Chapter 1-3:

1.Chemical Foundations

2.Atoms, Molecules, and Ions.

3. Stoichiometry.

Name _____ **Types of Reactions**

Choose the correct symbol for the type of reaction. Place that answer in the blank at the beginning of each equation and then balance each equation correctly.

S = synthesis
D = decomposition
C = combustion
SD = single displacement
DR = double replacement

1. _____ $Na\ (s) + H_2O\ (l) \rightarrow NaOH\ (aq) + H_2\ (g)$

2. _____ $CO\ (g) + O_2\ (g) \rightarrow CO_2\ (g)$

3. _____ $FeS\ (s) + HCl\ (aq) \rightarrow FeCl_2\ (aq) + H_2S\ (g)$

4. _____ $NaNO_3\ (s) \rightarrow NaNO_2\ (s) + O_2\ (g)$

5. _____ $CH_4\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (g)$

6. _____ $Fe\ (s) + CuNO_3\ (aq) \rightarrow Cu\ (s) + Fe(NO_3)_2\ (aq)$

7. _____ $KI\ (aq) + Cl_2\ (g) \rightarrow KCl\ (aq) + I_2\ (aq)$

8. _____ $Al\ (s) + S\ (s) \rightarrow Al_2S_3\ (s)$

9. _____ $KClO_3\ (s) \rightarrow KCl\ (s) + O_2\ (g)$

10. _____ $C_4H_{10}\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O$

Write the correctly balanced equation and the type of reaction:

1. When strongly heated, magnesium sulfide formed a crystalline deposit on the walls of a sealed reaction vessel. Metallic deposits were found on the bottom of the container.
   Equation:

   Type of reaction:

2. Nitrogen gas reacts with hydrogen gas to form gaseous ammonia.
   Equation:

   Type of reaction:

3. Oxygen gas reacts with solid copper metal to form copper (II) oxide solid.
   Equation:

   Type of reaction:

4. Hydrogen sulfide gas is bubbled through a solution of iron (III) chloride.
   Equation:

   Type of reaction:

5. Magnesium nitride solid is heated until it forms solid magnesium metal and nitrogen gas.
   Equation:

   Type of reaction:

6. Aluminum solid reacts with oxygen gas to form aluminum oxide solid.
   Equation:

   Type of reaction:

mono	di	tri	tetra	penta	hexa	hepta	octa	nona	deca

III. Writing Formulas of Binary Nonmetal Compounds

Name	Formula	Name	Formula
nitrogen trifluoride		phosphorus trichloride	
nitrogen monoxide		phosphorus pentachloride	
nitrogen dioxide		sulfur hexafluoride	
dinitrogen tetroxide		disulfur decafluoride	
dinitrogen monoxide		xenon tetrafluoride	

IV. Naming Binary Nonmetal Compounds

Name	Formula	Name	Formula
	CCl_4		HBr
	P_4O_{10}		N_2F_4
	ClF_3		XeF_3
	BCl_3		PI_3
	SF_4		SCl_2

V. Practice for Both Types of Compounds

Formula	Name
HCl	
PCl_5	
K_2S	
$NiSO_4$	
ClF_3	
OF_2	
$Al(OH)_3$	
NCl_3	
$(NH_4)_3PO_4$	
S_2Cl_2	

Formula	Name
	carbon dioxide
	ammonium carbonate
	sulfur dichloride
	calcium iodide
	boron trifluoride
	phosphorus triiodide
	magnesium perchlorate
	potassium permanganate
	aluminum phosphate
	dioxygen difluoride

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Name _____
Period ___ Date ___/___/___

3 • Molecules & Compounds

Writing Formulas and Naming Compounds

Introduction
Writing formulas and naming compounds can be confusing because there are different types of compounds that follow different rules. Additionally, some compounds (H_2O, NH_3, CH_4, etc.) simply have ***common names*** that must be memorized.

The two types of compounds we will focus on first are ***ionic compounds*** (formed from positive and negative ions) and ***binary nonmetal compounds*** (molecular compounds). Later we will add ***acids***. So… you must recognize the ***type*** of compound before you try to name it. [Note: + ion = "cation" and – ion = "anion".]

