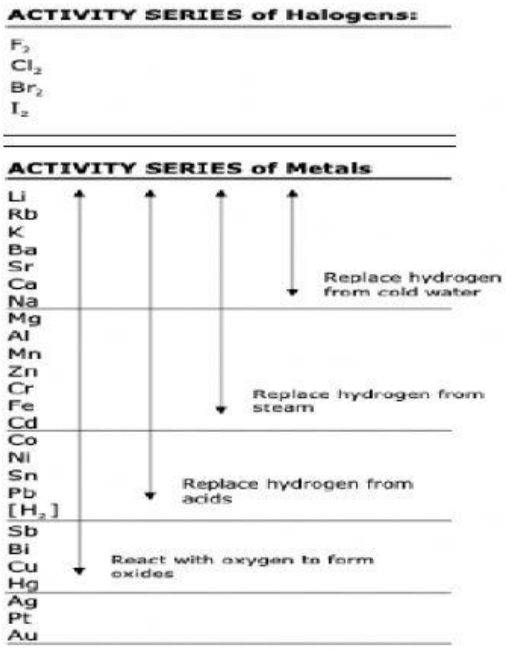
- The product Li_2S is _____ (insoluble, soluble) meaning that it would contain our _____ (spectator ions, precipitate)
- The product $CaCO_3$ is _____(insoluble, soluble) meaning that this product would be our _____ (spectator ions, precipitate)

The Net ionic equation for the reaction above would be

_____ (aq) + _____ (aq) → _____ (s)

Unit 4 Activity Series

Reference this section of your reference packet



The most reactive Halogen would be _____.

If a more reactive halogen is by itself in a single replacement reaction, it _____ (will, will not) swap with the _____ (less reactive metal, less reactive halogen) that is bonded.

The most reactive metal would be _____.

If a more reactive metal is by itself in a single replacement reaction, it _____ (will, will not) swap with the _____ (less reactive metal, less reactive halogen) that is bonded.

Determine if the following reactions occur. If the reaction occurs, write the correct products for the reaction. No need to balance the equation. If the reaction does not occur, write does not occur

__LiCl + __Mg → _____

__CuF_2+ __Al → _____

__ ZnO + __ Rb → _____

__BaS + __ Na → _____

__NaCl + __ F_2 → _____

__$AlBr_3$ + __ Cl_2 → _____

__CaF_2 + __ Br_2 → _____

__ Ni + __Pb_3N_2 → _____

__Ca + __$AlCl_3$ → _____

__Hg + __$SrBr_2$ → _____

__Fe + __NaCl→ _____

__Br_2 + __NaCl→ _____

__Cl_2 + __$AlBr_3$→ _____

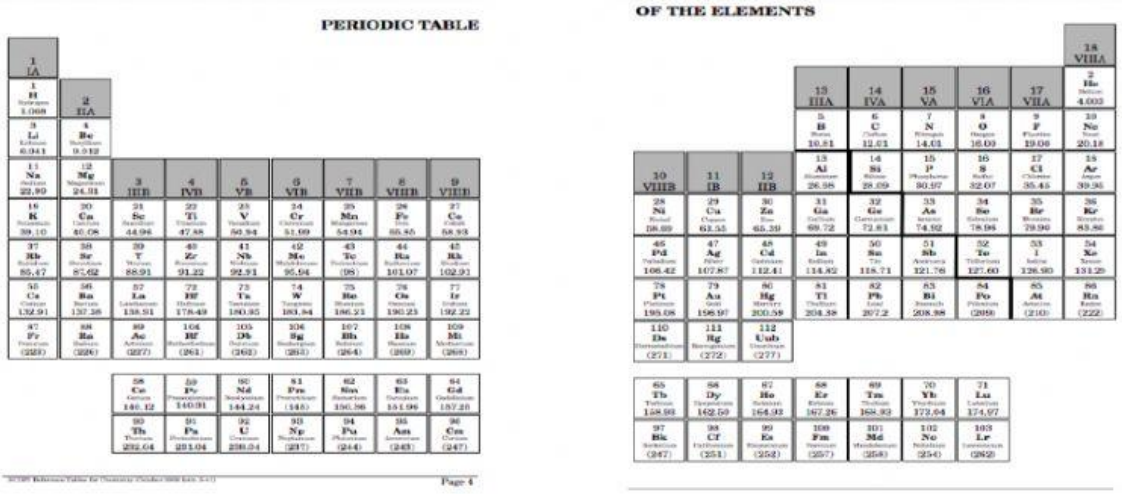
__F_2 + __$MgCl_2$→ _____

Unit 5 Activity Series

Reference this section of your reference packet

Chemistry Reference Tables

Name	Value
Avogadro's number	6.022×10^{23} particles/mole
Gas constant (R)	$0.0821 \frac{\text{L atm}}{\text{mole K}}$ $62.4 \frac{\text{L mmHg}}{\text{mole K}}$ $8.314 \frac{\text{L kPa}}{\text{mole K}}$
Standard pressure	1.00 atm = 101.3 kPa = 760. mmHg = 760. torr
Standard temperature	0°C or 273K
Volume of 1 mole of any gas at STP	22.4 L



Consider the reaction Below

$2\ Na + 1\ Cl_2 \rightarrow 2\ NaCl$

The Necessary mole equations for the reaction above would be:

