

UNIT 4 Identifying and Balancing Reactions

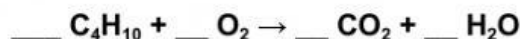
Reference this section of your reference packet

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: $MO + H_2O \rightarrow \text{base}$
 - c. Nonmetal oxide-water reactions: $(NM)O + H_2O \rightarrow \text{acid}$
2. **DECOMPOSITION:**
 - a. Binary compounds: $AB \rightarrow A + B$
 - b. Metallic carbonates: $MCO_3 \rightarrow MO + CO_2$
 - c. Metallic hydrogen carbonates: $MHCO_3 \rightarrow MO + H_2O + CO_2$
 - 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: $\text{acid} \rightarrow (NM)O + H_2O$
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 $\rightarrow$ carbon dioxide + water

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



Type of reaction: _____



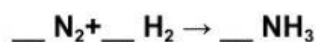
Type of reaction: _____



Type of reaction: _____



Type of reaction: _____



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 (II) 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.

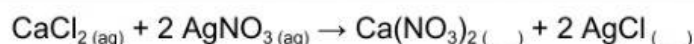
SOLUBILITY RULES

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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

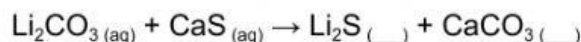
Insoluble (0.10 M or greater):

- 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)



- The product $\text{Ca}(\text{NO}_3)_2$ 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



- 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



Unit 4 Activity Series

Reference this section of your reference packet

ACTIVITY SERIES of Halogens:

F₂
Cl₂
Br₂
I₂

ACTIVITY SERIES of Metals

Li	↑	↑	↑	↑
Rb				
K				
Ba				
Sr				
Ca				
Na				
Mg				
Al				
Mn				
Zn				
Cr				
Fe				
Cd				
Co				
Ni				
Sn				
Pb				
[H ₂]				
Sb				
Bi				
Cu				
Hg				
Ag				
Pt				
Au				

Replace hydrogen from cold water

Replace hydrogen from steam

Replace hydrogen from acids

React with oxygen to form oxides

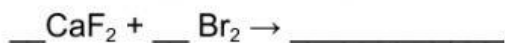
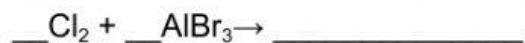
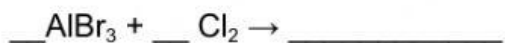
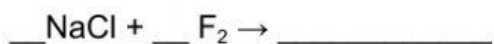
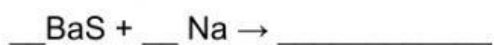
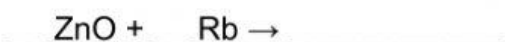
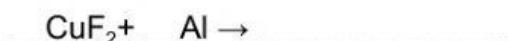
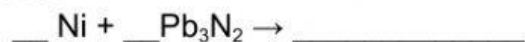
The most reactive Halogen would be _____.

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



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

OF THE ELEMENTS

										18 VIIIA
										19 IIA
										20 IIIA
										21 IVA
										22 VA
										23 VIA
										24 VIIA
										25 IIB
										26 IIIB
										27 IIIB
										28 IIIB
										29 IIIB
										30 IIIB
										31 IIIB
										32 IIIB
										33 IIIB
										34 IIIB
										35 IIIB
										36 IIIB
										37 IIIB
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$$2 \text{ Na} + 1 \text{ Cl}_2 \rightarrow 2 \text{ NaCl}$$

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 $\longleftrightarrow$ mole equation** from _____:

$\text{mole Na} = \quad \text{mole Cl}_2 = \quad \text{mol NaCl}$

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 ?

