

UNIT 4 Identifying and Balancing Reactions

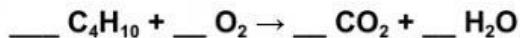
Reference this section of your reference packet

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: $MHCO_3 \rightarrow MO + H_2O + CO_2$
 - 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: 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: _____



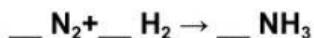
Type of reaction: _____



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.

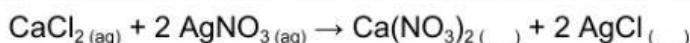
SOLUBILITY RULES

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

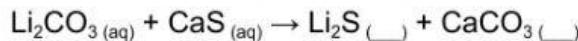
Insoluble (0.10 M or greater):

- 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)



- 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				

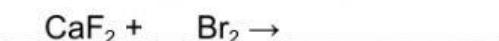
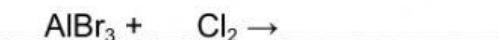
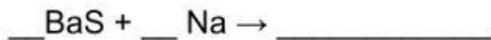
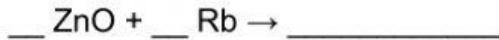
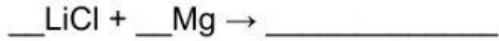
The most reactive Halogen would be _____.

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



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	$1.00 \text{ atm} = 101.3 \text{ kPa} = 760. \text{ mmHg} = 760. \text{ torr}$
Standard temperature	0°C or 273K
Volume of 1 mole of any gas at STP	22.4 L