	Ionic	Binary Nonmetal
Formula	+ ion before – ion ex: NaCl $(NH_4)SO_4$ Al_2S_3	usually the less electronegative atom is first ex: CO CO_2 N_2O
Naming	Name of cation + name of anion sodium chloride ammonium sulfate aluminum sulfide	Indicate the number (mono, di, tri, and kind of atoms. First element is simply name of element. Second element name ends with "ide" carbon monoxide carbon dioxide dinitrogen monoxide

I. Writing Ionic Formulas

	Cl^-	NO_3^-	S^{2-}	CO_3^{2-}	N^{3-}	PO_4^{3-}	OH^-
Na^+	NaCl	$NaNO_3$	Na_2S	Na_2CO_3	Na_3N	Na_3PO_4	NaOH
NH_4^+	NH_4Cl	NH_4NO_3	$(NH_4)_2S$	$(NH_4)_2CO_3$	$(NH_4)_3N$	$(NH_4)_3PO_4$	NH_4OH
Sn^{2+}	$SnCl_2$	$Sn(NO_3)_2$	SnS	$SnCO_3$	Sn_3N_2	$Sn_3(PO_4)_2$	$Sn(OH)_2$
Hg_2^{2+}	Hg_2Cl_2	$Hg_2(NO_3)_2$	Hg_2S	Hg_2CO_3	$(Hg_2)_3N_2$	$(Hg_2)_3(PO_4)_2$	$Hg_2(OH)_2$
Al^{3+}	$AlCl_3$	$Al(NO_3)_3$	Al_2S_3	$Al_2(CO_3)_3$	AlN	$AlPO_4$	$Al(OH)_3$
Sn^{4+}	$SnCl_4$	$Sn(NO_3)_4$	SnS_2	$Sn(CO_3)_2$	Sn_3N_4	$Sn_3(PO_4)_4$	$Sn(OH)_4$

II. Naming Ionic Compounds

Cation	Anion	Formula	Name
Cu^{2+}	OH^-	$Cu(OH)_2$	cupric hydroxide
Ba^{2+}	SO_4^{2-}	$BaSO_4$	barium sulfate
NH_4^+	$Cr_2O_7^{2-}$	$(NH_4)_2Cr_2O_7$	ammonium dichromate
Ag^+	$C_2H_3O_2^-$	$AgC_2H_3O_2$	silver acetate
Fe^{3+}	S^{2-}	Fe_2S_3	ferric sulfide

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Name _____
Period ___ Date ___/___/___

3 • Molecules & Compounds

Writing Formulas and Naming Compounds

Introduction

Writing formulas and naming compounds can be confusing because there are different types of compounds that follow different rules. Additionally, some compounds (H_2O, NH_3, CH_4, etc.) simply have ***common names*** that must be memorized.

The two types of compounds we will focus on first are ***ionic compounds*** (formed from positive and negative ions) and ***binary nonmetal compounds*** (molecular compounds). Later we will add ***acids***. So… you must recognize the ***type*** of compound before you try to name it. [Note: + ion = "cation" and – ion = "anion".]

	Ionic	Binary Nonmetal
Formula	+ ion before – ion ex: NaCl $(NH_4)_2SO_4$ Al_2S_3	usually the less electronegative atom is first ex: CO CO_2 N_2O
Naming	Name of cation + name of anion sodium chloride ammonium sulfate aluminum sulfide	Indicate the number (mono, di, tri, and kind of atoms. First element is simply name of element. Second element name ends with "ide" carbon monoxide carbon dioxide dinitrogen monoxide

I. Writing Ionic Formulas

	Cl^-	NO_3^-	S^{2-}	CO_3^{2-}	N^{3-}	PO_4^{3-}	OH^-
Na^+							
NH_4^+							
Sn^{2+}							
Hg_2^{2+}							
Al^{3+}							
Sn^{4+}							

II. Naming Ionic Compounds

Cation	Anion	Formula	Name
Cu^{2+}	OH^-		
Ba^{2+}	SO_4^{2-}		
NH_4^+	$Cr_2O_7^{2-}$		
Ag^+	$C_2H_3O_2^-$		
Fe^{3+}	S^{2-}		

mono	di	tri	tetra	penta	hexa	hepta	octa	nona	deca

III. Writing Formulas of Binary Nonmetal Compounds

Name	Formula	Name	Formula
nitrogen trifluoride	NF_3	phosphorus trichloride	PCl_3
nitrogen monoxide	NO	phosphorus pentachloride	PCl_5
nitrogen dioxide	NO_2	sulfur hexafluoride	SF_6
dinitrogen tetroxide	N_2O_4	disulfur decafluoride	S_2F_{10}
dinitrogen monoxide	N_2O	xenon tetrafluoride	XeF_4

IV. Naming Binary Nonmetal Compounds

Name	Formula	Name	Formula
carbon tetrachloride	CCl_4	hydrogen bromide	HBr
tetraphosphorus decoxide	P_4O_{10}	dinitrogen tetrafluoride	N_2F_4
chlorine trifluoride	ClF_3	xenon trifluoride	XeF_3
boron trichloride	BCl_3	phosphorus triiodide	PI_3
sulfur tetrafluoride	SF_4	sulfur dichloride	SCl_2

