Chem 1 Dr. Casagrande / Mrs. Rinaldi
Chapter 10 & 12 Review Sheet

Chapter 10

Be able to answer the following:

1) What are the four state symbols and what do they indicate?
2) What are some indications of the occurrence of a chemical reaction?
3) What do the coefficients in a chemical equation represent?
4) What must you Never, Never, Ever change when balancing a chemical equation?
5) What are the seven elements that exist as diatomic molecules when by themselves?
6) What are oxidation and reduction? Be able to identify the element that is oxidized and the element that is reduced in a chemical reaction and what their products are.
7) What is an aqueous solution?
8) What is a precipitate?

Balance each of the following reactions and indicate the reaction type in the blank at right.

Reaction Type

1) ___ Li_2O (s) + ___ H_2O (ℓ) ⟶ 2 LiOH (aq) — Synthesis

2) ___ $Ca(ClO_3)_2$ (s) $\xrightarrow{\Delta}$ ___ $CaCl_2$ (s) + 3 O_2 (g) — Decomposition

3) 2 NaBr (aq) + ___ F_2 (g) ⟶ 2 NaF (aq) + ___ Br_2 (ℓ) — Single Replacement

4) ___ C_5H_{12} (ℓ) + 8 O_2 (g) ⟶ 5 CO_2 (g) + 6 H_2O (g) — Combustion

5) ___ Au_2S_3 (aq) + 3 H_2 (g) ⟶ 2 Au (s) + 3 H_2S (g) — Single Replacement

6) 4 Fe (s) + 3 O_2 (g) ⟶ 2 Fe_2O_3 (s) — Synthesis/Combustion

Write the skeleton equations from the following word equations, then balance and indicate the reaction type at right.

Reaction Type

7) Aqueous barium chloride mixes with aqueous aluminum sulfate to form solid barium sulfate and aqueous aluminum chloride

$3\ BaCl_2\ (aq) + Al_2(SO_4)_3\ (aq) \longrightarrow 3\ BaSO_4\ (s) + 2\ AlCl_3\ (aq)$ — Double Replacement

8) Solid antimony reacts in oxygen gas to form solid tetraantimony hexoxide.

$4\ Sb\ (s) + 3\ O_2\ (g) \longrightarrow Sb_4O_6\ (s)$ — Synthesis/Combustion

9) Solid potassium chlorate is heated in a test tube and produces solid potassium chloride and oxygen gas.

$2\ KClO_3\ (s) \xrightarrow{\Delta} 2\ KCl\ (s) + 3\ O_2\ (g)$ — Decomposition

10) Liquid isopropanol (C_3H_7OH) reacts with oxygen gas to form gaseous carbon dioxide and water vapor.

$2\ C_3H_7OH\ (\ell) + 9\ O_2\ (g) \longrightarrow 6\ CO_2\ (g) + 8\ H_2O\ (g)$ — Combustion

DETERMINE the products and write the BALANCED EQUATION for each for each of these single-replacement reactions as if the reaction occurs. Based on the activity series (Chart E), indicate whether the reaction would occur.

11) __2__ Li (s) + ___ $ZnCl_2$ (aq) → 2 LiCl (aq) + Zn (s)

12) ___ Cu + ___ Na_2SO_4 (aq) → $CuSO_4$ (aq) + 2 Na (s) (N.R.)

13) Solid iron wire is placed into a solution of copper(II) chloride.

$$Fe\ (s) + CuCl_2\ (aq) \rightarrow FeCl_2\ (aq) + Cu\ (s)$$

14) Fluorine gas is bubbled through a solution of gallium(III) iodide.

$$3\ F_2\ (g) + 2\ GaI_3\ (aq) \rightarrow 2\ GaF_3\ (aq) + 3\ I_2\ (s)$$

15) Label these changes as either oxidation or reduction:

a) F^- (aq) → F_2 (g) oxidation

b) Al^0 (s) → Al^{3+} (aq) oxidation

c) Zn^{2+} (aq) → Zn^0 (s) reduction

d) I_2^0 (s) → I^- (aq) reduction

16) Put in all charges (oxidation numbers) in the following substances.