PERIODIC TABLE																		OF THE ELEMENTS																																																																																																																																																																																																																																																																																																																																																																				
1 1 H Hydrogen 1.008	2 1 He Helium 0.0041	3 2 Li Lithium 6.941	4 3 Be Boron 0.012	5 4 B Boron 10.81	6 5 C Carbon 12.01	7 6 N Nitrogen 14.03	8 7 O Oxygen 16.00	9 8 F Fluorine 19.00	10 9 Ne Neon 20.18	11 10 Mg Magnesium 24.31	12 11 Al Aluminum 26.98	13 12 Si Silicon 28.98	14 13 P Phosphorus 30.97	15 14 S Sulfur 32.07	16 15 Cl Chlorine 35.45	17 16 Ar Argon 39.90	18 17 VIIA	19 18 K Potassium 39.10	20 19 Ca Calcium 40.08	21 18 Sc Scandium 44.96	22 19 Ti Titanium 47.88	23 19 V Vanadium 50.94	24 20 Cr Chromium 51.99	25 21 Mn Manganese 54.94	26 22 Fe Iron 55.85	27 23 Co Cobalt 58.93	28 24 Ni Nickel 58.69	29 25 Cu Copper 63.55	30 26 Zn Zinc 65.39	31 27 Ga Gallium 69.72	32 28 Ge Germanium 72.63	33 29 As Arsenic 74.92	34 30 Se Selenium 78.98	35 31 Br Bromine 79.90	36 32 Kr Krypton 83.86	37 33 Rb Rubidium 85.42	38 34 Sr Strontium 87.62	39 35 Y Yttrium 88.91	40 36 Zr Zirconium 91.22	41 37 Nb Niobium 92.93	42 38 Ta Tantalum 98.04	43 39 Tc Technetium (98)	44 40 Ru Ruthenium (101)	45 41 Rh Rhodium (102)	46 42 Pd Palladium (103)	47 43 Ag Silver (104)	48 44 Cd Cadmium (105)	49 45 In Indium (107)	50 46 Sn Tin (108)	51 47 Sb Antimony (109)	52 48 Te Tellurium (110)	53 49 I Iodine (111)	54 50 Xe Xenon (112)	55 51 Kr Krypton (113)	56 52 Rn Radon (114)	57 53 Fr Francium (115)	58 54 Ra Radium (116)	59 55 Ac Actinium (117)	60 56 Th Thorium (118)	61 57 Pa Protactinium (119)	62 58 U Uranium (120)	63 59 Np Neptunium (121)	64 60 Pu Plutonium (122)	65 61 Tb Thulium (128)	66 62 Dy Dysprosium (140)	67 63 Ho Holmium (141)	68 64 Er Erbium (142)	69 65 Tm Thulium (144)	70 66 Yb Ytterbium (145)	71 67 Lu Lutetium (147)	72 68 Hf Hafnium (178)	73 69 Ta Tantalum (180)	74 70 W Tungsten (184)	75 71 Re Rhenium (186)	76 72 Os Osmium (190)	77 73 Ir Iridium (192)	78 74 Pt Platinum (195)	79 75 Au Gold (197)	80 76 Hg Mercury (199)	81 77 Tl Thallium (200)	82 78 Pb Lead (204)	83 79 Bi Bismuth (207)	84 80 Po Polonium (209)	85 81 At Astatine (210)	86 82 Rn Radon (210)	87 83 Fr Francium (210)	88 84 Ra Radium (210)	89 85 Ac Actinium (210)	90 86 Th Thorium (210)	91 87 Pa Protactinium (211)	92 88 U Uranium (210)	93 89 Np Neptunium (211)	94 90 Pu Plutonium (214)	95 91 Am Americium (243)	96 92 Cm Curium (247)	97 93 Bk Berkelium (247)	98 94 Cf Californium (251)	99 95 Es Einsteinium (252)	100 96 Fm Fermium (257)	101 97 Md Mendelevium (258)	102 98 No Neptunium (259)	103 99 Lr Lawrencium (259)	104 100 Nh Nhastium (260)	105 101 Nh Nhastium (260)	106 102 Nh Nhastium (260)	107 103 Nh Nhastium (260)	108 104 Nh Nhastium (260)	109 105 Nh Nhastium (260)	110 106 Nh Nhastium (260)	111 107 Nh Nhastium (260)	112 108 Nh Nhastium (260)	113 109 Nh Nhastium (260)	114 110 Nh Nhastium (260)	115 111 Nh Nhastium (260)	116 112 Nh Nhastium (260)	117 113 Nh Nhastium (260)	118 114 Nh Nhastium (260)	119 115 Nh Nhastium (260)	120 116 Nh Nhastium (260)	121 117 Nh Nhastium (260)	122 118 Nh Nhastium (260)	123 119 Nh Nhastium (260)	124 120 Nh Nhastium (260)	125 121 Nh Nhastium (260)	126 122 Nh Nhastium (260)	127 123 Nh Nhastium 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Nhastium (260)	320 316 Nh Nhastium (260)	321 317 Nh Nhastium (260)	322 318 Nh Nhastium (260)	323 319 Nh Nhastium (260)	324 320 Nh Nhastium (260)	325 321 Nh Nhastium (260)	326 322 Nh Nhastium (260)	327 323 Nh Nhastium (260)	328 324 Nh Nhastium (260)	329 325 Nh Nhastium (260)	330 326 Nh Nhastium (260)	331 327 Nh Nhastium (260)	332 328 Nh Nhastium (260)	333 329 Nh Nhastium (260)	334 330 Nh Nhastium (260)	335 331 Nh Nhastium (260)	336 332 Nh Nhastium (260)	337 333 Nh Nhastium (260)	338 334 Nh Nhastium (260)	339 335 Nh Nhastium (260)	340 336 Nh Nhastium (260)	341 337 Nh Nhastium (260)	342 338 Nh Nhastium (260)	343 339 Nh Nhastium (260)	344 340 Nh Nhastium (260)	345 341 Nh Nhastium (260)	346 342 Nh Nhastium (260)	347 343 Nh Nhastium (260)	348 344 Nh Nhastium (260)	349 345 Nh Nhastium (260)	350 346 Nh Nhastium (260)	351 347 Nh Nhastium (260)	352 348 Nh Nhastium (260)	353 349 Nh Nhastium (260)	354 350 Nh Nhastium (260)	355 351 Nh Nhastium (260)	356 352 Nh Nhastium (260)	357 353 Nh Nhastium 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PERIODIC TABLE

