Second Semester Final Exam Study Guide

Unit 6

Know how to name compounds and write chemical formulas.

a) How do you determine if a compound is ionic or molecular?

Ionic: between a cation and an anion (metal and non-metal, metal and polyatomic, polyatomic and polyatomic)
Molecular: between two nonmetals

b) What do you need to keep in mind when writing chemical formulas for ionic compounds?

Writing chemical formulas for ionic – you need to make sure you criss-cross charges to create neutral compounds

c) What do you need to keep in mind when naming molecular compounds?

Naming molecular compounds – you need to identify the number of each atom in the compound and use prefixes for both the first and second element (first element does not use mono-)

d) When a polyatomic ion is involved, what type of bond is occurring?

Compounds that involve polyatomic IONS are always ionic compounds.

e) Write the chemical formulas for the following compounds.
You should identify if they are ionic or molecular first

copper (I) bromide - Ionic: CuBr
ammonium sulfate - Ionic: $(NH_4)_2SO_4$
sulfur trichloride – Molecular: SCl_3
magnesium oxide - Ionic: MgO
diphosphorous trioxide – Molecular: P_2O_3
manganese (III) cyanide – Ionic: $Mn(CN)_3$

f) Write the names for the following compounds. *You should identify if they are ionic or molecular first*

AlF_3 – Ionic: Aluminum Fluoride
NO_3 – Molecular: Nitrogen trioxide
$Sr(NO_2)_2$ – Ionic: Strontium nitrite
$Fe(ClO_4)_3$ – Ionic: Iron (III) perchlorate
$Li(OH)$ – Ionic: Lithium hydroxide
CI_5 – Molecular: Carbon pentiodide

Know how to translate chemical reactions, balance equations, and predict chemical reactions.

Write the following chemical reactions into chemical formulas and a full chemical equation.

a) Sulfur burns in oxygen gas to produce sulfur dioxide.

$S + O_2 \rightarrow SO_2$

b) Sulfuric acid (H_2SO_4) and sodium hydroxide reaction together for form sodium sulfate and water.

$H_2SO_4 + 2\ NaOH \rightarrow Na_2SO_4 + 2\ H_2O$

c) Sodium oxide reacts with water to produce sodium hydroxide.

$Na_2O + H_2O \rightarrow 2\ NaOH$

d) Zinc sulfide reacts with oxygen gas to produce zinc oxide and sulfur dioxide.

$2\ ZnS + 3\ O_2 \rightarrow 2\ ZnO + 2\ SO_2$

Balance the following chemical equations:

e) $N_2 + 3\ H_2 \rightarrow 2\ NH_3$
f) $3\ Zn + 2\ MoO_3 \rightarrow \_\_Mo_2O_3 + 3\ ZnO$
g) $P_2O_5 + H_2O \rightarrow P(OH)_3$ - unable to balance!
h) $Cd(NO_3)_2 + Na_2S \rightarrow CdS + 2\ NaNO_3$
i) $Na_2O + H_2O \rightarrow 2\ NaOH$

Identify the type of equation that will occur using the reactants. Then predict the products and balance the equation.

j) $C_6H_{12} + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ (Combustion)
k) $CuCl_2 + H_2S \rightarrow CuS + 2\ HCl$ (Double Displacement)

l) $CaCl_2$ + K_2CO_3 → $CaCO_3$ + 2 KCl (Doubel Displacement)

m) Al + O_2 → Al_2O_3 (Synthesis)

n) $Al_2(CO_3)_3$ → Al_2O_3 + CO_2 (Decomposition)

Know how to use a balanced equation and a mole map to convert from one substance to another (stoichiometry).

$$2\ Cr + 3\ CuSO_4 \rightarrow 3\ Cu + Cr_2(SO_4)_3$$

a) How many grams of copper would be produced from 49.48 grams of chromium?

$$\frac{49.98\ grams\ Cr}{1} \times \frac{1\ mol\ Cr}{52.0\ grams} \times \frac{3\ mol\ Cu}{2\ mole\ Cr} \times \frac{63.55\ grams\ Cu}{1\ mol\ Cu} = 82.46 \text{ grams Cu}$$

b) How many grams of chromium are required to react with 125 mL of $CuSO_4$?

$$\frac{125\ mL\ of\ cuSo4}{1} \times \frac{1\ L}{1000\ ml} \times \frac{1\ mol\ CuSO4}{22.4\ L} \times \frac{2\ mol\ Cr}{3\ mole\ CuSO4} \times \frac{52.0\ grams\ Cr}{1\ mol\ Cr} = 0.1934 \text{ grams Cr}$$

$$2\ ZnS + 3\ O_2 \rightarrow 2\ ZnO + 2\ SO_2$$

c) How many liters of sulfur dioxide are created when 12.6 L of oxygen gas reacts with zinc sulfide?

$$\frac{12.6\ L\ O2}{1} \times \frac{1\ mol\ O2}{22.4\ L} \times \frac{2\ mol\ SO2}{3\ mole\ O2} \times \frac{22.4\ L\ SO2}{1\ mol\ SO2} = 8.4 \text{ L of } SO_2$$

d) If 3.45×10^{18} atoms of zinc sulfide react with oxygen gas, much many moles of zinc oxide are produced?