a) $Ni^{2+}Br_2^{1-}$ b) Co^0 c) $Au^{3+}Cl_3^{1-}$ d) F_2^0 e) $H^{1+}Br^{1-}$ f) Mg^0 g) $K^{1+}F^{1-}$

17) Put in all charges (oxidation numbers). Then indicate which substance is being oxidized, which is being reduced, and what their products are. [Remember LEO-GER!]

a) $3\ Mg^0\ (s) + 2\ Au^{3+}Cl_3^{1-}\ (aq) \rightarrow 3\ Mg^{2+}Cl_2^{1-}\ (aq) + 2\ Au^0\ (s)$

Oxidized: Mg Product: Mg^{2+}

Reduced: Au^{3+} Product: Au

b) __3__ Cl_2^0 (g) + __2__ $Al^{3+}Br_3^{1-}$ (aq) → $2\ Al^{3+}Cl_3^{1-}$ (aq) + $3\ Br_2^0$ (ℓ)

Oxidized: Br^- Product: Br_2

Reduced: Cl_2 Product: Cl^-

COMPLETE and BALANCE the following double-replacement equations. Write the correct formulas for the products and use the solubility rules to determine the product solubility.

18) ___ K_2S (aq) + ___ $CoCl_2$ (aq) → 2 KCl (aq) + CoS (s)

19) ___ RbI (aq) + ___ $AgNO_3$ (aq) → $RbNO_3$ (aq) + AgI (s)

20) Lithium carbonate solution reacts with molybdenum(VI) bromide solution.

$$3\ Li_2CO_3\ (aq) + MoBr_6\ (aq) \rightarrow 6\ LiBr\ (aq) + Mo(CO_3)_3\ (s)$$

21) Sodium chloride solution reacts with lead(II) chlorate solution.

$$2\ NaCl\ (aq) + Pb(ClO_3)_2\ (aq) \rightarrow 2\ NaClO_3\ (aq) + PbCl_2\ (s)$$

Chapter 12

Be able to answer the following questions:

1) How does the law of conservation of mass apply to stoichiometry?
2) What meanings can the coefficients in a balanced chemical equation have?
3) What are the mole ratios in a chemical equation and why are they important to stoichiometry?
4) Why do we convert from mass to moles before using the mole ratios from the balanced chemical equation?
5) What is the significance of the limiting reactant in a chemical equation? The excess reactant?
6) What is theoretical yield? Which reactant determines the theoretical yield of a reaction? Why?
7) What is percent yield? What should percent yield equal? Why might it be lower?

Problems

Perform the calculations based on the given balanced chemical equations. Show your work, make sure all numbers have units and a substance, and watch Sig Figs! Remember: Mass → Moles → Moles → Mass

1) If 5.50 mol CaC_2 reacts with an excess of H_2O according to the following reaction,

$$\_\_\_\ CaC_2\ (s) + \_2\_\ H_2O\ (\ell) \rightarrow \_\_\_\ Ca(OH)_2\ (aq) + \_\_\_\ C_2H_2\ (g)$$

how many moles of acetylene (C_2H_2) will be produced?

$$?\ \text{mol}\ C_2H_2 = 5.50\ \cancel{\text{mol}\ CaC_2} \times \frac{1\ \text{mol}\ C_2H_2}{1\ \cancel{\text{mol}\ CaC_2}} = \boxed{5.50\ \text{mol}\ C_2H_2}$$

2) Hydrogen is generated by passing hot steam of iron, which oxidizes to form Fe_3O_4, in the following equation:

$$\_3\_\ Fe\ (s) + \_4\_\ H_2O\ (g) \rightarrow \_4\_\ H_2\ (g) + \_\_\_\ Fe_3O_4\ (s)$$

How many grams of iron would be needed to generate 27.0 g of hydrogen?