V. Practice for Both Types of Compounds

Formula	Name
HCl	hydrogen chloride
PCl_5	phosphorus pentachloride
K_2S	potassium sulfide
$NiSO_4$	nickel sulfate
ClF_3	chlorine trifluoride
OF_2	oxygen difluoride
$Al(OH)_3$	aluminum hydroxide
NCl_3	nitrogen trichloride
$(NH_4)_3PO_4$	ammonium phosphate
S_2Cl_2	disulfur dichloride

Formula	Name
CO_2	carbon dioxide
$(NH_4)_2CO_3$	ammonium carbonate
SCl_2	sulfur dichloride
CaI_2	calcium iodide
BF_3	boron trifluoride
PI_3	phosphorus triiodide
$Mg(ClO_4)_2$	magnesium perchlorate
$KMnO_4$	potassium permanganate
$AlPO_4$	aluminum phosphate
O_2F_2	dioxygen difluoride

Types of Reactions Worksheet

Balance the following equations and indicate the type of reaction taking place:

1) ____ $NaBr$ + ____ H_3PO_4 → ____ Na_3PO_4 + ____ HBr

Type of reaction: _____

2) ____ $Ca(OH)_2$ + ____ $Al_2(SO_4)_3$ → ____ $CaSO_4$ + ____ $Al(OH)_3$

Type of reaction: _____

3) ____ Mg + ____ Fe_2O_3 → ____ Fe + ____ MgO

Type of reaction: _____

4) ____ C_2H_4 + ____ O_2 → ____ CO_2 + ____ H_2O

Type of reaction: _____

5) ____ $PbSO_4$ → ____ $PbSO_3$ + ____ O_2

Type of reaction: _____

6) ____ NH_3 + ____ I_2 → ____ N_2I_6 + ____ H_2

Type of reaction: _____

7) ____ H_2O + ____ SO_3 → ____ H_2SO_4

Type of reaction: _____

8) ____ H_2SO_4 + ____ NH_4OH → ____ H_2O + ____ $(NH_4)_2SO_4$

Type of reaction: _____

Word Equations Worksheet

Write the word equations for each of the following chemical reactions:

1) When dissolved beryllium chloride reacts with dissolved silver nitrate in water, aqueous beryllium nitrate ($Be(NO_3)_2$ and silver chloride powder are made.

2) When isopropanol (C_3H_8O) burns in oxygen, carbon dioxide, water, and heat are produced.

3) When dissolved sodium hydroxide reacts with sulfuric acid (H_2SO_4), aqueous sodium sulfate, water, and heat are formed.

4) When fluorine gas is put into contact with calcium metal at high temperatures, calcium fluoride powder is created in an exothermic reaction.

5) When sodium metal reacts with iron (II) chloride, iron metal and sodium chloride are formed.

Name: _____

Writing Chemical Reactions Review

Only use this sheet and a periodic table to complete this activity. All reactions **must** include phases. You do not need to balance the reactions unless you want to.

Single Replacement Reactions

Activity Series of Metals and Hydrogen

Most Reactive → Least Reactive

Li, Rb, K, Cs, Ba, Sr, Ca, Na, Mg, Al, Mn, Zn, Cr, Fe, Ni, Sn, Pb, H, Cu, Hg, Ag, Pt, Au

Activity Series of Nonmetals

Most Reactive → Least Reactive

F, Cl, Br, I

1. Using the activity series above write reactions that
   a. Active metals replace less active metals from their compounds in aqueous solutions.

   b. Active metals replace hydrogen in water.

   c. Active metals replace hydrogen in acids.

   d. Active nonmetals replace less active nonmetals from their compounds in aqueous solutions.

   e. If a less active element is combined with a more reactive element in compound form, there will be no reaction.

Double Replacement Reactions

Solubility Rules (memorize)

also on pg 48 of wkb.

Solubility Rules (memorize)

1. NH_4^+ and alkali metal (group IA) salts are soluble.

2. Nitrate, NO_3^-, acetate $C_2H_3O_2^-$, chlorate, ClO_3^-, perchlorate ClO_4^-, salts are soluble.
3. Chloride, Cl^-, bromide, Br^-,iodide, I^-, salts are soluble.
EXCEPT: Ag^+, Hg_2^{2+}, Pb^{2+} ($AgBr$, Hg_2I_2, $PbCl_2$)

4. Sulfate, SO_4^{2-} , salts are soluble.
EXCEPT: $PbSO_4$, $HgSO_4$, $CaSO_4$, $BaSO_4$, $AgSO_4$, $SrSO_4$

5. Most Hydroxide, OH- ,salts are insoluble.
Hydroxide salts of Group I elements are soluble (Li, Na, K, Rb, Cs, Fr).
Hydroxide salts of Group II elements (Ca, Sr, and Ba) are slightly soluble.
Hydroxide salts of transition metals and Al^{3+} are insoluble. Thus,
$Fe(OH)_3$, $Al(OH)_3$, $Co(OH)_2$ are not soluble.