$$\frac{3.45\ x\ 10^{18}\ atoms\ ZnS}{1} \times \frac{1\ mol\ ZnS}{6.022\ x\ 10^{23} atoms\ ZnS} \times \frac{2\ mol\ ZnO}{2\ mole\ ZnS} = 0.57 \times 10^{-5} \text{ atoms} = 5.7 \times 10^{-6} \text{ atoms}$$

e) When 54 grams of oxygen gas react with zinc sulfide, how many atoms of sulfur dioxide are produced?

$$\frac{54 grams\ O2}{1} \times \frac{1\ mol\ O2}{32.0\ grams\ O2} \times \frac{2\ mol\ SO2}{3\ mole\ O2} \times \frac{6.022\ x\ 10^{23} atoms\ SO2}{1\ mol\ SO2} = 6.77 \times 10^{23} \text{ atoms } SO_2$$

$$2\ NaClO_3 \rightarrow 2\ NaCl + 3\ O_2$$

f) What is the mole ratio between $NaClO_3$ and NaCl?

2 moles $NaClO_3$: 2 NaCl

g) 12 moles of $NaClO_3$ will produce how many grams of O_2?

$$\frac{12\ moles\ NaClO3}{1} \times \frac{3\ mol\ O2}{2\ mole\ NaClO3} \times \frac{32.0\ grams\ O2}{1\ mol\ O2} = 576 \text{ grams } O_2$$

h) If you have 24.7 grams $NaClO_3$ how many grams of NaCl will be produced?

$$\frac{24.7\ grams\ NaClO3}{1} \times \frac{1\ mol\ NaClO3}{106.44\ grams\ NaClO3} \times \frac{2\ mol\ NaCl}{2\ mole\ NaClO3} \times \frac{58.44\ grams\ NaCl}{1\ mol\ NaCl} = 13.56 \text{ grams NaCl}$$

i) If you have 10 grams $NaClO_3$, how many liters of oxygen gas will be produced?

$$\frac{10\ gra\square s\ NaClO3}{1} \times \frac{1\ mol\ NaClO3}{106.44\ grams\ NaClO3} \times \frac{3\ mol\ O2}{2\ mole\ NaClO3} \times \frac{22.4\ L\ O2}{1\ molO2} = 3.16 \text{ L } O_2$$

Know how to determine limiting and excess reactants.

$$2\ ZnS\ +\ 3\ O_2 \rightarrow 2\ ZnO\ +\ 2\ SO_2$$

a) 6.45 grams of zinc sulfide reacts with 9.20 grams of oxygen gas to produce zinc oxide. How many grams of ZnO are formed?

$$\frac{6.45\ grams\ ZnS}{1} \times \frac{1\ mol\ ZnS}{97.46\ grams\ ZnS} \times \frac{2\ mol\ ZnO}{2\ mole\ ZnS} \times \frac{81.39\ grams\ NaCl}{1\ mol\ ZnO} = \mathbf{5.39\ grams\ NaCl}$$

$$\frac{9.20 grams\ O2}{1} \times \frac{1\ mol\ O2}{32.0\ grams\ O2} \times \frac{2\ mol\ ZnO}{3\ mole\ O2} \times \frac{81.39\ grams\ NaCl}{1\ mol\ ZnO} = 15.6\ grams\ NaCl$$

b) What is the limiting and excess reactant?
The limiting reactant is zinc sulfide (ZnS).

c) The actual yield of this reaction is 12.5 grams. What is the percent yield of this reaction?

$$\frac{5.39\ grams}{12.5\ grams} \times\ 100 = 43.12\%\ yield$$

Know how to calculate the percentage composition of a substance.

a) What is the percentage composition of nitrogen in the compound HNO_3?

H: 1 x 1.01 = 1.01 grams — $\frac{1.01\ grams}{63.02\ grams} \times\ 100\ = 1.6\%$ hydrogen

N: 1 x 14.01 = 14.01 grams — $\frac{14.01\ grams}{63.02\ grams} \times\ 100\ = 22.2\ \%$ nitrogen

O: 3 x 16.0 = 48 grams — $\frac{48\ grams}{63.02\ grams} \times\ 100\ =\ 76.2\%$ oxygen

HNO_3 = 63.02 grams total

b) An 8.20 grams piece of Mg combines completely with 5.40 grams of O to form a compound. What is the percentage composition on Mg and O in this compound?

8.20 grams + 5.40 grams = 13.6 grams

$\frac{8.20\ grams}{13.6\ grams} \times\ 100\ = 60.3\ \%$ Mg

$\frac{5.40\ grams}{13.6\ grams} \times\ 100\ = 39.7\%$ O

c) 9.03 grams of Mg combines completely with 3.48 grams of N to form a compound. What is the percentage composition of Mg and N in the compound? **Hint: write out compound and find molar mass**

Mg_2N_3 = 90.65 grams

Mg = 48.62 grams — $\frac{48.62\ grams}{90.65\ grams} \times\ 100\ = 53.6\ \%$ Mg

N = 42.03 grams — $\frac{42.03\ grams}{90.65\ grams} \times\ 100\ = 46.4\ \%$ N