OF THE ELEMENTS

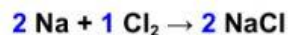
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										18 VIIIA
										2 He 4.003
										10 Ne 20.18
										18 Ar 39.95
										36 Kr 83.84
										86 Xe 131.29
										222 Rn 222
										286 Og 286
										294 Lv 294
										304 Ts 304
										315 Og 315
										329 Lr 329
										344 Nh 344
										360 Fl 360
										376 Mc 376
										392 Lv 392
										408 Ts 408
										424 Og 424
										440 Lr 440
										456 Nh 456
										472 Fl 472
										488 Mc 488
										504 Lv 504
										520 Ts 520
										536 Og 536
										552 Lr 552
										568 Nh 568
										584 Fl 584
										600 Mc 600
										616 Lv 616
										632 Ts 632
										648 Og 648
										664 Lr 664
										680 Nh 680
										696 Fl 696
										712 Mc 712
										728 Lv 728
										744 Ts 744
										760 Og 760
										776 Lr 776
										792 Nh 792
										808 Fl 808
										824 Mc 824
										840 Lv 840
										856 Ts 856
										872 Og 872
										888 Lr 888
										904 Nh 904
										920 Fl 920
										936 Mc 936
										952 Lv 952
										968 Ts 968
										984 Og 984
										1000 Lr 1000
										1016 Nh 1016
										1032 Fl 1032
										1048 Mc 1048
										1064 Lv 1064
										1080 Ts 1080
										1096 Og 1096
										1112 Lr 1112
										1128 Nh 1128
										1144 Fl 1144
										1160 Mc 1160
										1176 Lv 1176
										1192 Ts 1192
										1208 Og 1208
										1224 Lr 1224
										1240 Nh 1240
										1256 Fl 1256
										1272 Mc 1272
										1288 Lv 1288
										1304 Ts 1304
										1320 Og 1320
										1336 Lr 1336
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										1432 Og 1432
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										1464 Nh 1464
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										1512 Lv 1512
										1528 Ts 1528
										1544 Og 1544
										1560 Lr 1560
										1576 Nh 1576
										1592 Fl 1592
										1608 Mc 1608
										1624 Lv 1624
										1640 Ts 1640
										1656 Og 1656
										1672 Lr 1672
										1688 Nh 1688
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										1816 Fl 1816
										1832 Mc 1832
										1848 Lv 1848
										1864 Ts 1864
										1880 Og 1880
										1896 Lr 1896
										1912 Nh 1912
										1928 Fl 1928
										1944 Mc 1944
										1960 Lv 1960
										1976 Ts 1976
										1992 Og 1992
										2008 Lr 2008
										2024 Nh 2024
										2040 Fl 2040

20,000 Excesses Tables for Chemistry Students (2000) (see Appendix)

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Consider the reaction Below



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 $\longleftrightarrow$ 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 FeCl₃
1. Calculate the percentage of both hydrogen and oxygen in water. $\begin{array}{rcl} \text{H (2)} & 1.0 \text{ g} & = 2.0 \text{ g} \quad \text{Part} \\ \text{O (1)} & 16.0 \text{ g} & = 16.0 \text{ g} \quad \text{Part} \\ & & \hline & & 18.0 \text{ g} \quad \text{Whole} \end{array}$ $\% \text{ H} = \frac{2.0 \text{ g}}{18.0 \text{ g}} \times 100 = 11.1\%$ $\% \text{ O} = \frac{16.0 \text{ g}}{18.0 \text{ g}} \times 100 = 88.9\%$	Compound FeCl₃ %Fe = _____ % Cl = _____
Empirical formula Problem with worked out solution for NO₂	You try empirical formula example
Find the empirical formula for a substance consisting of 30.4 % nitrogen and 69.6 % oxygen. $\frac{30.4 \text{ g N}}{1} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 2.17 \text{ mol N} \quad \textcircled{1}$ $\frac{69.6 \text{ g O}}{1} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 4.35 \text{ mol O} \quad \textcircled{2}$ $\frac{4.35 \text{ mol O}}{2.17 \text{ mol N}} = 2 \text{ mol O} \quad \textcircled{3}$ empirical formula NO₂	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 NO₂ → times 2 → N₂O₄	Solution Molecular Formula mass _____ = _____ Empirical Formula mass Answer = _____