$$?\ \text{g Fe} = \underbrace{27.0\ \text{g}\ H_2 \times \frac{1\ \text{mol}\ H_2}{2.02\ \text{g}\ H_2}}_{13.4\ \text{mol}\ H_2} \times \underbrace{\frac{3\ \text{mol Fe}}{4\ \text{mol}\ H_2}}_{10.0\ \text{mol Fe}} \times \frac{55.85\ \text{g}}{\text{mol}} = \boxed{560.\ \text{g Fe}}$$

3) Copper reacts with gold(III) nitrate to form aqueous copper(II) nitrate and solid gold.
   a) Write the equation and balance it with the lowest whole-number coefficients.

$$3\ Cu\ (s) + 2\ Au(NO_3)_3 \rightarrow 3\ Cu(NO_3)_2\ (aq) + 2\ Au\ (s)$$

   b) If 5.94 g of copper and 23.23 g of gold(III) nitrate are combined, which reactant is limiting?

$$5.94\ \text{g Cu} \times \frac{1\ \text{mol Cu}}{63.55\ \text{g Cu}} = 0.0935\ \text{mol Cu};\ 23.23\ \text{g}\ Au(NO_3)_3 \times \frac{1\ \text{mol}\ Au(NO_3)_3}{382.99\ \text{g}\ Au(NO_3)_3} = 0.06065\ \text{mol}\ Au(NO_3)_3$$

$$\text{equiv. Cu} = \frac{0.0935\ \text{mol Cu}}{3\ \text{mol Cu}} = 0.0312;\ \ \text{equiv.}\ Au(NO_3)_2 = \frac{0.06065\ \text{mol}\ Au(NO_3)_3}{2\ \text{mol}\ Au(NO_3)_3} = 0.03033$$

Since $0.03033 < 0.0312$, $\boxed{Au(NO_3)_3\ \text{is limiting}}$

c) How much of the excess reactant is used during this reaction?

$$\text{mass Cu used} = 0.06065 \text{ mol } Au(NO_3)_3 \times \frac{3 \text{ mol Cu}}{2 \text{ mol } Au(NO_3)_3} \times \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}} = \boxed{5.781 \text{ g Cu used}}$$

d) How much of the excess reactant remains after the reaction is finished?

$$\text{Mass Cu remainint} = \left(5.94 \text{ g Cu present} - 5.781 \text{ g Cu used}\right) = \boxed{0.16 \text{ g Cu remaining}}$$

e) How many grams of copper(II) nitrate will be produced?

$$\text{? g } Cu(NO_3)_2 = \underbrace{0.06065 \text{ mol } Au(NO_3)_3 \times \frac{3 \text{ mol } Cu(NO_3)_2}{2 \text{ mol } Au(NO_3)_3}}_{0.09098 \text{ mol } Cu(NO_3)_2} \times \frac{187.6 \text{ g } Cu(NO_3)_2}{1 \text{ mol } Cu(NO_3)_2} = \boxed{17.07 \text{ g } Cu(NO_3)_2}$$

4) When solid tungsten(VI) oxide reacts with hydrogen gas at high temperature, it produces tungsten metal and water vapor.

a) Write the equation and balance it using the lowest whole-number coefficients.

$$WO_3\,(s) + 3\,H_2\,(g) \rightarrow W\,(s) + 3\,H_2O\,(g)$$

b) What is the theoretical yield of tungsten (in g) if 56.9 g of tungsten(VI) oxide reacts with an *excess* of hydrogen?

$$\text{? g W} = \underbrace{56.9 \text{ g } WO_3 \times \frac{1 \text{ mol } WO_3}{231.85 \text{ g } WO_3}}_{0.245 \text{ mol } WO_3} \times \underbrace{\frac{1 \text{ mol W}}{1 \text{ mol } WO_3}}_{0.0245 \text{ mol W}} \times \frac{183.85 \text{ g W}}{1 \text{ mol W}} = \boxed{45.1 \text{ g W}}$$

5) What is the percent yield in the previous problem if the actual amount of W obtained is 41.4 g?

$$\%\text{ Yield} = \frac{41.4 \text{ g W}}{45.1 \text{ g W}} \times 100 = \boxed{91.8\%}$$