2. Using the solubility rules above, complete the reactions. Included phases.

a. $Ca(OH)_2 + HF \rightarrow$

b. $Pb(NO_3)_2 + K_2CrO_4 \rightarrow$

c. $NaC_2H_3O_2 + H_2SO_4 \rightarrow$

d. $Cu(OH)_2 + H_3PO_4 \rightarrow$

e. $AgNO_3 + Na_2CO_3 \rightarrow$

f. $Pb(OH)_2 + Hg_2S \rightarrow$

Gas Forming Reactions

Common gases formed in double replacement (metathesis) reactions are:

H_2S – any sulfide (salt of S^{2-}) reacts with any acid to form H_2S (g) and a salt.

CO_2 – any carbonate (salt of CO_3^{2-}) reacts with any acid to form CO_2 (g) plus HOH and a salt.

SO_2 – any sulfite (salt of SO_3^{2-}) reacts with any acid to form SO_2 (g) plus HOH and a salt.

NH_3 – any ammonium salt (salt of NH_4^+) reacts with any soluble strong hydroxide when heated to form NH_3 (g), HOH, and a salt.

3. Write a reaction demonstrating each of the above gas forming reactions.
   a. H_2S

   b. CO_2

   c. SO_2

   d. NH_3

Name:_____ Class:_____

ADV Chemistry Chapter 1-3 Review Problems

For full credit: use complete sentences show all work, sig figs, and units. Circle final answers were applicable.

1.Convert 310.0 Kelvin to Celsius. Show your work.

2. A substance has a density of 1.54 g/ml and a volume of 23.4 ml. Determine its mass.

3. Convert 6.50 km^3 to L

4. Distinguish between a physical change and a chemical change. Then give an example of each.

5. Complete the following with the correct symbol or name (spelling counts)

a. dinitrogen trioxide _____

b. PCl_5 _____

c. PbO_2 _____

d. barium cyanide _____

e. magnesium chlorate _____

f. $AlPO_4$ _____

6. According to the law of conservation of mass, for the reaction:

$A + B \rightarrow C$

If 5.0 g A produced 12.0 g C, how many grams of B reacted?

10

7. How many Protons, neutrons, and electrons are in Cl-35?

8. List the seven diatomic particles then complete and balance the reaction below.

_____, _____, _____, _____, _____, _____, _____

Show the reaction for the auto ionization of water (remember to use the correct arrow)

9. Give the symbol of an element that matches the description.

a. A metal in the same group as carbon _____

b. The noble gas in the same period as potassium _____

c. A member of the halogen group _____

d. A member of the alkali metal group _____

10. The recommended daily allowance of chromium is 1.0×10^{-6} g. Convert this to atoms.

11. In a chemical reaction the theoretical yield is 145.0 g. Of the percent yield was 92.0%, what was the actual yield?

12. Naturally occurring lithium is 7.42% Li-6 which has a mass of 6.01513 amu and 92.58% Li-7 which has a mass of 7.01601 amu. Calculate the average atomic mass of lithium.

(11)

13. Glyceraldehye is 40.0% carbon, 6.70% hydrogen, and 53.3% oxygen. What is its empirical formula?

14. How many grams of CO_2 are produced when 20.0 grams C_3H_8 are burned as follows.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

15. The empirical formula of a substance is CH. If the molar mass is 78 g/mol, what is the molecular formula?

16. How many grams of urea can be produced from 10.0 g of NH_3 and 10.0 g of CO_2? (Be sure to identify the limiting reagent specifically)

$$2NH_3 + CO_2 \rightarrow \underset{\text{(urea)}}{CH_4N_2O} + H_2O$$

17. How many grams of P_4O_{10} can be produced from 3.75 g of P_4 and 6.55 g of O_2? (Be sure to identify the limiting reagent specifically)

$$P_4 + O_2 \rightarrow P_4O_{10}$$

12

18. A compound contains only nitrogen and oxygen and is 30.4% nitrogen by mass. What is the empirical formula?

19. Complete the following reactions included phases, s, l, g, aq (you do not need to balance):

a. Magnesium turnings are added to a solution of iron (III) chloride.

b. Solid Zinc in placed in a solution of sodium chloride.

c. Aqueous solutions of zinc acetate and cesium hydroxide are mixed.

d. Aqueous solutions of tin (IV) nitrate and potassium sulfite are mixed.

e. Solid aluminum Sulfide is mixed with nitric aci.

f. Ammonium bromide is mixed with lithium hydroxide and is heated.

(13)