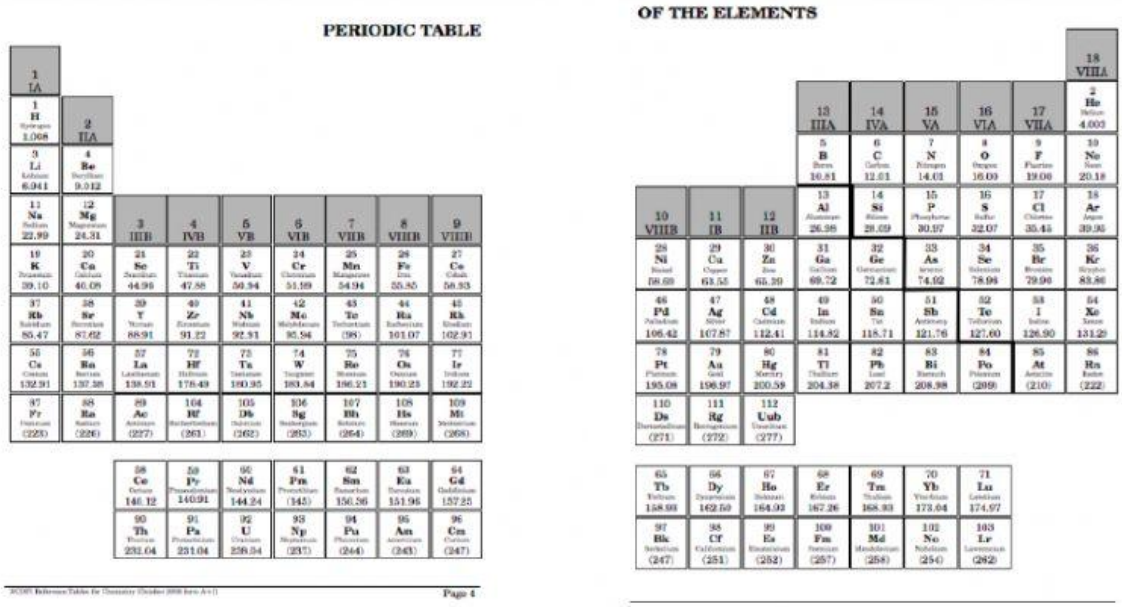
- **Particle Equation:** 1 Mole Particles = _____ Particles
- **Molar Mass Equation:**
  - 1 Mole Substance = _____ found from Periodic table
- **Volume Equation:** 1 Mole of gas = 22.4 Liters @ STP
- **Mole ←→ mole equation** from _____:

__ mole Na = __ mole Cl_2 = __ mol NaCl

What is the molar mass for NaCl? _____

How many molecules would be contained in 50 grams of NaCl?

How many liters would be contained in $5.0*10^{24}$ molecules of Cl_2?



Consider the reaction Below

2 Na + 1 Cl_2 → 2 NaCl

The Necessary mole equations for the reaction above would be:

- 1 Mole Particles = $6.02*10^{23}$ Particles
- 1 Mole Substance = _____ found from the element symbol
- 1 Mole of gas = 22.4 Liters @ STP
- Mole ←→ mole equation: 2 mole Na = 1 mole Cl_2 = 2 mol NaCl

Question 1: How many moles of NaCl could be produced from the addition of 8 moles of Chlorine gas?

Question 2: How many moles of NaCl could be produced from the addition of 100 Liters of Chlorine gas?

Question 3: How many grams of NaCl could be produced from the addition of 100 Liters of Chlorine gas?

Question 4: How many Liters of chlorine gas would be required to react with $5.0*10^{24}$ Sodium atoms?

% Composition, Empirical Formula, Molecular Formula

% Composition worked out example	Determine the % composition of Iron and Chlorine in the compound $FeCl_3$
1. Calculate the percentage of both hydrogen and oxygen in water. H (2) 1.0 g = 2.0 g — Part O (1) 16.0 g = 16.0 g — Part 18.0 g — Whole $\%H = \frac{2.0\ g}{18.0\ g} \times 100 = 11.1\%$ $\%O = \frac{16.0\ g}{18.0\ g} \times 100 = 88.9\%$	**Compound $FeCl_3$** **%Fe = _____** **% Cl = _____**
Empirical formula Problem with worked out solution for NO_2	**You try empirical formula example**
Find the empirical formula for a substance consisting of 30.4 % nitrogen and 69.6 % oxygen. 30.4 g N / 1 × 1 mol N / 14.01 g N = 2.17 mol N / 2.17 = 1 mol N 69.6 g O / 1 × 1 mol O / 16.00 g O = 4.35 mol O / 2.17 = 2 mol O → NO_2 empirical formula	Find the empirical formula for a compound consisting of 15.8 % Carbon and 84.2 % Sulfur.
What is the molecular formula for a substance with this empirical formula that has a mass of 92.02 grams?	**What is the molecular formula for a substance with the empirical formula that has a mass of 228.45 grams?**
Solution Molecular Formula mass ——————————— = 2 Empirical Formula mass **NO_2 → times 2 → N_2O_4**	**Solution** Molecular Formula mass ——————————— = _____ Empirical Formula mass Answer = _____