1 H Hydrogen 1.008	2 He Helium 4.003	OF THE ELEMENTS												18 He Helium 4.003		
3 Li Lithium 6.941	4 Be Boron 9.012	5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18	11 Na Sodium 22.99	12 Mg Magnesium 24.31	13 Al Aluminum 26.99	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.90	
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.86	23 V Vanadium 50.94	24 Cr Chromium 51.99	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.39	31 Ga Gallium 69.72	32 Ge Germanium 72.61	33 As Arsenic 74.92	34 Se Selenium 78.94	35 Kr Krypton 83.86
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.23	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium (98)	45 Rh Rhodium (98)	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sb Antimony 118.71	51 Te Tellurium 121.76	52 I Iodine 127.60	53 Xe Xenon 131.25
55 Cs Cesium 132.91	56 Ba Barium 137.38	57 La Lanthanum 139.91	58 Hf Hafnium 178.49	59 Ta Tantalum 180.35	60 W Tungsten 183.94	61 Re Rhenium 186.21	62 Os Osmium 190.23	63 Os Osmium 192.21	64 Pt Platinum 195.08	65 Au Gold 196.97	66 Hg Mercury 200.59	67 Tl Thallium 204.38	68 Bi Bismuth 207.2	69 Po Polonium 208.98	70 At Astatine (210)	71 Rn Radium (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	90 Rf Rutherfordium (262)	91 Nh Nhastium (263)	92 U Uranium (235)	93 Nh Nhastium (264)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (253)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Neptunium (259)	103 Lr Lawrencium (242)

2018 Reference Tables for Chemistry (October 2018) Item #411

Page 4

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 Cl₂ = 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
<p>1. Calculate the percentage of both hydrogen and oxygen in water.</p> $\begin{array}{l} \text{H (2)} 1.0 \text{ g} = 2.0 \text{ g} \xrightarrow{\text{Part}} \\ \text{O (1)} 16.0 \text{ g} = 16.0 \text{ g} \xrightarrow{\text{Part}} \\ 18.0 \text{ g} \xrightarrow{\text{Whole}} \end{array}$ $\% \text{ H} = \frac{2.0 \text{ g}}{18.0 \text{ g}} \times 100 = 11.1\%$ $\% \text{ O} = \frac{16.0 \text{ g}}{18.0 \text{ g}} \times 100 = 88.9\%$	Compound FeCl_3 $\% \text{Fe} = \underline{\hspace{2cm}}$ $\% \text{Cl} = \underline{\hspace{2cm}}$
Empirical formula Problem with worked out solution for NO_2	You try empirical formula example
<p>Find the empirical formula for a substance consisting of 30.4 % nitrogen and 69.6 % oxygen.</p> $\begin{array}{l} \frac{30.4 \text{ g N}}{1} \times \frac{1 \text{ mol N}}{14.0 \text{ g N}} = 2.17 \text{ mol N} \xrightarrow{\text{①}} \frac{2.17}{2.17} = 1 \text{ mol N} \\ \frac{69.6 \text{ g O}}{1} \times \frac{1 \text{ mol O}}{16.0 \text{ g O}} = 4.35 \text{ mol O} \xrightarrow{\text{②}} \frac{4.35}{2.17} = 2 \text{ mol O} \xrightarrow{\text{③}} \text{ empirical formula} \end{array}$	<p>Find the empirical formula for a compound consisting of 15.8 % Carbon and 84.2 % Sulfur.</p>
<p>What is the molecular formula for a substance with this empirical formula that has a mass of 92.02 grams?</p>	<p>What is the molecular formula for a substance with the empirical formula that has a mass of 228.45 grams?</p>
<p>Solution $\frac{\text{Molecular Formula mass}}{\text{Empirical Formula mass}} = 2$ $\text{NO}_2 \rightarrow \text{times 2} \rightarrow \text{N}_2\text{O}_4$</p>	<p>Solution $\frac{\text{Molecular Formula mass}}{\text{Empirical Formula mass}} = \underline{\hspace{2cm}}$ $\text{Answer} = \underline{\hspace{2cm}}$</p>